

CARNEGIE MELLON UNIVERSITY

School of Architecture

College of Fine Arts

Thesis

Submitted in Partial Fulfillment of the requirements for the degree of

Masters of Science in Computational Design

TITLE:

Keeping in Touch:

Situating myself amidst the incomprehensible systems of the modern world
through intimate, everyday interactions

AUTHOR:

Malika Khurana

ACCEPTED BY ADVISORY COMMITTEE:

Daragh Byrne

Professor NAME



Principal Advisor

May 10th 2022

DATE

Golan Levin

Professor NAME



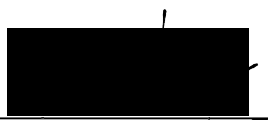
Advisor

5/9/22

DATE

Mark Baskinger

Professor NAME



Advisor

10 May 2022

DATE

keeping / in touch

Situating myself amidst the
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Malika Khurana

MSc Computational Design Thesis
Carnegie Mellon University
May 2022

In the modern world, we find ourselves with a proliferation of technologies for communicating and understanding, but they've created gaps in our relationships with nature and other people.

How might we design tangible ways to keep in touch with everyday phenomena and to maintain relationships with people and the natural world?

Abstract

In our modern world of networks, sensors, and interfaces, there is a promise that technology will allow us to connect to others and better understand and predict the world around us. Our digital tools manage our experience of time, space, and relationships to make them supposedly better: efficient, seamless, and accessible. In that convenience, we stop effortfully orienting and noticing for ourselves, and grow disconnected from phenomena around us. Rather than striving for interactions that are so seamless that we do not feel or register anything, we need to create more seams in how we experience the world: the way we mark months, perceive global-scale distances, and/or check the time of day. These seams give us opportunities to stay engaged and anchor ourselves in time and space through our relationships with the natural world and other people.

In this thesis, I outline my criteria for experiences that create these anchoring opportunities, as a directive for this project and my future work. I design three intimate, daily interactions with a situated and embodied approach, to anchor myself in the relationships and contexts in which I am entangled. I enable myself to participate in the passage of time with a textile calendar that I unravel each day, direct my thoughts to loved ones in other parts of the world through an orientation-based radio, and reference the time of day through a web application that shows a photograph of the sky. I find that the interactions that ask for some effort from myself, through physical movement, time, and attention, are most enriching and anchoring. The craft of designing interactions that ask something of a person, without feeling like work, requires nuance and understanding that this thesis explores in detail.

1. Introduction

1.1 Motivation & Hypothesis

Digital calendar applications unceremoniously flip the page on a new day, month, and year, managing time for us so we do not need to think about it. Remote communication tools instantly drop us into view of someone halfway around the world, so the timezones and space between us seem inconsequential. Mapping algorithms give us the fastest route from here to there, so we need only to follow directions and not worry about knowing the places in between.

Information technologies have given us such seamlessness in managing time, accessing information, and navigating the world that these experiences of situating ourselves are rendered invisible: they happen to us rather than requiring our active participation.

Though information technology has given us these incredible means of overcoming physical constraints and improving efficiency, it has taken on the task that was once ours, of connecting to the temporal, spatial, and material phenomena around us.

My goal is to design experiences to re-engage with these phenomena that frame our lives but that we no longer actively grasp on a day-to-day level. By taking small, everyday interactions as opportunities for intervention, we can engage and celebrate what it means to be a human, interdependent participant in our local systems of relationships. I believe we can take responsibility for connecting to the natural world and other people, reinforcing the ecology of relationships we have with the world around us.

1.1.1 Omnipresence: technology to communicate

Proponents of social media and video chatting have posited that these technologies let us connect with people we care about around the world¹, work remotely², and keep up with “what’s happening now”³ in distant places. Video chatting tools and virtual places for socializing purport to allow us to be everywhere, together (Miller, 2021, p. 867). Social media allows us to maintain parasocial relationships with our friends and internet personalities, albeit in “one-sided intimacies” mediated by technologies that present a “powerful illusion of connection” (Hitchcock, 2021). The peak of the COVID-19 pandemic exaggerated our reliance on these technology-mediated modes

¹ <https://support.apple.com/facetime>

² <https://zoom.us/>

³ <https://about.twitter.com/en>

of communication for work and maintaining relationships (Austin, 2020). The pressure of our dependence revealed their pain points; despite their improvements in terms of bandwidth, security, and features, we still experience Zoom fatigue and feel the need to cleanse ourselves with long walks outside (Rogers, 2020).

In taking the claimed connection and closeness of communication technology at face value, we start to forget the presence of really being in-touch. Being everywhere means we are not here. Content that is curated to be performed on the social media stage starts to resemble personal advertisements vying for our attention. As my friend Andrew Edman recently said : “We aren’t digital bits that can be popped across the world network, as much as our modern tooling tries to make it so.”

What is so challenging about modern communication tools? The primary goal of many of these tools is to facilitate remote work and productivity.

When we focus on these particular communication contexts, we leave little bandwidth for situated, subtle, and attentive communication with other agents. In *Staying with the Trouble*, Donna Haraway calls for collaboration between humans and non-humans, a form of communication largely unconsidered by the technologies described above: “Staying with the trouble requires making oddkin; that is, we require each other in unexpected collaborations and combinations, in hot compost piles. We become-with each other or not at all. That kind of material semiotics is always situated, someplace and not noplac, entangled and worldly” (2016, p. 4). Haraway’s proposal for humans and other species to “become-with” each other necessitates that both sides put in effort to understand, adapt, and evolve together. Though humans do not share a spoken or written language with the chthonic ones, the shared language is one of “attunement” (p. 7). Rather than encoding and decoding meaning through words, we must decode meaning through other interactions and simply paying better attention: “intensely inhabiting specific bodies,” “think[ing]-with other beings,” “attend[ing] to...what beings evoke from and with each other...” (p. 7). Though Haraway is speaking about other species, this generous, attentive, and present form of communication she suggests is just as clearly needed in our human-to-human relationships.

The immediacy of communication technologies, while convenient and fast, also has the effect of narrowing our perceptual focus to the short-term: we think of consequences on an hourly or daily scale. Likewise communication technologies narrow our focus and consideration to ourselves as individuals and our insular echo chambers accessible through instant messaging and social media. In *The Long Now*, Stewart Brand speaks to our culture’s inability to think in the long term: “‘now’ consists of this week, slightly haunted by the ghost of last week” (1999, p. 29). This is the realm of immediate responsibility, one in which we feel we have volition, where the consequences of our actions are obvious and surprises limited.” He quotes sociologist Elise Boulding on our contemporary “temporal exhaustion”:

“If one is mentally out of breath all the time from dealing with the present, there is no energy left for imagining the future.” (Brand, 1999, p. 29). How can we think of timespans and relationships beyond what is immediately in front of us, when the immediate demands so much of our attention and energy?

With his “pace layers,” Brand draws parallels between how we think temporally, the loyalties and relationships we feel towards others, and how we design materially through objects, tools, and structures:

“On a time scale of years, the unit [of survival] is the individual. On a time scale of decades, the unit is the family. On a time scale of centuries, the unit is the tribe or nation. On a time scale of millennia, the unit is the culture. On a time scale of tens of millennia, the unit is the species. On a time scale of eons, the unit is the whole web of life on our planet... In order to survive, we have needed to be loyal to ourselves, to our families, to our tribes, to our cultures, to our species, to our planet... Considered operationally rather than in terms of loyalty, I propose six significant levels of pace and size in the working structure of a robust and adaptable civilization. From fast to slow the levels are: Fashion/art, Commerce, Infrastructure, Governance, Culture, Nature.” (1999, pp. 35-36)

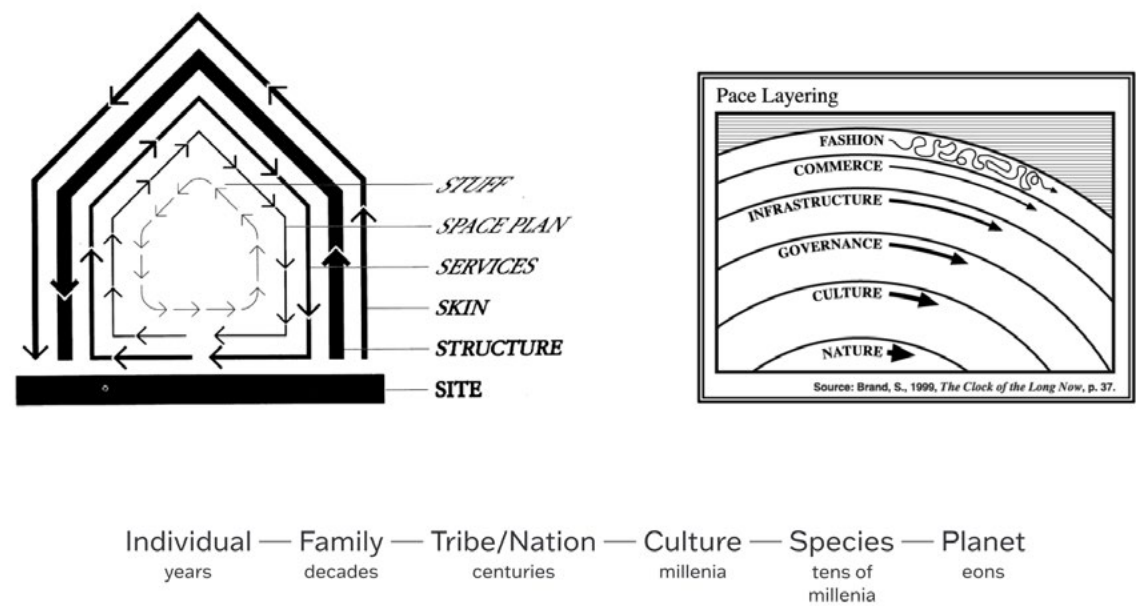


Figure 1. (Brand, 1994, p. 13; Brand, 1999, p. 37)

If we think of communication as a means of relating to others, reinforcing our loyalties and units of survival, it follows that our preoccupation with shorter timespans and in-groups have narrowed together.

1.1.2 Omnipotence: technology to understand

The technologies we use to sense and understand the world allow us to

perceive that we otherwise could not access, then make decisions and optimizations based on this understanding. Wearables, personal tracking software, and scheduling applications can tell us exactly what time we should sleep to optimize our rest cycles⁴, when we’re most productive, and when we can claim another person’s time⁵. Navigation software guides us from one location to another, optimized for speed based on live traffic data⁶. Similar path-optimization algorithms also guide and coordinate our goods along their supply chain, from Earth’s raw materials to a cardboard box outside our door (Crawford & Joler, 2018, XI). Soil sensors and biotrackers quantify inputs and outputs of ecological systems, which can then be modeled and evaluated to decide how much water and fertilizer a crop needs⁷, or how much an animal can be hunted.

Our applications of technology increasingly leverage machine learning, which relies on data collection, cleaning, and labeling - and every step of the process is vulnerable to social forces including bias, power dynamics, and control (Sinders, 2020; Crawford, 2021). This critical reflection challenges the assumption our society has made that computational practices are inherently logical and correct - rather than the (in retrospect) obvious conclusion that systems constructed by humans are susceptible to the same flaws and inequalities that affect our society. “Data is not a denatured subject – it is not the pinnacle of abstraction”: it has a context that we cannot ignore, and yet “data is going to have a capacity to defy the expectations of the places where it was created and traveled, and will start to have another life” (Bell et al., 2015, p. 18). The social, political, capitalist, etc. contexts of data shape it in ways we cannot anticipate or control. The term “sociotechnical” is especially apt in reminding us how inseparable the social is from the technological.

When we use sensors, data, and optimization to make decisions, we outsource the complex, messy details of a system to technology that reflects the biases of our society. Further, when we rely on computational methods of synthesis, we only need to focus on the outcome, allowing us to abstract the incomprehensible, but also leading us to forget the nuance of getting there.

How did we get to this point of understanding our place in the world, where we are so concerned with productivity and the bottom line? Can we back up and retrace our steps to remind ourselves what our metrics really mean? At the most fundamental level, we orient ourselves in time and space using nature. From natural phenomena, we get information that is abstracted into representations of time and space: clocks, calendars, maps, coordinates, and compasses.

As Joanna Drucker discusses the history of timekeeping: “celestial coordinate systems become a reified intellectual construct, a graphical

4 <https://ouraring.com/>
5 <https://calendly.com/>
6 <https://www.waze.com/company>
7 <https://www.deere.com/en/technology-products/precision-ag-technology/>

scheme through which human beings create a relation to the phenomenal world” (2014, pp. 72-73). That is, information structures (diagrams) serve as the everyday and embodied ways that humans relate to natural phenomena. Drucker characterizes the celestial chart as a diagram that “imposes a conventional, schematic order on natural phenomena and then functions as if it were equivalent to the original” (2014, p. 72). These celestial charts, which one could call calendars, are diagrammatic abstractions of the sun, moon, and stars that work and are treated like one-to-one equivalents.

Though abstractions are helpful in distilling essential qualities of phenomena and enabling more efficient and complex thought to build from them, there are other implications of constantly treating them as stand-ins for the original. In our modern timekeeping and spacefinding interfaces built on layers of abstraction, we lose the anchor to the original phenomena. Because these interfaces are so embedded in how we orient ourselves and think, we forget they are constructs or filters between us and the world.

Dietmar Offenhuber models how information is abstracted from phenomena, by diagramming the relationships between observed phenomena, data collected, and analysis of this data. He shows where there are gaps when we don’t participate in observing, analyzing, and abstracting phenomena ourselves. This gap arises in part because information is not truly abstract, even when we treat it that way.

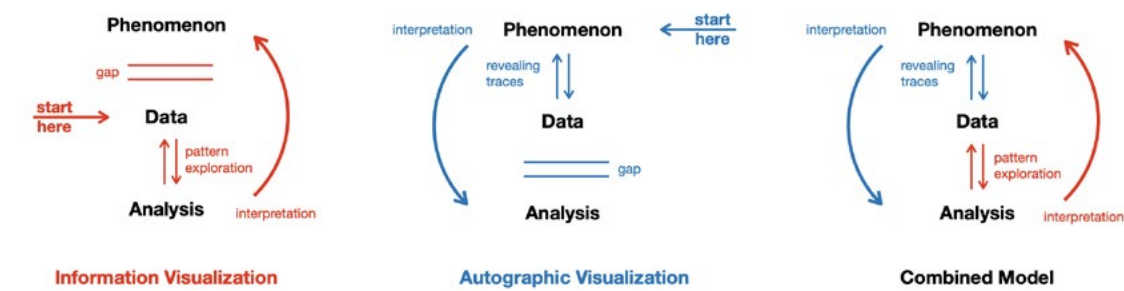


Figure 2. (Offenhuber, 2019)

In his work, Offenhuber explores the ways information is material. He cites the example of Particulate Matter, which is observed by taking the weight of the dust — messy, with smell and color — accumulated on a filter. The material closeness of this measuring process becomes the distant and abstract “PM” value we find on our weather forecast applications to represent how polluted the air is: collapsing, as he says “a very complex, multi-faceted qualitative phenomenon, but that is ultimately invisible” (2020). If we dig into what the PM or Air Quality value means materially, we might realize what contributed to the air pollution that day – whether it smells smoky or sulfuric – and what impacts it has on our health and the health of the living beings around us. With the sensory experience of particulates accumulated on an air filter in mind, we cannot avoid imagining it in our lungs, settled on the leaves of trees, in bird nests, and in soil.

When our understanding of the world and systems around us is so abstracted and mediated by information technology, we need to constantly remind ourselves what it really is we are dealing with, often to uncover insights that were otherwise opaque.

1.1.3 Summary of gaps

In analyzing these ways of communicating and knowing via technology, we start to realize how much we depend on them to give us everything we need, but all the ways they fall short. For the sake of wrapping my head around this analysis, I made a list of the types of “gaps” that remain in our interactions with technology and more broadly in our modern, entangled world.

Capitalist Distance

Globalized supply chains for manufactured products are so convoluted that the brands that make them cannot always reliably trace where they have been (Crawford & Joer, 2018, XI). There is a resulting gap between natural resources extracted from the environment, the people who are involved in production, and the end consumer. As a consumer, one rarely is confronted with the long and fraught story of where a product came from and how it came to be.

Long-term Thinking

Our contemporary culture and perceptual limits prevent us from thinking beyond short timespans and small circles of relationships. We do not feel responsible nor empowered to shape the long-term or long-reaching consequences of our actions.

Ecological Perception

We think of nature as separate from human, an opaque system of interdependencies that is the job of scientists and farmers to understand. Even when we take a scientific approach to understanding nature, we impose mental models we have formulated onto systems that do not fit in so neatly. We make assumptions and miss nuance that can make all the difference. Through a study on how to preserve sweetgrass, botanist Robin Wall Kimmerer found that the Western science worldview equated preservation with keeping humans away, while listening to Indigenous wisdom led her team to discover that basket-makers who harvested wild sweetgrass were actually stimulating its growth and helping to preserve it (2015, p. 163).

Information Abstraction

Data has so much weight when we talk about understanding the world through technology, but we are so often at a distance from data: it is abstract to us so we almost forget what it truly represents, and as a result we overlook the flaws and particular contexts from which it cannot be separated.

Automation & Efficiency

The underlying assumption of many technology platforms and products is that our goal is to be more productive and efficient (Aylett et al., 2015), and to automate as much as possible. This assumption does not acknowledge that some of the things that fulfill us most are inefficient.

Attention Economy

The people and relationships we want to spend our time and attention on are not always aligned with those that we are pressured by societal expectations and social media platforms to spend our attention on. We end up spread thin, giving our attention to places and times that are not here, without even realizing it.

Intangibility

So much of our technological development and knowledge work happens in digital, intangible “spaces,” yet we still occupy a physical world and are very good at intuiting and synthesizing information through our senses. There is a tension between humanity’s emphasis on (digital) computation and our existence, desires, and pleasures that are rooted in tangible perception.

1.1.4 How we bridge gaps

It’s one task to identify and analyze the gaps that make us feel disengaged and disconnected from people and ecologies around us — but by also trying to actively bridge those gaps, we understand them better. So how do we go about bridging these gaps? How do we anchor ourselves in our relationships and environment? How do we keep in touch with people and the natural world? How do we demystify systems that feel so urgent to perceive?

These are big questions, at risk of consuming us to the point we feel lost, but they are the ones many designers and artists seek to answer when making meaningful objects and experiences.

My hypothesis is that in seeking out seamful interactions for myself, I can find the tractable ground in a world that feels so slippery to me (Chalmers,

2003; Vertesi, 2014). In starting from my personal experiences, aches, and desires, my aim is to design intimate, daily interactions that help me attend to my relationships with people and nature, and be present in the Big Here and the Long Now (Brand, 1999, p. 28). As an interaction designer and creative technologist, I reflect on how modern technologies contribute to my feelings of disengagement but also on their potential to be used in alternative ways, that encourage me to be present and help me feel whole. My hope is that these personal interventions will resonate with others and provide me with guidelines for designing “anchoring” experiences in the future.

1.2 Overview of Thesis

This thesis is organized into four chapters.

After this introduction, Chapter 2, the Background chapter, studies how others have addressed the gaps I described above by designing experiences, products, and research projects. This is the soil from which I grew this project, which I formalize into my Criteria for Anchoring Experiences in Chapter 3.

Chapter 3 first presents my ethos and approach as a designer, including the Criteria for Anchoring Experiences, and how I work through design-led inquiry. Next, I focus on each of the three interventions I developed to engender anchoring experiences that bring me to particular places and times. Each intervention is an exploration with its distinct concept, design, and experience, and so I devote a section to each – attempting to recreate the way you might encounter it if you and I were in a room together with the artifacts. I start by introducing the intervention and what was on my mind at the time I created it. Then, to prime your experience, I meditate on my intention: how I want it to feel when you interact with it. Finally I hand the artifact over to you (as well as I can manage, via a paper). I offer my personal reflection on episodes of using the artifact in my daily life, and how it makes me feel after, then provide the feedback and responses of others who were generous enough to offer their critique. I close by evaluating the intervention according to my Criteria, and summarizing takeaways for future designs. For readers who are curious for more detail on how I designed and built the interventions, I have a more technical addendum at the end of each intervention section.

Chapter 4 steps back and evaluates the results of the project as a whole: through maps of the space of Criteria and Gaps that each intervention addresses, critique sessions with other designers, and personal responses to living with the tools for one week.

Chapter 5 concludes the thesis by acknowledging contributions and limitations of the research, and identifying opportunities for future development.

1.3 Summary of Contributions

My goal with this thesis is to design and build interventions for myself that demonstrate and test alternative uses of technology, to aid me in feeling present and anchored in my context and interpersonal relationships — my personal ecologies. To that end, each intervention has been implemented as a functional proof-of-concept, to the point that it can be used day-to-day and I can observe how it shapes my relationship to people and natural phenomena.

The thesis covers and connects three interventions as experiments or case studies to demonstrate strategies for designing anchoring, seamful interactions. The first intervention is a knit calendar that is unraveled each day, which enables me to participate in and actively observe the passage of time. The second is an orientation radio that helps me direct my thoughts towards a person, as it is tuned by pointing it in the direction of a person I love somewhere in the world. The final intervention is an image-based clock that offers a flexible but universal interpretation of time, by displaying a crowd-sourced image of the sky that was taken at the current minute of the day.

Through the design and implementation of these interventions, this thesis has contributed the following.

A survey of art and design works that address the gaps in ecologies of human-human and human-nature relationships.

A criteria for anchoring experiences, which can serve as a set of guiding design principles.

A Javascript program and interface for designing knit graphics based on the Knitout file format.

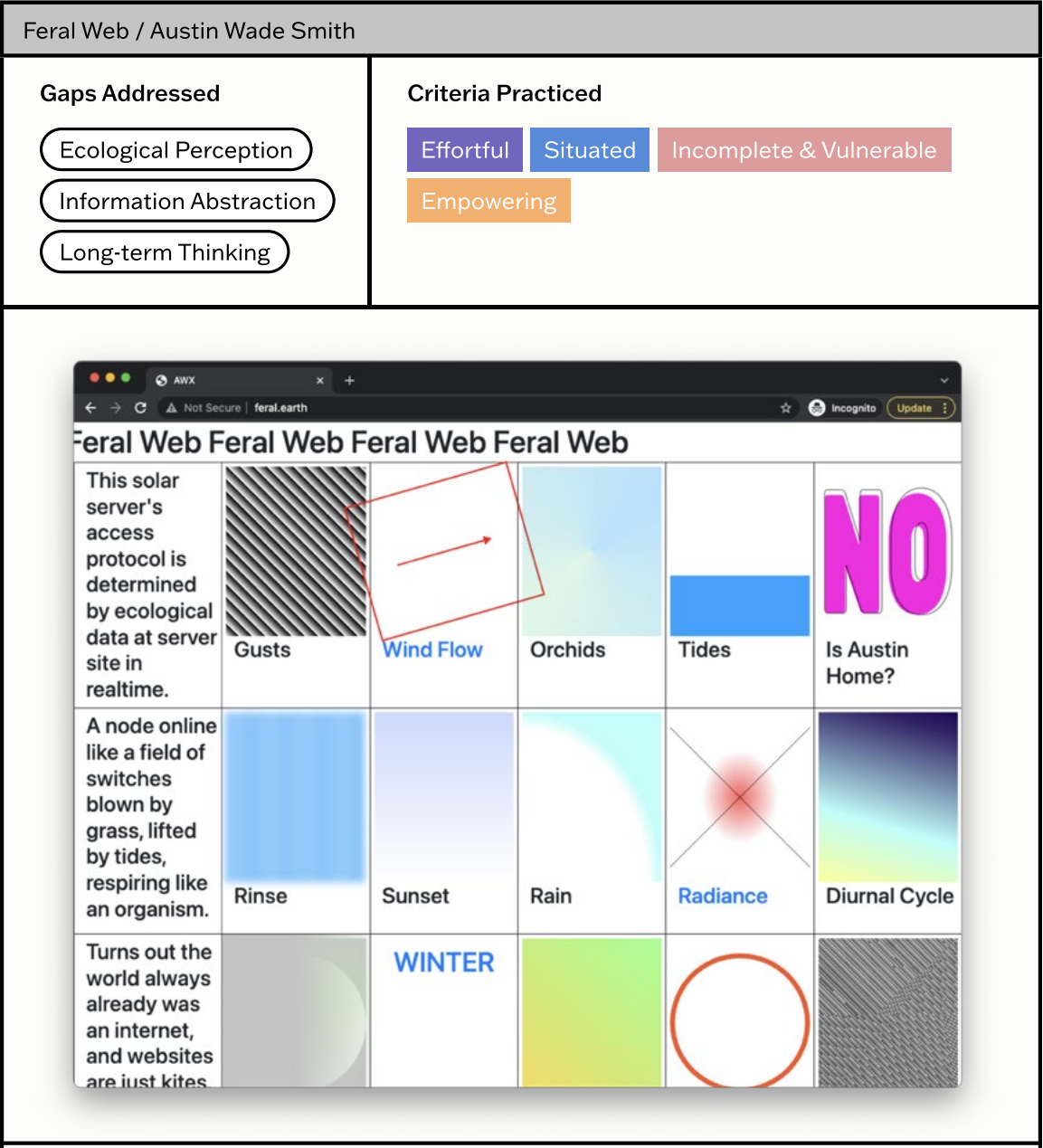
An interaction design case study for leveraging magnetic orientation as an input parameter.

A Python framework for crowdsourcing images captured at a particular time, based on the Flickr API.

A reflection and set of takeaways for designing tangible anchors in future design case studies.

2. Background

Other designers and artists have made work in response to this modern problem of seamless technology creating gaps in our relationships with nature and people. They explore the “productive frictions” that can be designed into websites, apps, devices, installations, and research projects that aim to address these gaps as their primary goal.



Description Feral Web by Austin Wade Smith (AWS) is an experimental website that links internet access to situated ecology, by making certain pages only available when it is high tide, or a full moon, or the wind is blowing just right at the server site. In their words: “Imagine a node online like a field of switches blown by grass, lifted by tides, respiring like an organism. Access to feral.earth is determined by climate and ecological data at server site in realtime.”
Ideologies This project and their other work in digital animism and sensing frames computational design as a way to make ecological and technological systems more legible. Building off the proposition of citizen sensing, they turn technological tools that typically serve capitalist motives towards alternate goals of attuning to and corresponding with the environment. In doing so, they also aim to expand the definition of technology and the internet to bring it close to the natural world and people again (rather than being opposite): “Turns out the world always already was an internet, and websites are just kites,” “Any distinction between a server, a person, and an ecosystem is false.” Through their projects, they scale the experience of ecological systems to be intimate: sensed and experienced on an individual and site-specific level; legible: emphasizing patterns and relationships as “nodes”; familiar: building new understanding of the environment through metaphor and animism; and empowering: giving individuals “small” tools to reconnect with their environment and re-envision their relationship with the natural world.
Relation to My Ethos I appreciate how AWS makes accessible their own process of relating to complex ecological systems through site-specific sensing at their home/studio. They created a web experience that engages others in that “naive” understanding, and asks what an internet entwined with the natural world could look like. I describe it as “naive” because it is knowingly imperfect, relying on Western scientific methods of quantitative sensing and not capturing all the subtleties of an ecosystem. The site uses these sensed values as switches for website access somewhat inexplicably: it functions purely to encourage visitors to attend to the time of day, direction of wind, and tides, among other natural phenomena. But this is how we start to imagine another world – as artist and educator Grayson Earle suggests, “it’s the responsibility of artists to produce culture that alters the course of what’s happening and shifts the conversation.” I see that humble but visionary approach, both through talks and conversations with AWS, but also telegraphed through language and an aesthetic that is unapologetically poetic, playful, and experimental for a typical technology context. Supports vulnerability (doesn’t take itself too seriously), Shifts your perception, Can be reformed (empowers), Proposes and implements alternatives.
Citation Smith, Austin Wade. (n.d.). Feral Web. AWX. http://feral.earth/

Time Since Launch / CW&T	
Gaps Addressed Long-term Thinking Tangibility Information Abstraction	Criteria Practiced Situated Incomplete & Vulnerable Embodied & Material
	
Description Time Since Launch is a part-artwork, part-product that is a physical count-up clock by artists Che-Wei Wang and Taylor Levy. The clock is triggered by the user in a moment that they would like to remember, then forever (for 2,738 years) displays the days, hours, minutes, and seconds that have passed since that moment.	
Ideologies The clock follows on the ideologies of The Long Now and the associated 10,000 Year Clock by Danny Hillis, as cited by Wang in his Master’s thesis at MIT. It also follows on work with telecommunication devices for long-distance relationships – it doesn’t exactly come through but references projects like Untitled (Perfect Lovers) by Felix Gonzalez-Torres, which syncs clocks for lovers in two places that eventually fall out of sync.	
Relation to My Ethos The project seems to reflect an ethos very similar to mine, attempting to create “intimate time meridians shared between two people... like an anchor in time, a time meridian keeps our reference of time situated and comprehensible” (Wang, 2015, p. 28).	

Citation Wang, Che-Wei. 2015. Tools for mindful timekeeping : 4 devices to change our relationship to time [Master's thesis, Massachusetts Institute of Technology]. MIT. https://dspace.mit.edu/handle/1721.1/98615	
Alternative Avenues for IoT, Soft Fading / Audrey Desjardins	
Gaps Addressed Attention Economy Tangibility Information Abstraction Ecological Perception	Criteria Practiced Effortful Situated Incomplete & Vulnerable Empowering Embodied & Material
	
Description In “Alternative avenues for IoT,” Desjardins et al. consider how IoT devices are designed for stereotypical homes and generic users, then invites people to participate in conceptualizing and designing personalized devices for their particular home, needs, and desires. The result is a number of imaginative device concepts, including a projection of animal tracks that residents of a camper van wake up to each morning, which shows a record of the animals that passed around them as they slept.	
Ideologies This project and Desjardins’ other research share a hope to use IoT technologies to facilitate connections among people and between people and their environment. These “alternative” goals for IoT involve critical reflection on the way technologies in the home are largely used for efficiency and automation, rather than fulfilling their users’ more human, sensitive needs. Desjardins’ research builds on the work of Anthony Dunne and Fiona Raby, Bill Gaver, and the like, who were some of the first designers to suggest speculative applications for physical-digital technologies. Her approach also reflects	

contemporary critical ideologies of technology design, including Lucy Suchman’s points that the particular and personal contexts in which technologies are used often go unconsidered.	
Relation to My Ethos Desjardins’ work leverages digital-physical technologies and infrastructures to play out and help us imagine a world where devices empathize with our humanity. The devices she proposes are always grounded in the physical world of materials and embodied interactions, they are specific and personal to their users’ contexts and desires, and often they actually work. These are all goals of my work, and so the approach and content of Desjardins’ designs resonates deeply with me. Embodied & material, situated, effortful, room for vulnerability, Proposes and implements alternatives	
Citation Desjardins, A., Viny, J. E., Key, C., & Johnston, N. (2019). Alternative Avenues for IoT. In Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems. CHI '19: CHI Conference on Human Factors in Computing Systems. ACM. https://doi.org/10.1145/3290605.3300581 Studio Tilt. (2019 September). Soft Fading. https://www.studiotilt.design/soft-fading	
The Space Between Us / David Horvitz	
Gaps Addressed Attention Economy Information Abstraction Tangibility	Criteria Practiced Effortful Situated Incomplete & Vulnerable Empowering Embodied & Material
	



Description

The Space Between Us is a smartphone application by David Horvitz that simply indicates the direction of a loved one: a compass anchored to your person rather than magnetic north. In leveraging the smartphone to create an embodied connection between people who are not together, Horvitz demonstrates how reimagining communication even based on an existing, at-times uninspired device can create experiences that strongly anchor and reconnect us in novel ways. Although we may know abstractly that our loved one is in a city somewhere northeast of us, actually orienting ourselves to them suddenly creates a magnetic pull that links us.

Ideologies

Horvitz contributes to the often-explored but still rich space of creating remote presence through telecommunication technologies. These explorations usually leverage ambient or tangible interaction – Horvitz’s app is not exactly tangible, but embodied in a way that brings the user out of the screen and shifts their perspective to create new associations with the physical world around them (“my loved one is in the direction of the oak tree I see out of my office window”).

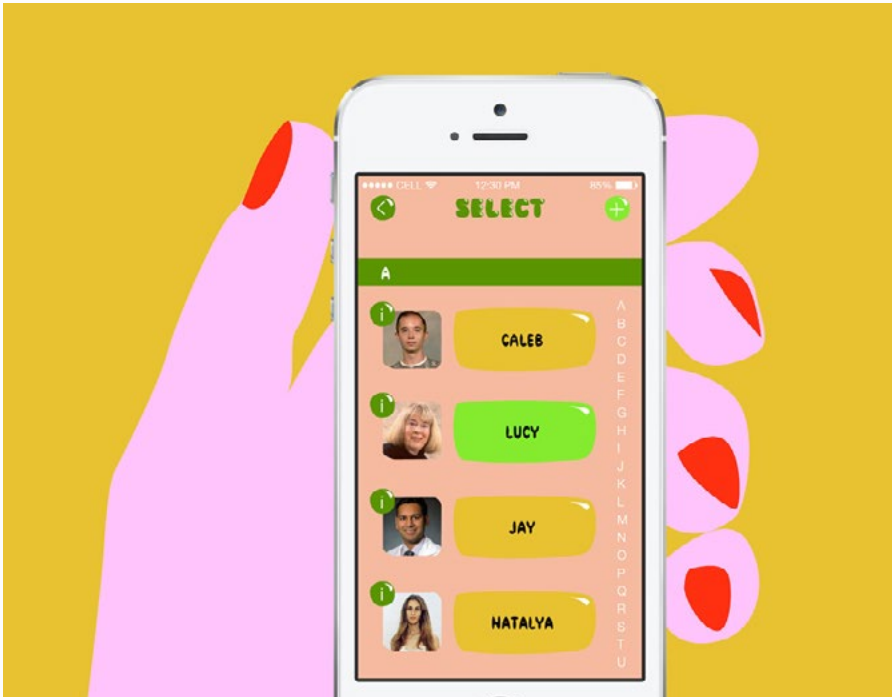
Somebody / Miranda July

Gaps Addressed

- Automation & Efficiency
- Attention Economy
- Capitalist Distance

Criteria Practiced

- Situated
- Incomplete & Vulnerable
- Empowering



Description

Somebody by Miranda July was both a functional mobile app and experimental art work that explored the possibility of a world in which the gig economy created opportunities for new and unexpected types of interpersonal interactions. The app helped friends and loved ones deliver heartfelt messages to each other, via a stranger.

Ideologies

July riffs on projects related to telecommunication for emotional connection between two people, but instead of using technology as a medium for the connection, she employs a third person to create a real-world connection, only facilitated with technology.

Relation to My Ethos

Somebody borrows the gig platform structure, repurposed to facilitate radical vulnerability and create an opportunity to connect deeply but transiently with a stranger. As mentioned above, it leverages telecommunication technology in a unique way that maintains the “connection” moment of communication in the real world, between real people. It embraces awkwardness and vulnerability over seamlessness, taking the position that these are the types of interactions that really fulfill our emotional needs for expression and connection. Though conceived of as an art piece, the follow-through on actually building and launching the functioning app allows it to exist beyond being a concept in a museum: it actually performs the world that it proposes, and in that way becomes a sort of case study for designing connection between friends and strangers. Supports vulnerability, Only exists as much as it needs to, Proposes and implements alternatives

Citation

July, Miranda. (2014-2015). Somebody. <http://somebodyapp.com/>

No Place Like Home / Dominic Wilcox

Gaps Addressed

- Automation & Efficiency
- Information Abstraction

Criteria Practiced

- Effortful
- Situated
- Incomplete & Vulnerable
- Empowering
- Embodied & Material





Description

Dominic Wilcox takes an imaginative, almost child-like approach to design. He wonders “what if” without judgment, and with complete commitment to seeing through his thoughtful wonderings. One such project is his “No Place Like Home” shoes inspired by The Wizard of Oz, which point (using LEDs) in the direction of the wearer’s home when their heels are clicked together.

Ideologies

Wilcox’s work often deals with themes of technology, interaction, anchoring, and perception, but by taking a playful view, he is able to break out of constraints we typically place on product design to solve problems. This playful philosophy grants him a certain lightness and freedom to imagine rich alternatives to the way things are. His projects may seem silly on the surface, but they contain some kernels of propositions that resonate in the world we live in today.

Relation to My Ethos

Wilcox deals with many of the same topics that I attempt to in my work – the social role of technology, how we relate to the environment around us, the gap between what actually fulfills us and what society tells us will fulfill us. His medium is often physical and digital, using material, interaction, and sensation in unexpected ways to make his alternate, imagined world more real. He masterfully uses humor and play in his work to help users let down their guard in a way, creating space to imagine, laugh, and be vulnerable.

Citation

Wilcox, Dominic. (2012). No Place Like Home GPS Shoes. <https://dominicwilcox.com/?portfolio=gpsshoe>

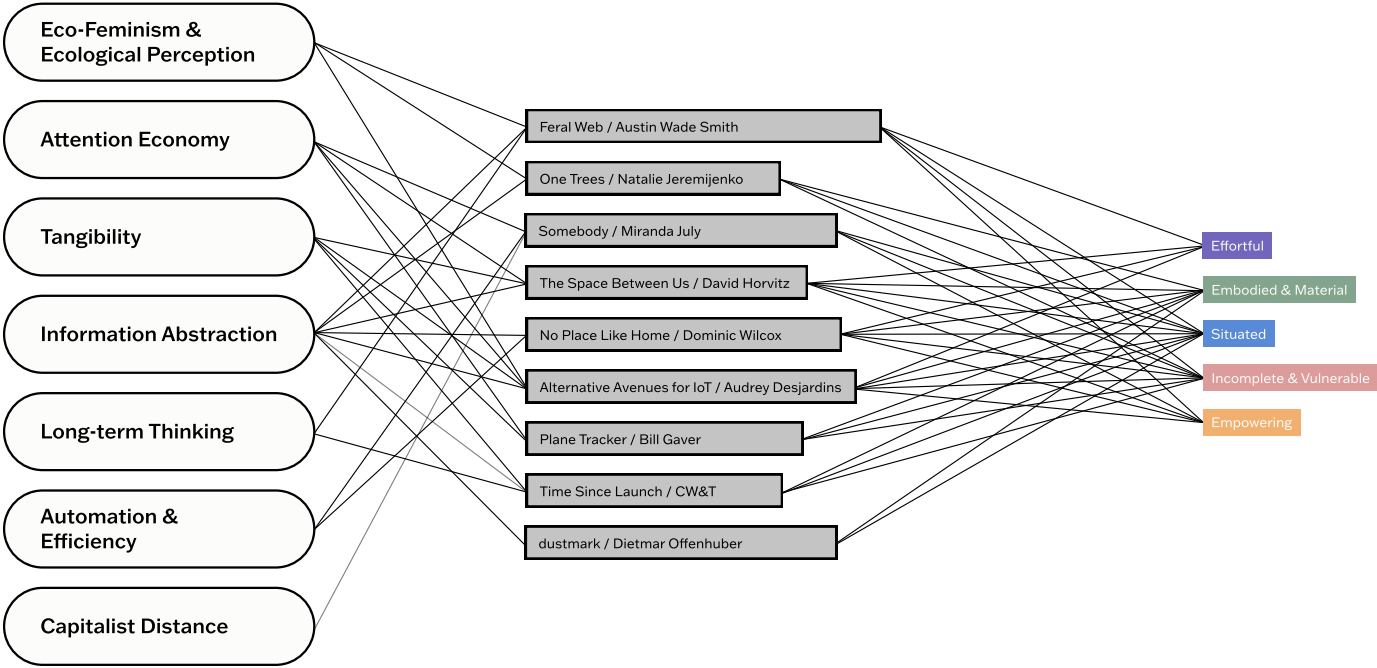


Figure 3.

3. Methods

My process of designing anchors and intentionally seamful experiences for myself involved two main parts: first, reflecting on my ethos and intention, and second, creating projects that attempt to follow through on that intention and actually practice designing such experiences. I responded to my personal needs and desires to keep in touch with people, practice reflecting and noticing, and relating my personal scales of time, space, and loyalties to the broader circles that surround me.

3.1 Criteria for anchoring experiences

From analyzing this work of designers and artists who inspire me, and reflecting on my past work and values, I developed a set of Criteria for anchoring experiences. In some ways, these criteria synthesize strategies used by the above projects, and tie them together with my personal values

and approach as a designer, which I describe in more detail in the following section.

I see these criteria as a guideline or rubric to shape and evaluate my interventions, but also works in progress themselves. In using the criteria as an evaluation structure, I am also evaluating the criteria themselves – whether they are helpful as guidelines and how they might need to be adjusted.

3.1.1 Embodied and Material

The experience is brought close to my body to bridge scales and shift my perception. It makes systems and information tangible, and may require my physical engagement.

3.1.2 Situated

The experience relates to a specific place and time; it could not exist elsewhere or at another time. It connects me to the world around me and helps me notice my context. It exists as much and as long as it needs to: a light touch.

3.1.3 Effortful

The experience takes conscious care and encourages me to direct my attention, time, and energy with intention. It may not be the most direct or efficient way to take an action, but the extra time and care it takes enriches it with more meaning.

3.1.4 Empowering

I am equipped with a means of re-making or re-envisioning the experience itself or my context. I am not completely dependent on the designer; I can grow and direct the experience myself.

3.1.5 Incomplete, with room for vulnerability

The experience is imperfect and never captures it all. It acknowledges its flaws with grace and humor, giving me permission to be flawed, silly, and vulnerable (as I am). There is opportunity to personalize the experience in a way, with space left for me to project what is meaningful to me.

3.2 How I work

As I described above, these criteria synthesize the strategies of the work that inspires me with my current ethos and values. As a designer, I have (inevitably) developed my own approach to creating work that has evolved with the work itself. To better contextualize the criteria, I will attempt to provide a snapshot of my evolving way of making.

I use design to lead my inquiry, attempting to tackle large, systemic problems and open-ended questions by grounding them in a concrete output that takes the form of an artifact or experience. In focusing on this tangible output, I frame all questioning in terms of how an individual would engage with a system, and strive for outcomes that actually work: they function in this world and in the alternative world they propose, becoming a bridge or window to that world. As educator and artist Grayson Earle frames his own work, “I feel drawn to taking on projects that can have more of an impact than just “raising awareness” about a political issue, for example, because I feel like we’re at peak awareness. Everyone knows what’s going on now, for the most part. So for me it’s more about doing projects that can intervene directly on the systems themselves, rather than talking about those systems and why they need to be intervened upon” (Köerner , 2020).

My work is rarely driven by the technology itself: it is motivated by concept and intention, which tend to gravitate towards tangibility, perceiving information and framing thought, as I attempt to make sense of systems through making at an individual experiential scale. I try to use my work to also make sense of the medium and approach it inherits from design and technology history. The “concrete output” of my thinking spans media, but most often takes the form of tangible devices and information visualizations, as these media afford my conceptual interests. Tangible interaction design has always attracted me, but I am still making sense of its role in interactive technology, and why, despite the number and richness of tangible projects made over the past three decades, their playful, empathetic spirit has not really taken hold in mainstream consumer products. The field of information visualization has an equally long history but seems to be continuously evolving and emerging in a more generative way, so I am trying to understand how the strands of experimental curation/community platforms, research on spatial modes of interacting with information, and custom and commercial note-taking applications intersect and interact, as all seem to involve groups of thoughtful technologists and designers who circle similar spheres on Twitter, the Are.na platform, and Brooklyn, among some other contexts.

Finally, extremely important to the way I work are my relationships with people. I am constantly talking to the friends and mentors I have been lucky to find who are intentional, attentive, and seem to be searching for the same meaningful experiences and alternatives to the parts of our world that do not feel right. These conversations facilitate my reframing and

smoothing out my ideas, inspire new directions, and help me understand what qualities and concepts resonate with other people. Though I have written in this thesis about others’ critiques and responses to my work, it is almost impossible for me to separate this part of the process from the rest: feedback comes in at almost every stage of the work.

3.3 Unravel calendar

I rarely know what the date is off the top of my head – whenever I’m asked to write the date or plan around an upcoming event, I pull out my phone or open my desktop calendar app. A few times a year, I will locate myself in time: I’ll suddenly think about the last time I saw my niece, what has happened since I started grad school, realize how short it has been but how long it feels since I met someone who has become important in my life. I made the diagram in Figure 4 to explore such measures of “human” time and their potential as metaphors, referencing specific relatable experiences,

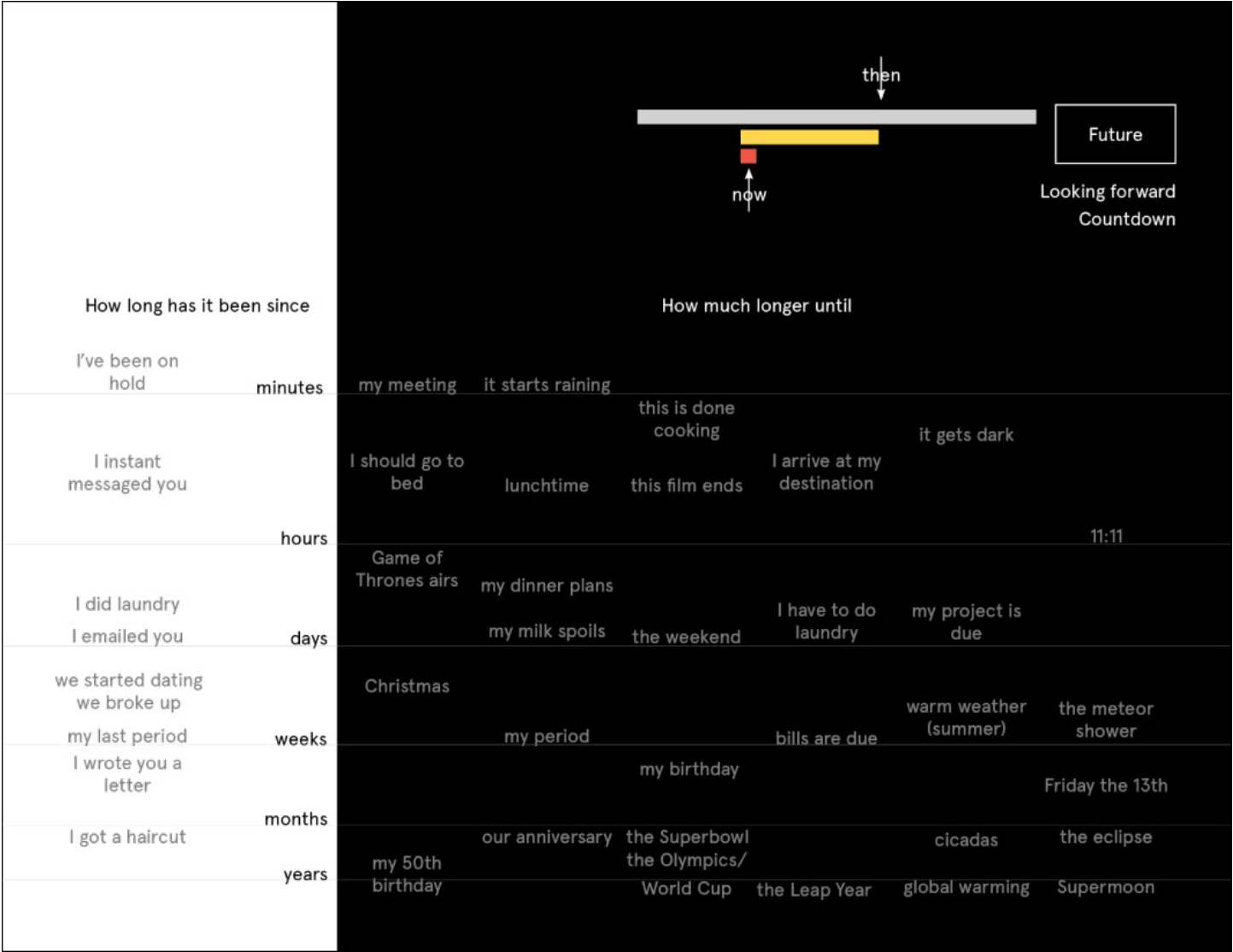


Figure 4.

like the time “since I got a haircut,” which we experience both as the memory of our last haircut, and how long and unruly our hair has grown.

The *Unravel Calendar* attempts to make each day an opportunity to actively participate in the passage of time, to situate myself relative to past and future events, and to reflect on material cycles and scales of transience. It is a wall-hanging calendar made entirely of knit yarn, which I unravel each day to mark my place in the month and year. As time passes, I transform more of the calendar into yarn, accumulating material potential that I may make into another knit artifact.

The *Unravel Calendar* proposes a material philosophy of products that are made to be unmade. This approach builds on sustainable design movements including design for disassembly, cradle-to-cradle, distributed making, and emotionally durable design. The Calendar is made from a single material that the user disassembles into a usable form simply by interacting with the object over time. The user can recycle the yarn themselves without special equipment, leveraging the accessibility and latent knowledge of knitting as a domestic and distributed method of making. The yarn is embedded with the memory of the year, carrying its material significance into the next phase of its life as a sweater or blanket.

3.3.1 Concept

The calendar was born of an opportunity I had to experiment with computational textiles and access an industrial knitting machine. As an interaction designer, I was curious about the kinds of dynamic experiences that could be created around textiles. We think of textiles as static materials and fields of pattern, but they have the potential to be quite reactive and change over time. Textiles wear as they age, not snapping the way a hard product might, but slowly growing holes that can be organically filled in through processes like darning, highlighted through the work of artist Celia Pym⁸. Textiles can compellingly function as a ground plane for images, pattern, and information – but also integrate any graphic markings into their material structure. T’ai Smith describes this dual role of the textile when introducing the Bauhaus philosophy of weaving:

“The woven design is built in tandem with its physical matrix, so the tapestry’s picture is not imposed onto a material ground but, rather, embedded in and transformed by the different kinds of threads and structures used in the process. So while another weave— the canvas— provides the forgotten, or neglected, structural ground for painting’s content, the visual design of the tapestry cannot pretend to detach itself from, or supersede, the material through which it is made on a particular apparatus —the loom.” (2014, p. 4).

8

<http://celiapym.com/>

While contemplating these material and conceptual affordances of textiles, I was one year into the COVID-19 pandemic. A common refrain by that point (spoken with a note of wistful awe) was how long it had been since the pandemic started. What especially struck me was, one, how we had not anticipated the mental state of lockdown and life-on-pause to last more than a couple months, and two, how comparatively so little was allowed to happen for such a long period of time. Though I had moved to a new city and started a new graduate program, my day-to-day quickly became uneventful: I did not meet new people, I went on the same walks every day, I called the



Figure 5.

same friends each week. In other words, there were no significant ways to mark time, and so time slipped away from me, just a number on the top right corner of my computer interface that would change of its own accord. I felt the urge to get a better grasp on time, to feel it as a push and pull, friction in my hands.

3.3.2 Intent & Experience

The *Unravel Calendar* makes the marking of time an embodied, material act that itself takes some time and effort, keeping the hands busy to give the mind a moment of peace, when it is not asked to do anything. Though it does not directly connect us with nature or social relationships, it does offer an interaction through which we can align to a rhythm and find comfort in material touch for the sake of touch. It’s hard to put my finger on how those qualities resonate with experiencing nature – perhaps it’s like watching the sunrise each day, or drawing lines in the dirt.

The physical paper calendars that some still place on their walls or desks also offer that ritual moment of satisfaction in crossing the day off. In these paper calendars, the graphical grid structure of the calendar is printed on the paper’s surface; the information exists on its own plane of ink, from where it structures our experience of time. On the other hand, the material, representation of information, and interaction of using the *Unravel Calendar* are so intertwined that it could not exist the same way in another material. As a result, marking time on the *Unravel Calendar* feels like more than adding a mark to a surface plane: you are unmaking time and generating



Figure 6.

yarn as you go. It tries to embody our experience of time as durational, involving movement and transformation. The day is reflected but simply compressed into the ten seconds it takes to unravel the calendar. By the time you reach the final stitches, you feel as if you’ve worked through the day and have let it go, actively participating in moving time forward by releasing the condensed stitches into loose strands of yarn. Without your mindful interaction, the *Unravel Calendar* would be incomplete – it would be stuck in time.

3.3.3 Discussion

Personal Reflection

In actually using and living with the *Unravel Calendar*, I found it created a sort of ritual, a regular act with my hands that marked each day. With the opportunity to perform such a routine but unnecessary act, I had space to think about what happened that day, or remember the last time I had unraveled the calendar. For some days it was every night before I went up to bed, just before I went around the house turning off all the lights. On these days, I was usually too tired to think deeply or intentionally about unraveling (anyway, that would make it feel too much like work).

There is that tension in using the calendar, that it takes a bit longer than we are comfortable with, and that it can easily become lumped into the tasks we need to check off each day. I found “frogging” or unraveling knits cathartic and satisfying, but it quickly became tedious when I needed to manage the trailing yarn, rather than letting it clump up on the floor. This tension does not work in favor of the vision of products that can be unmade into useful material and then remade, as following through on this continual lifecycle takes the joy out of the unraveling. I believe there is potential to resolve this by creating better yarn management tools as part of the calendar system, and to leverage the idea in general that taking things apart is fun – so such interactions may also have potential in disassembling e-waste products, as an example.

Reactions & Feedback

The calendar concept and materiality immediately resonated with all people involved in informal critiques, with most connecting it to artifacts with similar interactions: bubble-wrap calendars and artist Simone Giertz’s Every Day Calendar⁹; and with similar materials: the climate change and the train delay data physicalizations both use knitting and information as their medium. Professor Jonathan Chapman (JC) was drawn to the way that materializing time and participating in this (mostly) one-way interaction liberated him from the past in a way, unlike his experience with digital

9 <https://www.simonegiertz.com/every-day-calendar>



Figure 7.

calendar apps: “I hate it sometimes when I go back a month in iCalendar and I see all the things I didn’t do very well. All the meetings that went really bad. (JC)”

Some participants misunderstood the concept, which as often happens, led to inspiration: rather than operating as a typical calendar that tracks each calendar day, it could be reinterpreted as a tracker – with unraveled days marking the occurrence of a certain event. This “tracker” version of the calendar leaves more space for the user to fill in their own meaningful time record.

A few people suggested attaching the yarn end to a stepper motor, so it would unravel itself. I intentionally stayed away from this direction, because it takes the opportunity for material engagement and performing seamful interactions away from the user. Still, it is fascinating that some had the instinct to automate the “work” of unraveling, even when it is intended for meditative purposes.

Many participants were interested in the implications of remaking the calendar’s material into a new artifact – how many cycles it could last for, what knots and stains the yarn would accumulate, and how long it would take to make next year’s calendar by hand. Through these questions they seemed to express a curiosity rather than a concern in the ways that the cycle would break down. Perhaps they were being kind, but I believe these questions came from a place of wanting to see how the ideal of zero-waste and material recyclability would play out in this microcosm of the calendar, and from relating to the artifact in a human way: rather than expecting it to perform perfectly, approaching its imperfectness from a place of curiosity and sympathy.

Evaluation

Criteria	Description	Evaluation
Embodied & Material	Close to the body, bridging scales, physical action, tangible.	3 / 3 Interaction is tactile and action-based, involves transforming material from knit stitches into “raw” yarn.
Situated	Relating to a specific place & time, could not exist elsewhere or at another time. connects you to the world around you, exists as much & as long as it needs to.	1.5 / 3 Calendar form is general, not place-specific. Time-specific to the user’s habits, only the days that are left to count “exist” as an artifact.
Effortful	Conscious care, attending, intention.	3 / 3 To use the calendar is to intentionally slow down, and inevitably pay attention to time through material accumulation of the yarn.
Empowering	Gives you tools for re-envisioning, re-making.	2 / 3 Knitting is an accessible at-home method of production, experienced knitters can easily “read” the pattern from seeing the artifact, potential for users to make and re-make their own calendar. Transforming the product and participating in its lifecycle makes the user an active agent in the otherwise inaccessible supply chain.
Incomplete, room for vulnerability	The experience is knowingly imperfect and never captures it all, leaving space for the user to project what is meaningful to them.	0.5 / 3 As-is the calendar does not leave much for the user to fill in, apart from reflecting when they miss days of unraveling. Potential of re-knitting the calendar into new “lives” and creating the “tracker” version of the calendar would enable more room for the user to project their own meaning.

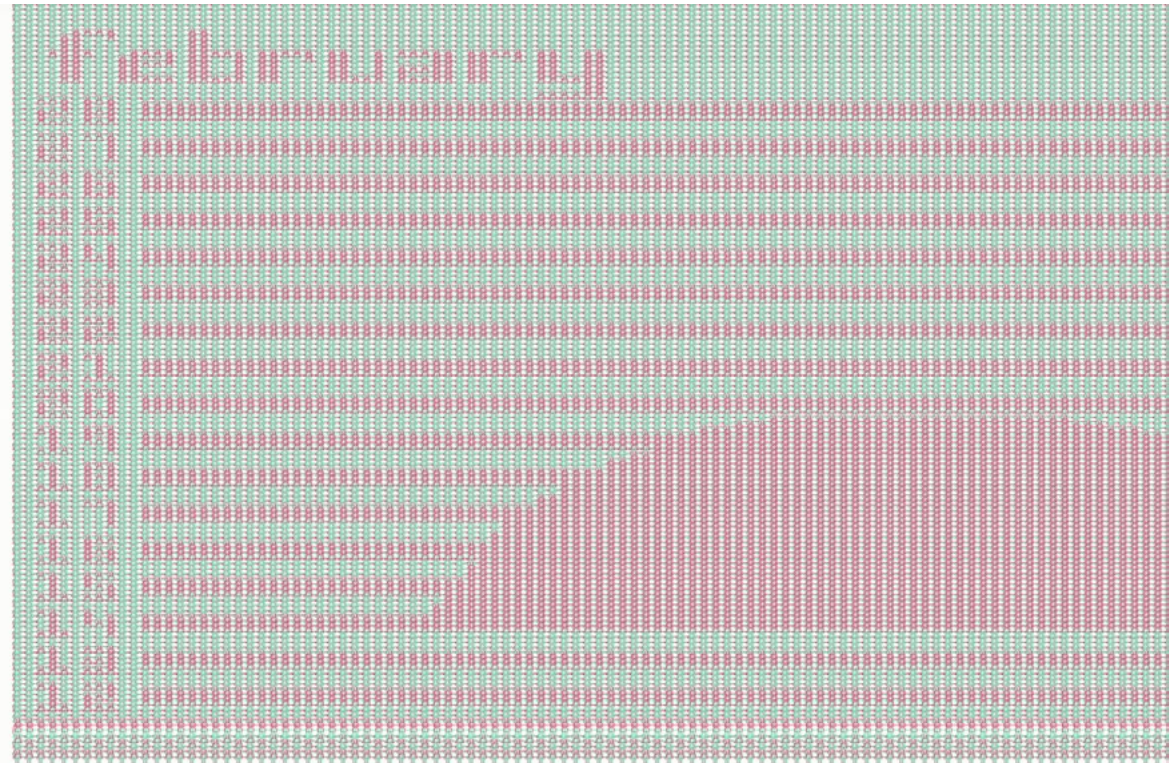


Figure 8.

The calendar was intended to address some of the gaps I described in the introduction as arising from our modern world of seamless technologies. It encourages long-term thinking through material lifecycles, it makes the information “appliance” of calendars less abstract by reconnecting it to a daily routine, it challenges the typical automation and efficiency goals of technology by intentionally scheduling time to produce nothing, and it scratches that modern itch to interact with tangible things when most of our devices involve touching flat unyielding panes of glass. Through its proposition around material cycles, it also suggests potential in designing the unmaking of products, empowering users to reclaim and recycle materials that are distributed through use. This opens up possibilities to explore the emotional, material, and production implications of using functional objects whose materials can be remade into other objects.

Takeaways for Anchoring Experiences

Using material as a metaphor for information/intangible concepts gives you a tool to think with that is not purely digital

When you participate in transforming an artifact, you gain agency and traction to grasp abstract information

Material reuse, or more generally actively taking part in product

lifecycles (e.g. through upcycling), is both a sustainable practice and a means of reflecting on long time periods and accessing supply chain systems that feel beyond us

There must be a reward in sight, like a satisfying sound or physical feedback, to motivate effortful interactions. The reward of spooling yarn to make artifacts in the future is too far removed.

3.3.4 Design & Engineering Details

Calendar Layout & Pattern Design

I developed two variations on the calendar layout. The final iteration of the *Unravel Calendar* represents each day as 1440 cumulative stitches over multiple rows, one stitch for each minute of the day. The days and months of the *Unravel Calendar* read bottom-up, so January 1st is at the bottom of the calendar, with January 2nd above it and so on. This is so that the calendar can be hung, with the unraveled end on the bottom. In the final iteration, two colors are used to visualize graphics and annotate dates and months. The two colors are incorporated using the tubular jacquard technique, where colors are knit on both the front and back bed of needles, with the visible color on the front needles.

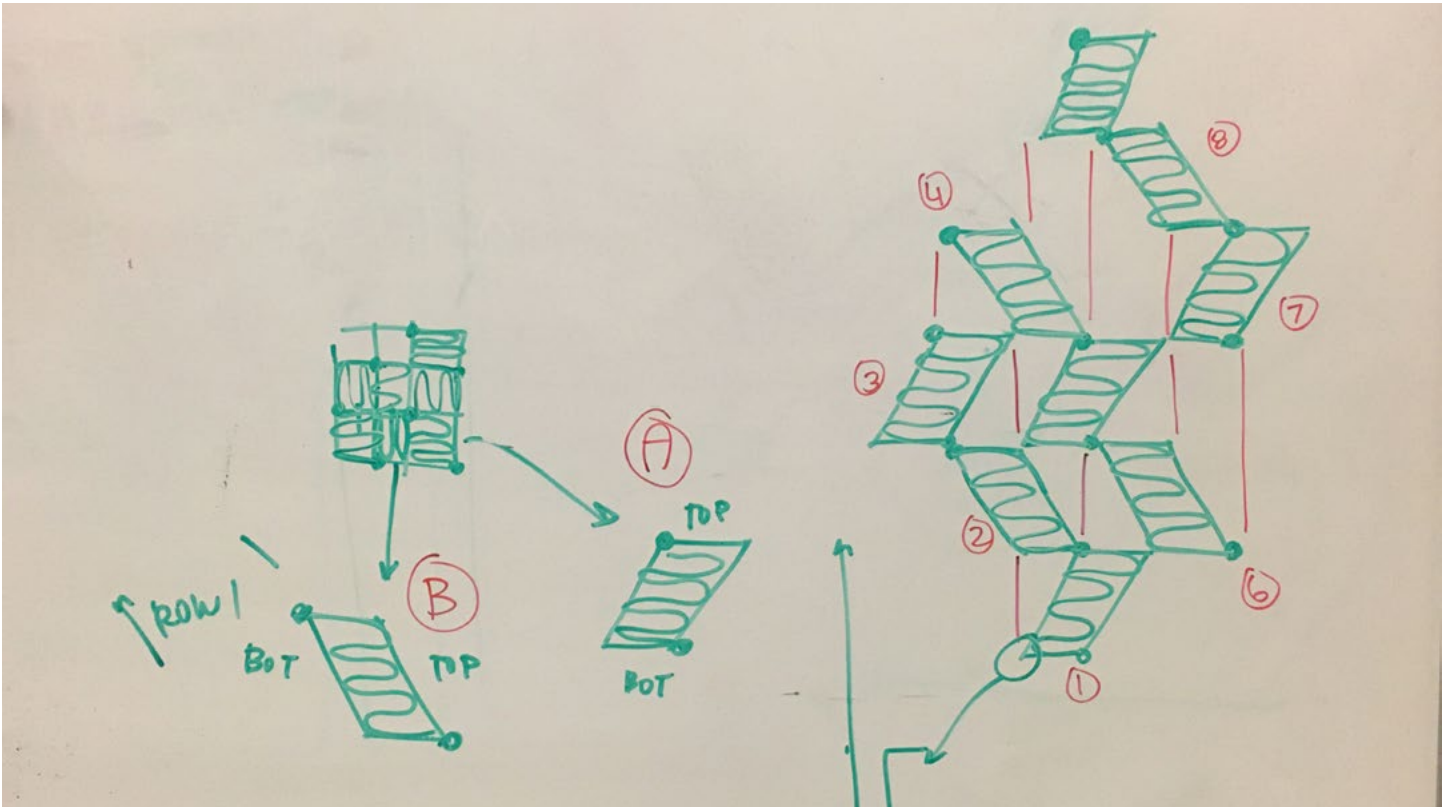


Figure 9. Sketches for developing the knit day modules and designing the yarn path

The original iteration followed the layout of a typical desktop calendar, with knit squares representing days, arranged in rows of weeks, which in turn make up blocks of months. When one square unravels, it feeds into the next square to its right. Because knitting typically is done in rows back and forth, I needed to design and develop a technique to allow one day-square to unravel into the next day beside it.

Designing knit patterns comes down to designing the yarn path. The knit days are implemented in two different modules: A) where yarn enters at the bottom right, runs left to right, then exits at the top left; and B) where yarn enters at the top right, runs up and down, and exits at the bottom left. The pattern is a variation on the entrelac knitting technique, which is typically used to produce a diamond pattern that “resembles basket-woven strips of knitted fabric” and involves the diamonds running in two orientations.

The grid variation was first developed as a one-color pattern to test the structure and correctness of the knit paths. In order to incorporate graphics, I needed to convert this into a two-color pattern. One approach to two-color knitting is the “plating” technique, in which two yarns are laid on the needles together, and changing the order in which they are laid on the needles controls which color is shown on top. Both the yarns’ tensions play an important role in properly controlling which color stays on the front of the fabric: when not precisely calibrated, the yarns can twist, resulting in the



Figure 10. Two-color entrelac pattern using the plating technique.

“wrong” color coming to the front. Because the tensions must be manually calibrated with each use of the machine, it becomes very challenging to reproduce and fully control plated patterns.

Another approach to two-color knitting is the tubular jacquard technique, previously described. Combining this technique with entrelac becomes complicated, as both techniques require conflicting use of the front and back needles. As a result, for the final iteration I reverted to the simpler layout where days are knit as rows spanning the full width of the calendar.

Workflow & Production

The calendar is knit on a Wholegarment Shima Seiki knitting machine (SWG091N2), and so the pattern must be ultimately encoded as a .dat file. The pattern has been developed through learning and following the workflow at the Carnegie Mellon University Textiles Lab. The calendar pattern is written in a javascript program that logs lines of Knitout instructions, “a file format that can represent low-level knitting machine instructions,” akin to G-Code for knitting machines. A typical line of Knitout

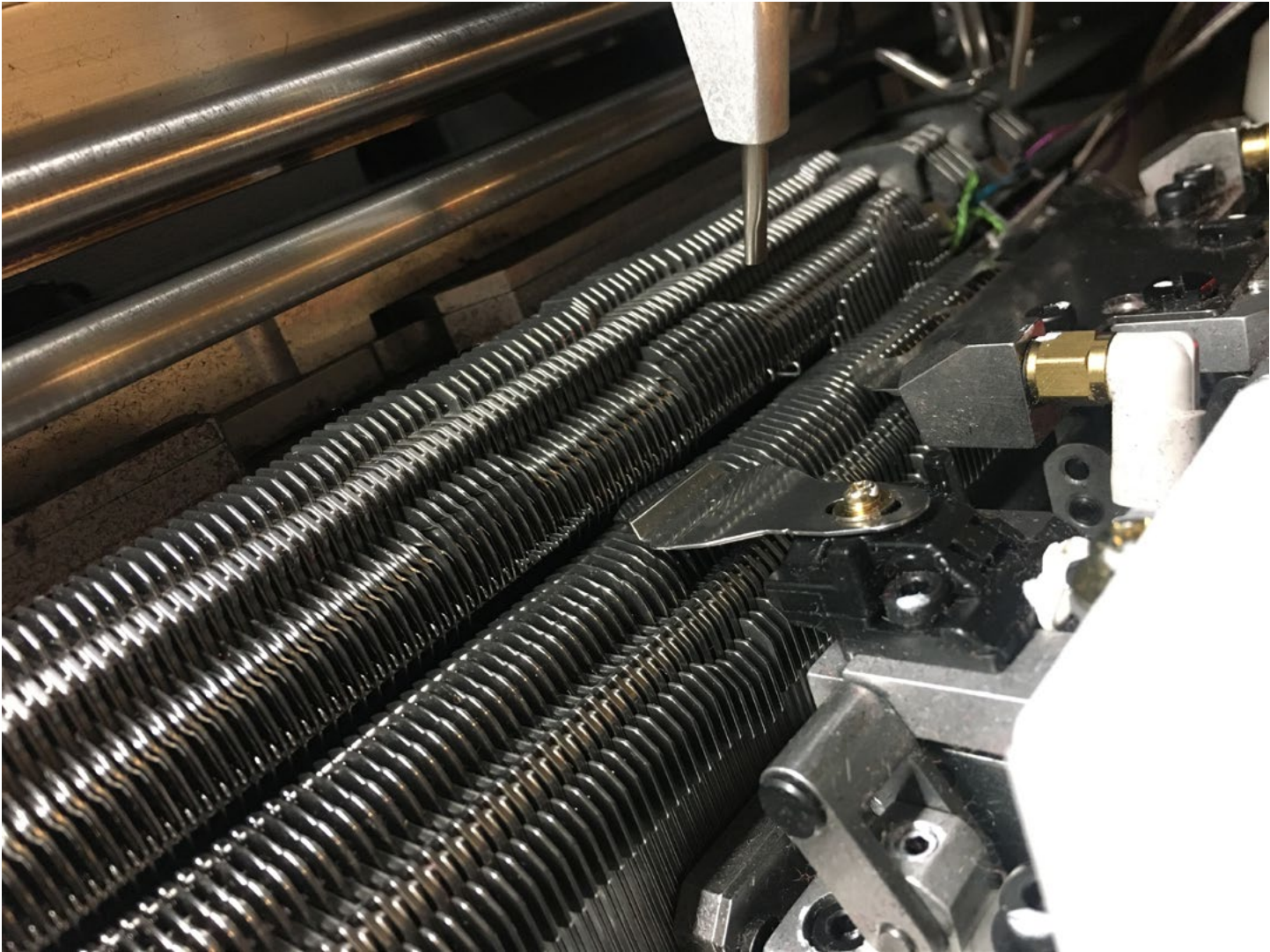


Figure 11. Wholegarment Shima Seiki knitting machine

code might read “knit + f60 9” which translates to “knit to on the front bed needle #60, moving right, and using carrier 9.” The output Knitout file can be visualized and parsed into a .dat file using utilities developed at the CMU Textiles Lab¹⁰.

10 <https://textiles-lab.github.io/>

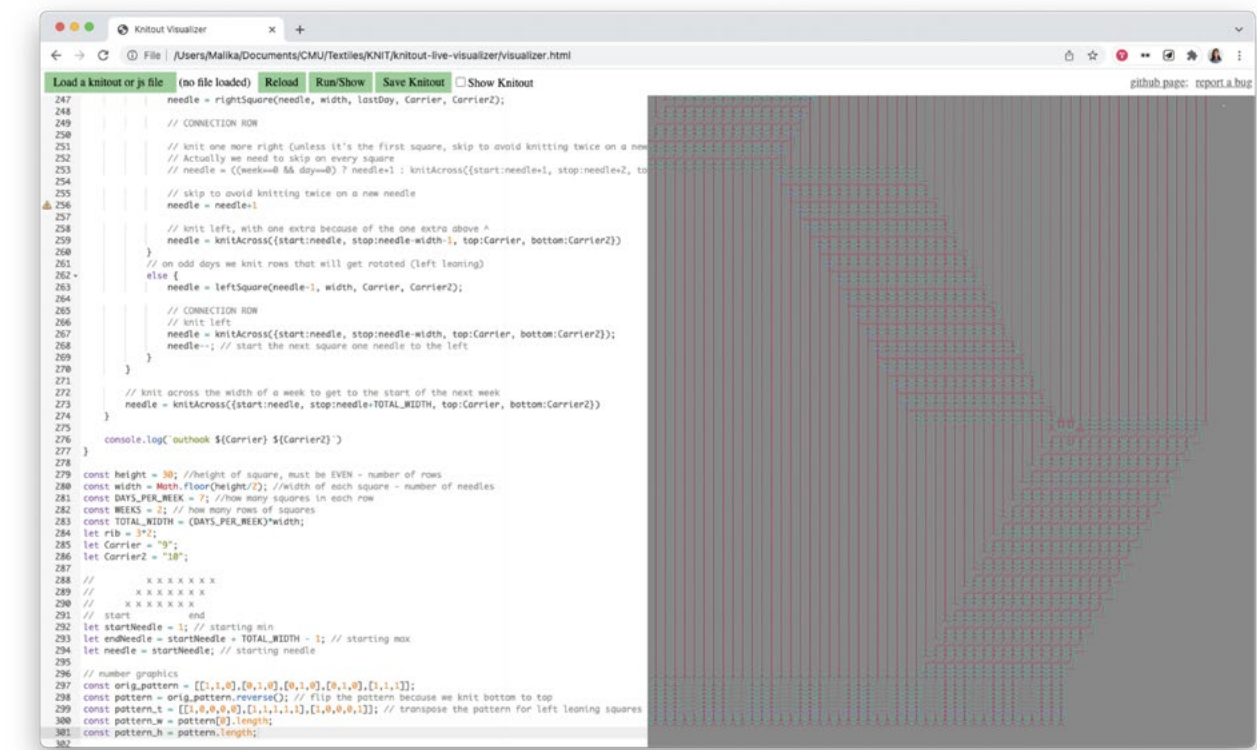


Figure 12. Scripted Knitout and visualizer.

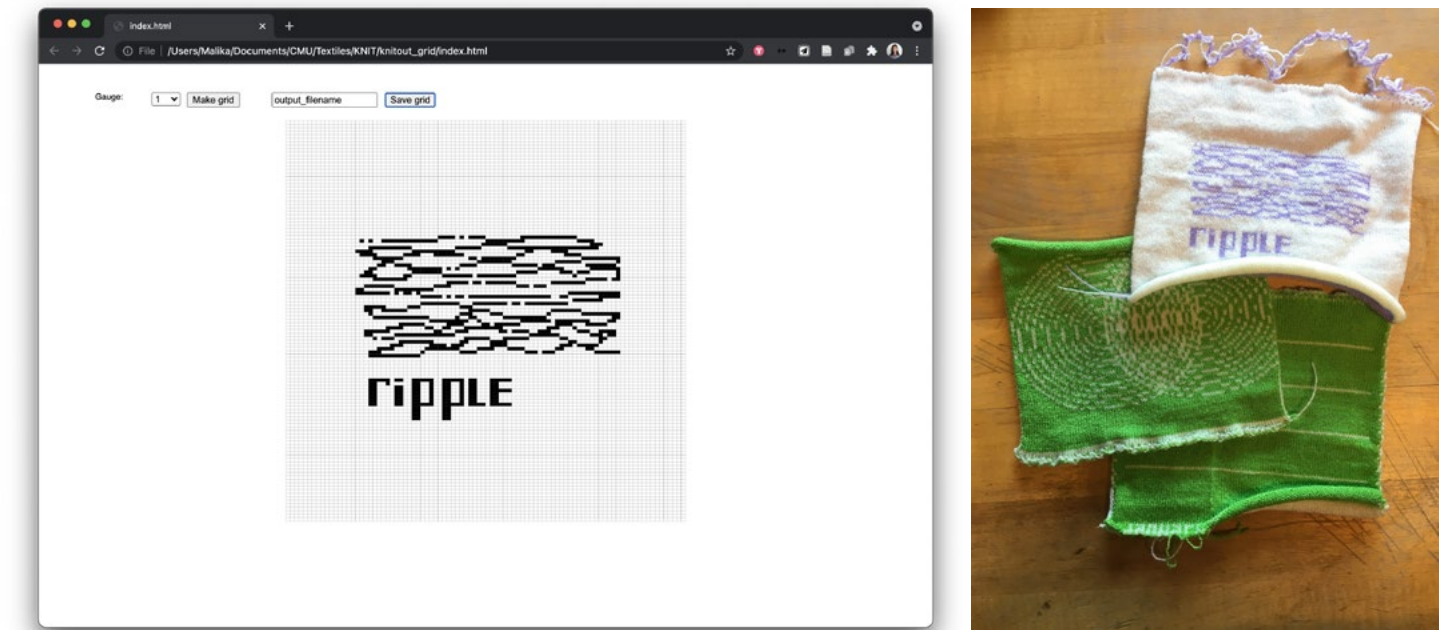


Figure 13. Pixel art tool that generates Knitout patterns.

Graphic Design

I treated the calendar graphics as 1-bit pixel art, where each stitch is a pixel with a roughly 3:2 width-to-height ratio. I designed all graphics and type for the calendar first on graph paper, and then used a custom pixel art tool I wrote to allow the easy design of knit graphics. This tool takes a pixel drawing and converts it into a bit array and then a two-color Knitout pattern using the tubular Jacquard knitting technique.

3.4 Compass Radio

When we direct our thoughts to a loved one far away, we might try to imagine what they are doing and experiencing at that time: what time it is, whether the sky is gray and rainy or sunny and clear, how they are feeling. Music neatly captures these factors by conveying a particular mood and atmosphere, and in this way, local radio stations pipe a constant stream of a place’s atmosphere.

The *Compass Radio* taps into this stream to help you feel closer to the people you care about all over the world. When you orient the radio towards the home of someone important to you, it plays an internet radio station from that place. For me, the radio is programmed to orient to Boston, MA; Ann Arbor, MI; San Francisco, CA; Dubai, UAE; and Seoul, South Korea. Over time and touch, the radio develops a patina that marks how it has been held and used.

3.4.1 Concept

I developed the concept for the radio while in isolation in my Pittsburgh apartment during the peak of the COVID-19 pandemic. I was grateful to stay in touch with friends and family all over the world, often waking up to photos from my good friend in Korea. It was comforting to pause and imagine what they might be doing, even when we were not video chatting or messaging.

With the stresses and constraints placed on socializing due to the pandemic, I found a renewed case to be made for imagining new and intimate ways of connecting people across distances. We have entered a world in which remote work has become more normalized, yet we have also become more acutely aware of the limitations of mainstream communication technologies. It is more important than ever that we design ways to connect that prioritize emotional value, and offer moments of softness, familiarity, and serendipity.

This notion of attuning ourselves to relationships beyond what we can immediately perceive is not only relevant to how we connect in human-to-human relationships, but it is also essential to thinking ecologically

through design. In this way, the radio connects to the larger project of using interactive technologies to anchor us to relationships and timescales that are human and beyond human.

The concept of the radio was thus born out of a personal desire to keep in touch with my important people around the world and find alternative means of connecting with them. Its form and interaction is not an answer to the problem of how to operate a radio, but as a proposition to explore the ways in which a radio might expose the distances we feel in relationships.

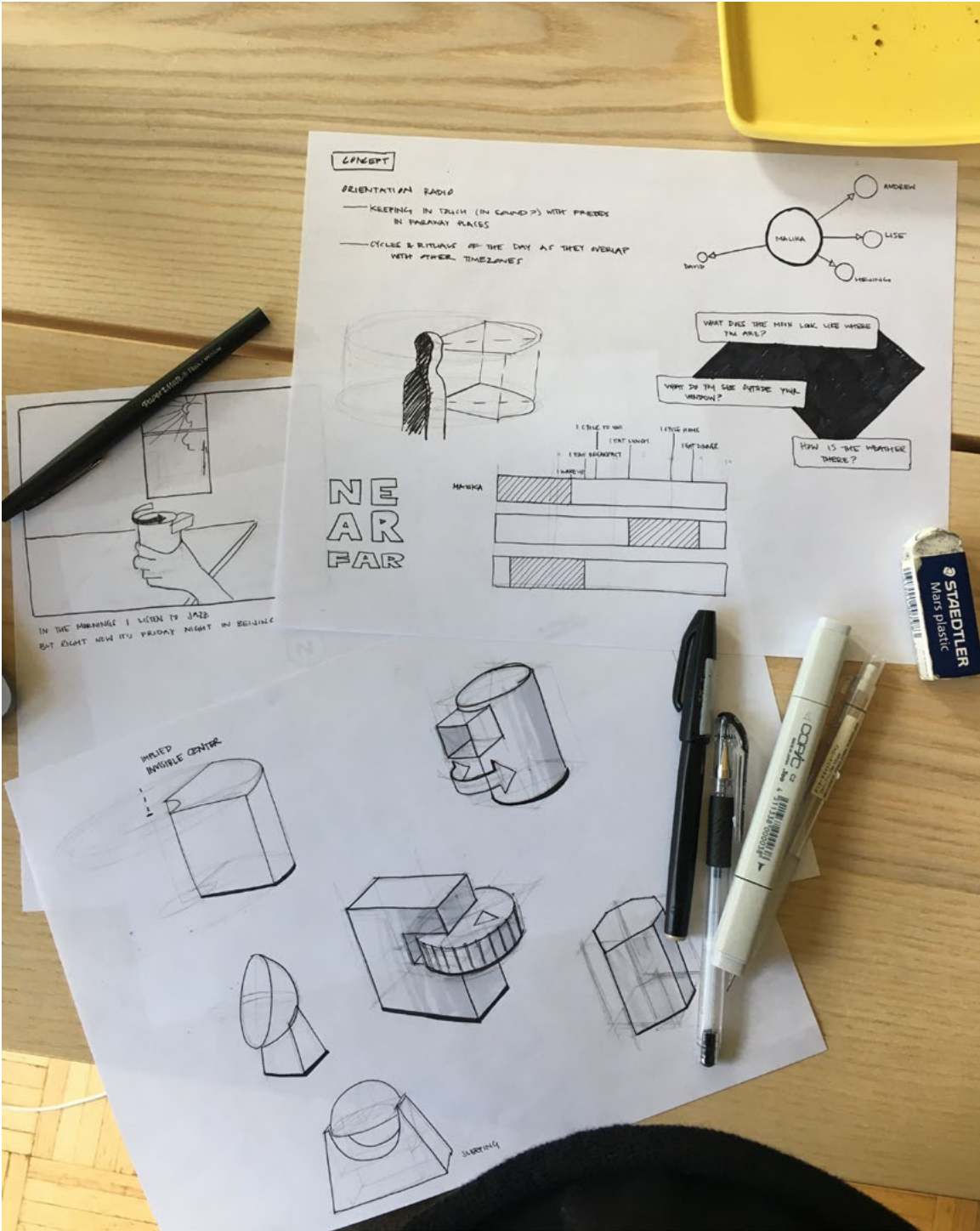


Figure 14. Radio concept sketches

As a broadcast technology, radio requires listeners to tune in – they are dropped into an existing live stream of music and conversation, getting a slice of life right in the middle. This act of tuning in a radio mirrors the emotional tuning that I do when my thoughts go to a loved one in another place, with both enacted through the interaction of the *Compass Radio*: a sort of geospatial tuning that involves turning the radio to “face” a person in order to listen to their radio station.

There’s a romantic idea of looking at the same moon as the people we love, that no matter where we are, there is this natural phenomenon we all share. Moons, weather, atmosphere, feelings, radio – these are all phenomena we can share with people around the world. Radio DJs make this connection via shared phenomena to their listeners when they choose music to fit the time of day, their personal mood, and what is popular at the time. The radio becomes a stream of the atmosphere that surrounds them, and through it I can connect to the atmosphere where they are. I find comfort in the thought of sharing the experience of music, the feeling of a rainy day: it reduces distances and makes us feel that we are with each other.

3.4.2 Intent & Experience



Figure 15.

The *Compass Radio* specifically deals with the ways we can connect with other people and direct our thoughts in a sort of one-way communication that does not demand too much of us or fully remove us from our present place and time. When I orient myself to Seoul, I am temporarily transported to Korea as K-pop streams out of the radio, but I am still here: Seoul is now brought closer, into the corner of my kitchen with the wooden table and dried lavender in a glass.

In bringing other places closer, the radio tries to directly close the gaps I experience in a globalized world, where I care for people who live multiple timezones away. There’s a tension in that I have the technology to connect with them, so I hold onto these relationships with the expectation that we will stay in touch and meet again, but still I cannot give them my attention in the way I want to. It does not directly try to anchor me to nature, but through social relationships, makes me more attuned to all the factors that make up place: weather, air quality, time of day, atmosphere. The radio also pushes back on the expectation that connected devices are used to make our lives easier, more convenient, and more efficient. Tuning to a radio station through orientation is certainly not the most effective way to listen to music, but listening to music and maintaining relationships with people are both about emotion and meaning, not efficiency.

Using the *Compass Radio* relies on your geospatial sense of the world – knowing what direction Seoul, Dubai, Boston, Ann Arbor, and San Francisco are relative to where you are. Through the interaction, you have the opportunity to develop this sense. You might start by thinking about the direction in which the sun rose this morning to orient yourself, or begin turning the radio to find a station that is recognizably from a place. When searching for a station, you must turn slowly, carefully listening for any interruption in the quiet static coming from that direction. It’s easy to overshoot a station, so you might need to turn the radio back, slowly narrowing in on a single direction. After discovering and identifying one station and its corresponding orientation, you can find the others relative to it. Because the radio treats places at different distances equally, you can mentally assemble a basic circle of stations and places around you, where San Francisco is in front of you, Michigan is by your right shoulder, Dubai is almost directly behind you.

Because these places hold a special meaning to me, the experience of putting together this circle spatializes the pull of distributed attention and care I feel towards people and places I love around the world. The vectors of directed presence and attention from all my people act on me simultaneously, pulling me in different directions – but rather than spreading me thin, the radio helps me find an equilibrium in those forces. Orienting myself to one at a time makes me aware of the pull in that direction, but it is always centered and relative to where I am.

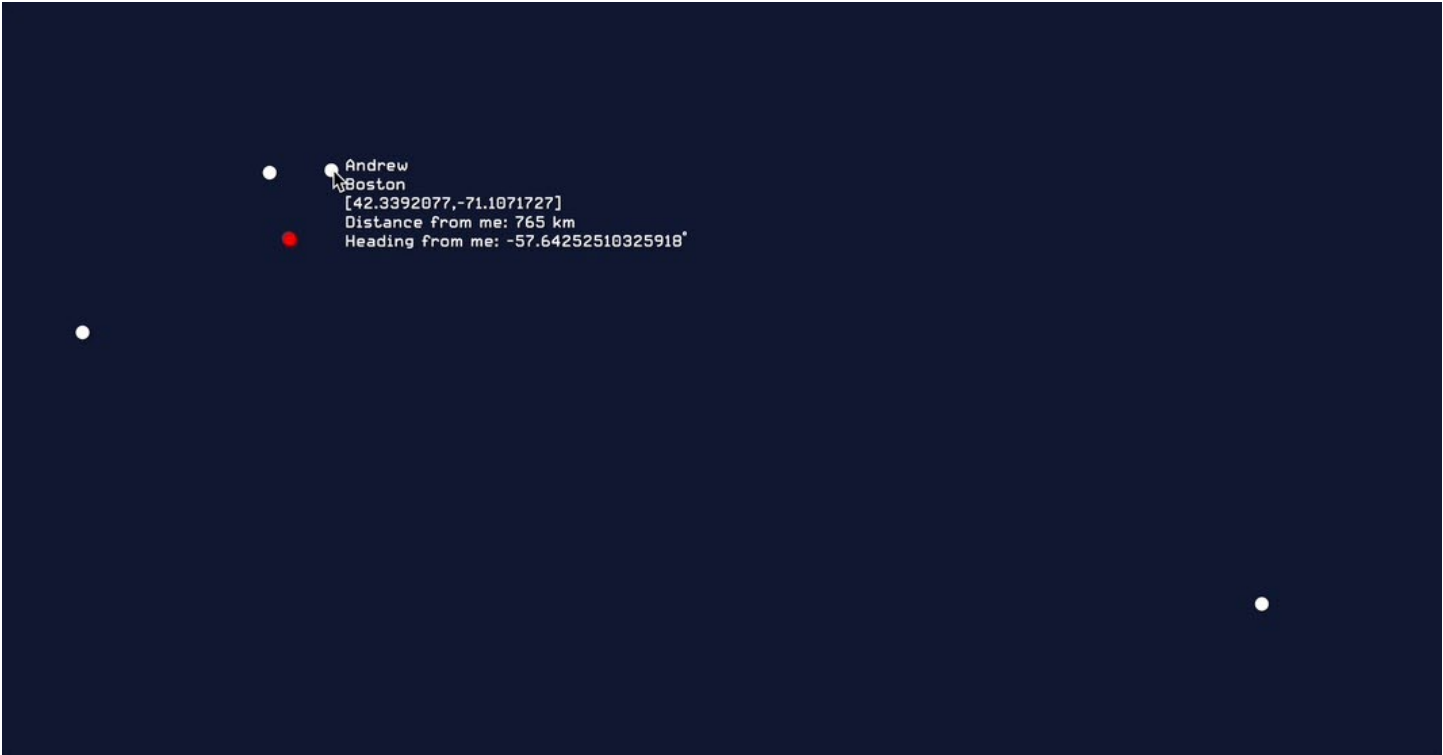


Figure 16.

3.4.3 Discussion

Personal Reflection

The experience of living with and using the *Compass Radio* has built up my geospatial sense of where places are relative to me, especially from my apartment. At first, I tended to rely on the sunrise and sunset to help orient me, then I could find the places and radio stations that I knew were roughly East (Seoul, Dubai) or West (San Francisco), and then determine where the others were relative to those orientations. After using the radio regularly in my apartment, I have developed a more direct sense of where each person is relative to the layout of my space, without needing to step through the same logic of orienting.

Here I share a particular episode of using the *Compass Radio*, to illustrate this process of orienting through the interaction, and highlight some of the flaws I found with the concept.

I woke up one morning thinking of one of my best friends from college, Jill, who is currently getting her PhD in California. I calculated that it was around 5:30 am for her, so she must have been sleeping. If it was later in the day, I might have tried giving her a spontaneous call, as is our habit. This instead seemed like a good opportunity to practice orienting and intentionally directing my thoughts to her, so I went to the kitchen and turned on the Compass Radio.

I found East easily - the sun was still early on its path so I just needed to find it to orient myself cardinally. On my radio, this is close to where the South Korean radio station is, which is also the loudest and clearest station, so it's quite easy to find. I pointed the radio at the rising sun and sure enough, K-pop suddenly blasted into my quiet and still kitchen. I closed my eyes, imagining Seoul cast in the direction of the sunrise, then me in Pittsburgh, and then San Francisco in the opposite direction, almost in a line. I found the San Francisco station by turning the radio 180 degrees from Seoul. I could not tell exactly what was playing, but it did not fit the peaceful introspective moment in my kitchen, nor did it fit how I thought about Jill.

The interaction of tuning the radio directed me to think about what time it was for her, what she might be doing, where she is relative to me and other places I know – for a moment feeling closer to her time and place, making her presence less abstract and distant, and also feeling stabilized in that almost magnetic pull of attention from where I am to where she is. On the other hand, the music itself did not contribute to the experience for me – perhaps it even detracted from it. It was not the music I felt like listening to, and didn't feel personally connected to Jill.

My theory that radio DJs broadcast the atmosphere and mood of the place they are in did not seem to hold very well – perhaps because I am not familiar enough with these radio stations, or the music they play is influenced by some other factors that I overlooked.

Reactions & Feedback

In addition to having the typical conversations about the radio with my friends and mentors, I was able to present it in Professor Jonathan Chapman's Design That Lasts course workshop on "Rich Experience." The reaction I heard most was one of resonance and personal connection – it seems many relate to the feeling of being pulled towards people they care about who are not where they are, trying to be in a place when you can't, an almost inevitable feeling in the modern world. One of my peers said that it makes it feel like if you just walked in the direction of the radio station, you'd find them.

The tangibility and materiality seemed important to many, especially those who were able to interact with the radio in-

person. JC described it as being a technological device that feels like two pieces of stone you're turning against each other, and another peer pointed out how its tangibility helps close the gap between your concrete experience and an abstract faraway place, saying that you can always look at pictures of the moon, but it becomes an entirely different experience when you can hold a rock from the moon.

The specialized function of the artifact as a radio was significant to multiple people, so they could focus on the interaction and the person they were thinking of without getting distracted, especially when I asked how they think of it compared to an internet radio service on their phone or computer.

One piece of the conversation in JC's class on Rich Experience was about defining experience as the mismatch, positive or negative, between what we expect to happen and what actually happens. My peers in the class observed that the radio creates a richer and more rewarding experience by opening that gap: asking the user to put in more effort to align the radio just-right. They also pointed out that it makes for a more forgiving and organic interaction – because you do not expect a direct mapping of "I push this button and this should happen," it creates some space for play and opportunity for effort, rather than frustration when things don't go to plan.

Evaluation Against Criteria

Criteria	Description	Evaluation
Embodied & Material	Close to the body, bridging scales, physical action, tangible.	3 / 3 Interaction is physical and action-based, involves reorienting the body to feel closer to distant places.
Situated	Relating to a specific place & time, could not exist elsewhere or at another time. connects you to the world around you, exists as much & as long as it needs to.	3 / 3 Programmed radio orientations are specific to where it is used - where is the other place relative to here? Radio is inherently ephemeral - music is transmitted on stations at a given time and then disappears.
Effortful	Conscious care, attending, intention.	3 / 3 There are other easier ways to listen to internet radio stations, but choosing to do so with the Compass Radio is intentional: it takes effort, care, and orienting oneself to properly align in a given direction.
Empowering	Gives you tools for re-envisioning, re-making.	0.5 / 3 The radio does not provide tools or means of re-making.
Incomplete, room for vulnerability	The experience is knowingly imperfect and never captures it all, leaving space for the user to project what is meaningful to them.	2 / 3 The current radio is personalized to people who are important to me. The music played may not exactly connect me to the person, but the process of orienting to them does, and the music becomes another element of the experience to respond to.

Takeaways for Anchoring Experiences

- When an interaction is personalized to the relationships that are meaningful to you, it celebrates and makes you aware of your unique context.
- Setting less direct/fuzzier expectation mappings (vs “I do this and this should happen as a result”) creates space for effortful interactions that are rewarding and enriching, rather than annoying.
- Physically orienting your body through an embodied interaction is an effective way to connect to other places while also staying grounded in Here.
- Material finishes and tangible interactions work together to make technology-driven experiences feel organic and analog – taking the attention away from the tech itself and instead focusing on the experience.

3.4.4 Design & Engineering Details

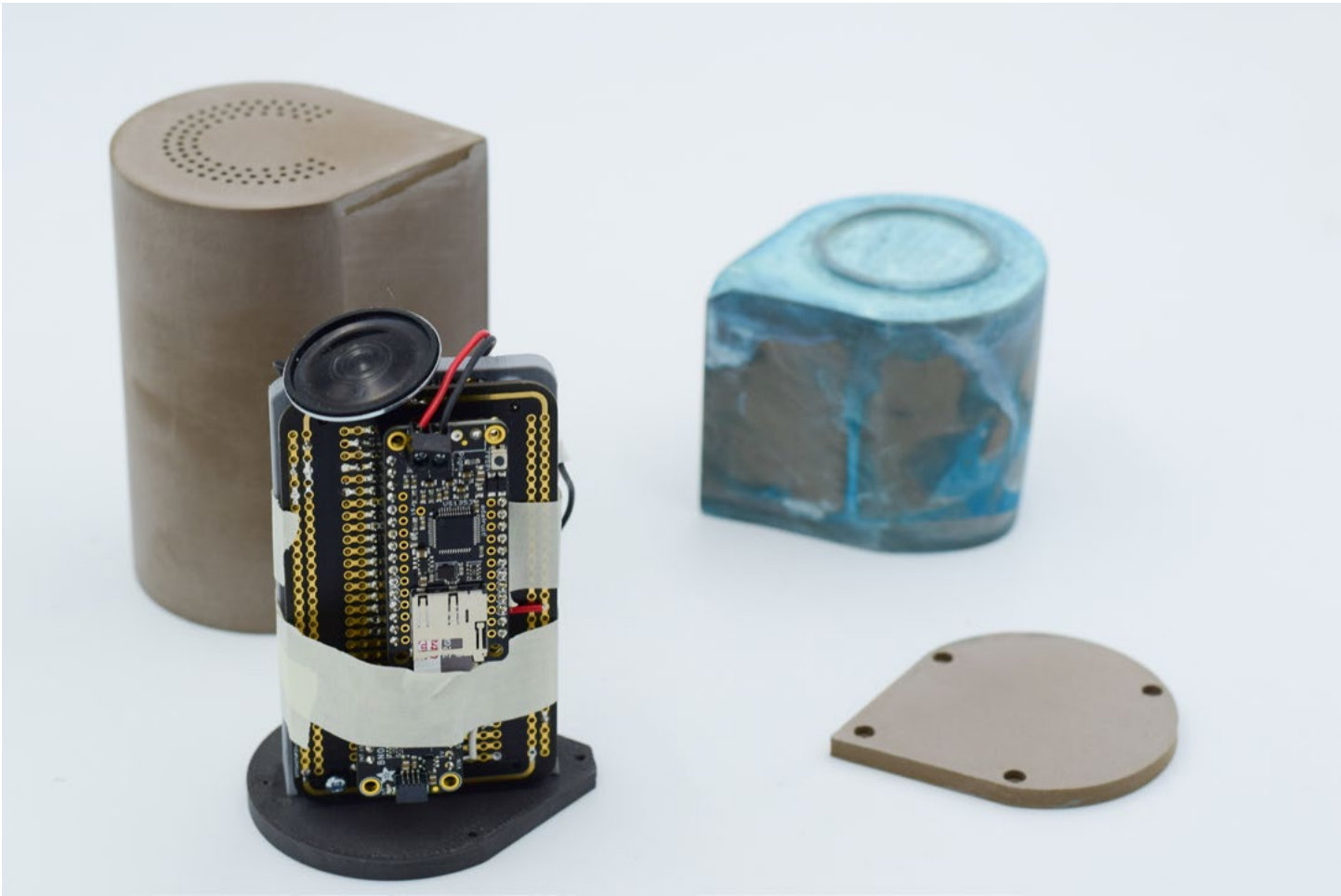


Figure 16.

The radio is designed and 3D printed in five parts using FDM printing in bronzeFill PLA, then is sanded and polished. The top rotating element houses all the electronics, and is wirelessly charged through the base element. The radio depends on an WiFi-enabled MCU (ESP8266), an MP3 decoder (VS1053), a 9-DoF Inertial Measurement Unit (IMU) sensor (BNO055), and an 8-ohm speaker.

Electronics & Firmware

I developed the electronics first, prototyping each component of the interaction incrementally using the Arduino platform:

- 1. Reading out headings from the IMU sensor using the Adafruit BNO055 and Sensor library.
- 2. Connecting to Internet radio stations hosted online using the ESP8266 WiFi library to create TCP connections.
- 3. Loading the byte stream from Internet radio stations into a buffer and decoding it using the Adafruit VS1053 library.

After getting each piece to work independently, I brought it all together to have the IMU heading snap to the nearest location in my programmed list, within 20 degrees, then connect to the Internet radio server associated with that location, and read the audio data from the station into the MP3 buffer. The radio is powered by a lithium-ion battery, connected to the MCU via a switch.

Physical part design

As soon as the electronic components were set and the MCU programmed, I planned out how to stack the boards to minimize height, and soldered the components and wiring onto a protoboard. I modeled and 3D printed a mount for the internals to slide into the outer bronzeFill shell. The whole object was modeled in Solidworks parametrically, so the dimensions of the internal mount drove dimensions of the shell. I installed heat set threaded inserts in the shell to allow for easy disassembly and reassembly.

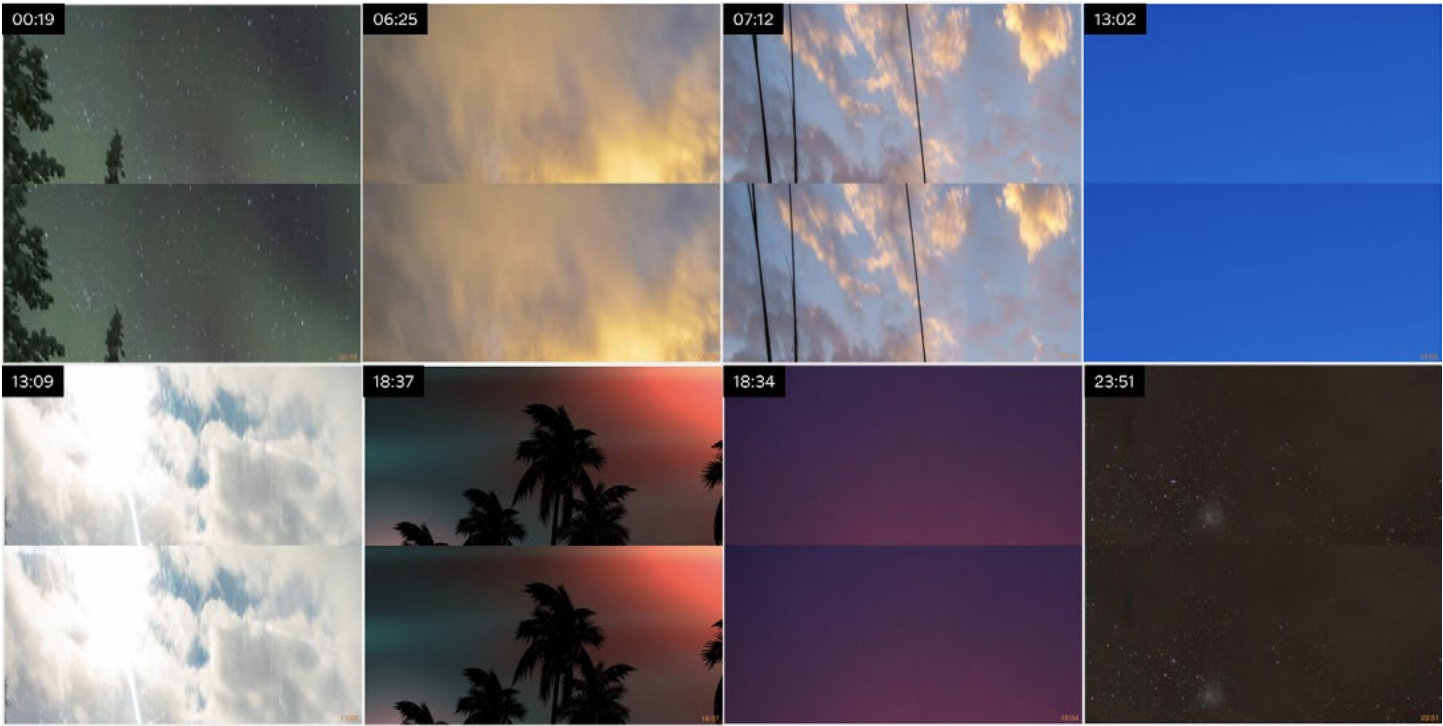


Figure 17. *Sky Clock* images throughout the day.

3.5 Sky Clock

When we look at the clock, we are really asking a question about time and duration relative to now: how long has it been since I woke up, how long until I get to see a person I love, how much daylight do I have left to soak up? Our ubiquitous 12 and 24-hour clocks are helpful in the standard, regular structure they provide, so they can serve as neutral tools to answer these questions. Still, they do not allow for subjectivity or the “discontinuous, multi-directional, and variable” modes in which humans actually experience time – as Joanna Drucker asks in *Graphesis*: “How to find the right graphical language to communicate this knowledge in ways that are sufficiently consistent to achieve consensus while being flexible enough to inscribe the inflections that characterize subjective experience?” (2014, pp. 72-73).

The *Sky Clock*¹¹ provides an alternative way of representing time that is flexible and forgiving, but still shared. It shows an image of the sky every minute, which was captured at that minute by a user on Flickr.

3.5.1 Concept

The concept for *Sky Clock* was prompted by this aim to find other, more flexible ways of representing time. When I am at my desk working, I look out my window throughout the day, usually to help me work through a thought, subconsciously noting the shades and hues of the day, how they shift, how the sun is moving from one side of my home to the other. This urge

¹¹ <https://openprocessing.org/sketch/1475544>

to represent time in an ambient way that ties back to the sky seems to be shared by many, inspiring product concepts like the “Patch of Sky” lamp, which is a desktop device that shows shifting gradients to represent the sky over the course of the day, and James Turrell’s “Skyspace,” an installation that plays with perception and sensory awareness by essentially cutting a hole to the sky in the gallery ceiling. I was also drawn to the experiential impact of crowd-sourcing images from the internet, as in the Human Clock¹², which represents the time through public photos in which the time is written or displayed. This has the additional effect of connecting us, as the viewer, to the person who took or is in the photo, fostering a feeling of universal experience.

3.5.2 Intent & Experience

Sky Clock is intended to be an ambient clock that holds me a little less tightly to the rigidity of time to the minute, by reframing time as the balance of daylight and darkness. In that way it connects me to natural phenomena, but does so through the photographic lens of other people. The fact that it depends on others’ photos brings in an element of human connection, linking me both to a stranger’s intention and to their incidental context. The clock loosely addresses the gaps I experience with ecological perception and information abstraction, as it tries to reinject meaning into time, by concretely linking it back to the sky.

When you first open the clock, you spend a few moments watching it intently. If there are many photos in the database that were taken at the current time, you can watch them cycle through – but otherwise you need to wait for the next minute to arrive to see what new images it brings. Some images are clearly representational, with tops of trees or slices of buildings visible, while others are so abstract and unexpected that you need to remind yourself that you’re looking at photos of the sky.

3.5.3 Discussion

Personal Reflection

As a shorter project that was conceptualized, designed, and built in one week, I did not have the time to iterate on *Sky Clock*. As a result, its intent reads as less rigorous and defined to me, and I have many ideas to improve upon it. In using *Sky Clock*, I quickly found it to be less engaging because it was not personal to me nor activated by my interaction. Apart from testing it for the purpose of reflection, I wondered when I would actually use it – I cannot think of a scenario in which I would decide to open up the *Sky Clock* page, instead of just looking out the window. This is both because the concept came from a place that was more about universal rather than

¹² <https://humanclock.com/>

personal experience, and because the interaction is not embodied or engaging. Though tying it to the clock enables it to constantly shift, it also becomes a more seamless experience, in which I am not asked to put in any effort or intention.

Though my intention with tiling the sky image was to get closer to a pure representation of sky without other distractions, these “bonus” subjects actually became a compelling and surprising outcome from using the clock. Tiling did have the effect of abstracting the photos slightly, making a kind of mosaic of color from the photo, but because the photo was only tiled once, it retained some of its representational quality.

I kept *Sky Clock* open on my computer in the background for stretches of time while I worked, so I would have the opportunity to softly focus on its images of the sky while thinking. I found it served a similar role as looking out the window does for me while I work, except that the sudden slideshow transition (basically a “cut”) between photos would slightly disrupt my focus, even in my peripheral vision. One change I would like to make there is to lerp each pixel from one image to the next, so that there is more of a sense of calm, infinitely transitioning skies. An alternative approach could be to extract the dominant color palette from each image, and instead shift through that more abstract representation of the photographed sky – though this would likely become too abstract and lose the connection to the photographer and their context.

It was initially frustrating to discover the photos’ timezone errors and my oversight that different seasons and latitudes will affect how the sky will look at a given time. Still, I wonder if these errors in the current iteration of the clock could become a moment of engagement, if only they were made more legible. It makes me think of David Horvitz’s related project, “The Distance of a Day,”¹³ which documents the sunset as seen by the artist’s mother in Los Angeles, juxtaposed with the sunrise as seen by himself in the Maldives. By calling attention to the different skies we see at a given time, we get another sky to compare to our real, situated sky – and we more poignantly feel the space and time between even our shared skies.

Reactions & Feedback

As I anticipated, the clock concept did not resonate as deeply with others as my other interventions, seemingly because it came from a less personal and thus less unique place, and because the interaction and design flaws I quickly realized from using it were distracting enough that they detracted from the experience of the clock. In a critique with Golan Levin’s class, one of my peers anonymously pointed out that “the notion of using the sky as a means for timetelling is not unique,” but that leveraging real, crowd-sourced images made it more concrete and emergent, where the landscape or other subjects in the photo might come through. Most were confused by

¹³ <https://www.converge45.org/david-horvitz>

the decision to tile the photo, it seems because it was only tiled once, it did not clearly read as intentional. Though I felt the timestamp at the bottom created some tension with the intent of the clock, several people noted that it was a compelling detail that they wanted to see emphasized more, perhaps with some variety in focus and alignment with the photo to evoke the individual idiosyncracies of each camera’s LCD date projector.

Evaluation Against Criteria

Criteria	Description	Evaluation
Embodied & Material	Close to the body, bridging scales, physical action, tangible.	1 / 3 Interaction is passive and ambient, not active and physical. Brings the sky from around the world to be accessible and close.
Situated	Relating to a specific place & time, could not exist elsewhere or at another time. connects you to the world around you, exists as much & as long as it needs to.	2 / 3 The images of the sky are very time and place-specific, almost too much so: when time zones get mixed up, you suddenly see an image of the night sky in the middle of the afternoon, and there is no clear way to make sense of it or make the error legible. The clock itself embodies transience as it is constantly shifting: you cannot grasp one image for long, especially during sunrise and sunset, when the colors vary greatly.
Effortful	Conscious care, attending, intention.	0.5 / 3 The ambient nature of the clock means that it takes little effort or intention to engage with it - either it is always on in the background, or you go to the website for a few minutes.
Empowering	Gives you tools for re-envisioning, re-making.	0.5 / 3 Does not give the user tools to make their own visions or clocks.
Incomplete, room for vulnerability	The experience is knowingly imperfect and never captures it all, leaving space for the user to project what is meaningful to them.	2 / 3 The crowd-sourced images are suggestive but leave space for the user to imagine moments of their own life.

Takeaways for Anchoring Experiences

Concepts that come from a personal experience tend to be more engaging and unique, but still relatable. General concepts like the Sky Clock still feel quite abstract and removed from your experience.

Ambient interactions contribute to an immersive atmosphere, but lose out on the user’s engagement and intentional effort.

Embrace and engage flaws in the experience: rather than attempting to erase them, make them legible to the user, so they can participate in understanding and reacting to them. Miscommunication can be a rich source of inspiration!

Crowd-sourced content has the effect of linking us with the (anonymous) contributor’s intention and context, fostering a feeling of universality.

3.5.3 Design & Engineering

To get images from Flickr, I wrote a Python script¹⁴ that fetches photos that matched the search “sky,” using the Flickr API. I filtered the results to only use photos with EXIF metadata (to get the actual capture time, not the time the photo was uploaded to Flickr). Then, I saved these photos into a json file, with keys for each ‘HH:MM’ time, and values with the urls of matching photos.

I rendered the clock on the web, using p5.js. I loaded this json into my p5 sketch to take the current system time, format it as ‘HH:MM’ and then pull a corresponding image URL from the json to display an image that was taken at that time. I cropped the top half of the image and tile it once, based on the basic assumption that the sky is typically at least in the top half of an image of “sky.” I chose to do this with the hope that it would more likely create a swatch of pure sky. The actual time is printed in small orange text on the bottom right of the photo, reminiscent of the timestamp on developed film photos.

I ran into issues with capture time in EXIF metadata, as the time is simply the camera system time, so it depends on the user to properly set their camera time. There is also no consistent way to know what time zone a photo was taken in, unless set properly by the user or GPS location is included.

¹⁴ <https://deepnote.com/workspace/merlerker-861569b0-7acb-4921-abd9-0b47ac39082b/project/sky-clock-a09c5339-8894-4d83-84cc-397f7d5ee80d/%2Fnotebook.ipynb>

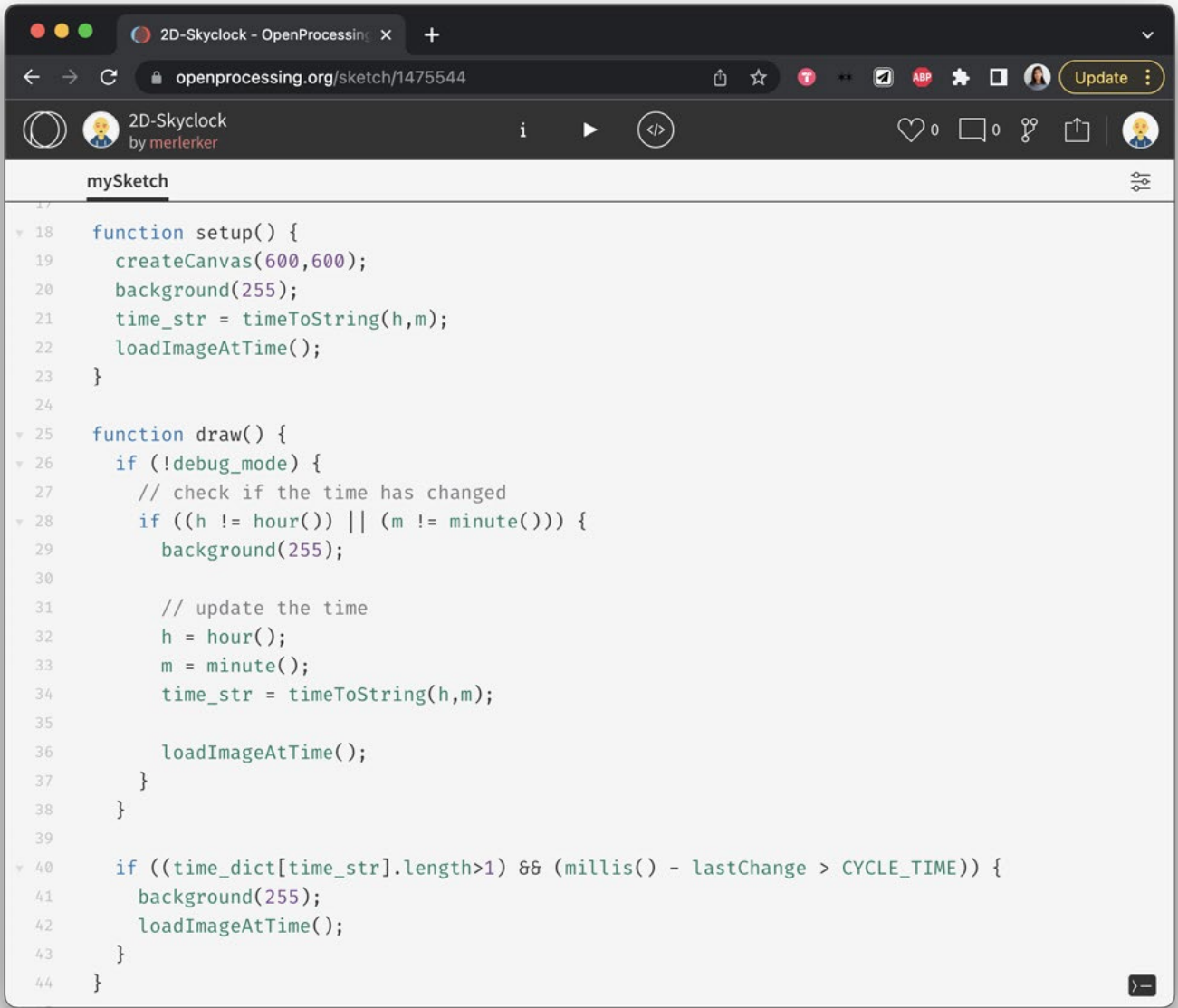


Figure 18. Sky Clock p5.js script to display images based on current time.

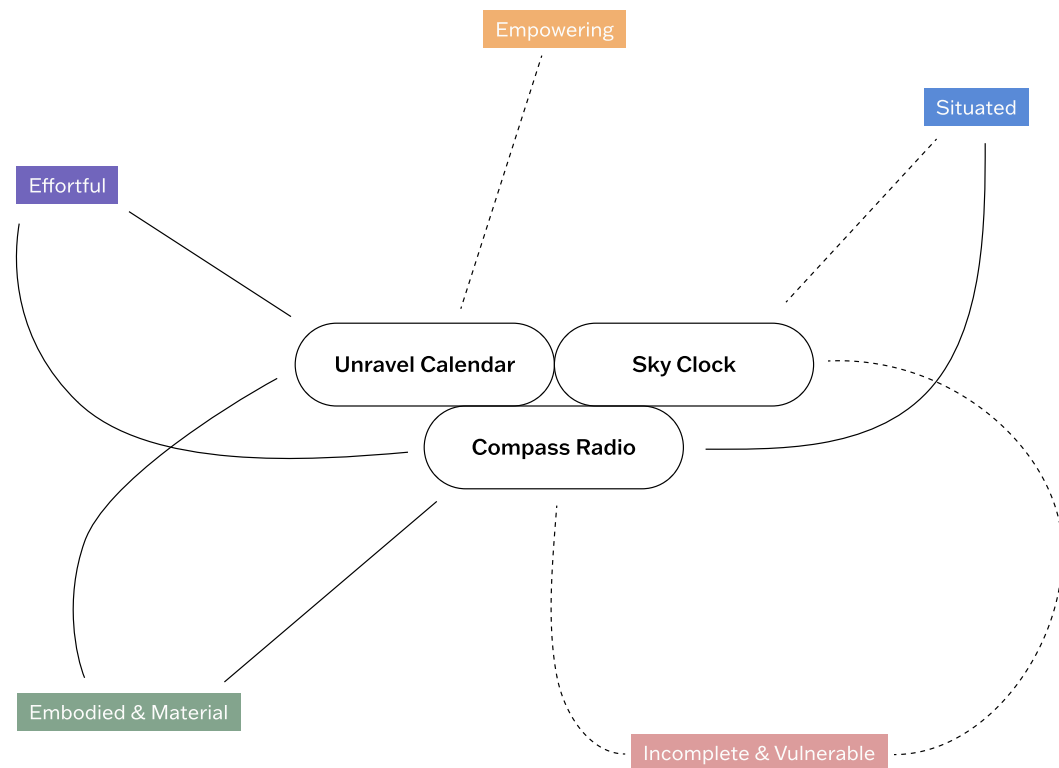


Figure 19. Criteria addressed by each intervention.

4. Evaluation & Reflection

I conducted the three interventions described above as distinct design case studies with the goal of designing seamfulness into my everyday interactions. They also served to test my hypothesis that such interactions will help me feel more anchored and present in my relationships with people and nature. I have evaluated each of these interventions individually in each of the previous sections, but how do they work together?

4.1 Reflection on Criteria

As presented in the Introduction, I developed a Criteria for Anchoring Experiences from analyzing the gaps that make me feel disconnected from people and ecologies, and from synthesizing the strategies of related projects. One task of this thesis was to use this criteria to inform and evaluate my interventions; but a meta task was to reflect on and evaluate the criteria themselves.

The interventions touch on all the criteria in some way, but the criteria that they engaged least were **Empowering** and **Incomplete & Vulnerable**. I believe these are essential values for fostering meaningful experiences that actually intervene in existing systems, but I interpret them as secondary to the goal of anchoring us to relationships with people and the natural world. These two criteria speak more to the implications of the design interventions: how do they prepare us to intervene in systems ourselves, and how well do they invite our personal re-interpretation and values?

Even though two of the five criteria were not core to my goal in this thesis, the criteria as a whole were helpful guidelines in shaping and evaluating my work. They were open-ended enough to invite interpretation, but distinct enough and specific enough to the idea of anchoring to be meaningful and concrete. In terms of my current ethos as a designer, I did not feel that they were missing any of my core values.

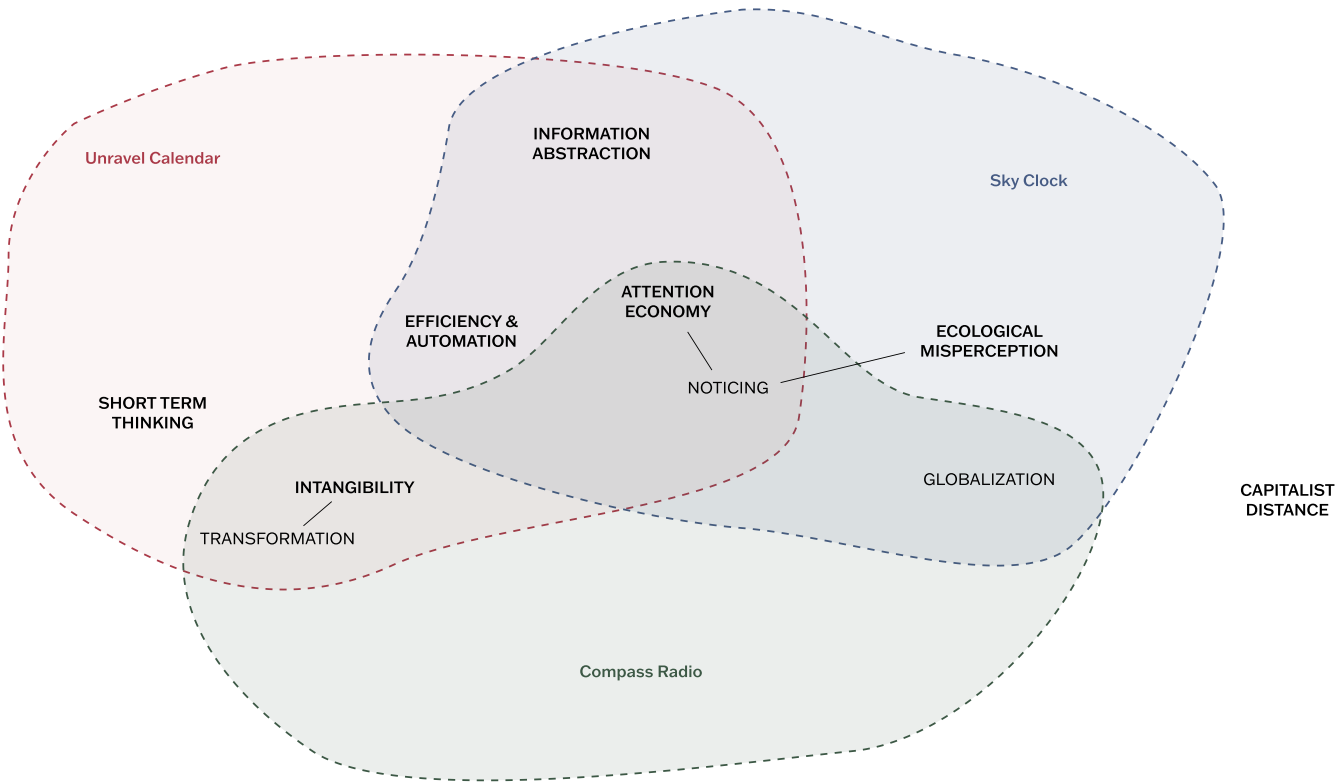


Figure 20. Gaps addressed by each intervention.

4.2 Reflection on Gaps

The motivation of this thesis was to address the gaps and disconnections that distance us from meaningful relationships with people and nature. Though not all gaps were addressed by the interventions indirectly or directly, they form a sort map of landscapes that have been partially explored through my work – or have yet to be explored.

The gap addressed by all three interventions, the Attention Economy, is also the one I interpreted most broadly, as focusing our energy and attention on what actually fulfills us. My interventions try to foreground examples of what fulfills me: feeling grateful for the experiences I’ve had in a day, working with my hands and with materials, thinking about the people I love, looking at the sky, and feeling universally connected to humanity. This may be too broad of an interpretation, and perhaps the Attention Economy gap could be split into more specific sub-points, but it has been effective in reflecting on what I want to prioritize through the experiences I design. The other gaps most addressed by the interventions, Tangibility, Efficiency, and Information Abstraction, map closely to the Criteria that are also most demonstrated through the interventions: Embodied & Material, Effortful and Situated . The interventions did not directly touch on Capitalist Distance, except through the related theme of globalization. This makes sense, as in my mind it maps to the empowering criteria, which as I noted in the previous section, was also less demonstrated through the interventions.

Like my criteria, I believe the gaps I identified here will continue to motivate my work beyond this thesis, and so I see the gaps that were less addressed, like Capitalist Distance, as a topic that I will continue to wrestle with and inevitably address through my work in the future. The gaps are likewise a work-in-progress, that I will continue to update and refine, both as I develop my work and as the needs and pressures of the world around me shift.

4.3 Summary of Takeaways

The takeaways noted at the end of each intervention serve as a growing toolkit of concrete design strategies for designing anchoring experiences. I mapped these strategies according to the intervention they came from and which of the Criteria for Anchoring Experiences they address.

Criteria	Description	Evaluation
Embodied & Material	Close to the body, bridging scales, physical action, tangible.	MATERIAL AS METAPHOR TRANSFORMING AN ARTIFACT ORIENTING YOUR BODY MATERIAL FINISH HIDING TECH
Situated	Relating to a specific place & time, could not exist elsewhere or at another time. connects you to the world around you, exists as much & as long as it needs to.	PERSONALIZED CROWD-SOURCED CONTENT
Effortful	Conscious care, attending, intention.	TRANSFORMING AN ARTIFACT MOTIVATE THE EFFORT ORIENTING YOUR BODY AVOID AMBIENT
Empowering	Gives you tools for re-envisioning, re-making.	TRANSFORMING AN ARTIFACT TAKE PART IN PRODUCT LIFECYCLES ENGAGE FLAWS IN EXPERIENCE
Incomplete, room for vulnerability	The experience is knowingly imperfect and never captures it all, leaving space for the user to project what is meaningful to them.	PERSONALIZED ENGAGE FLAWS IN EXPERIENCE CROWD-SOURCED CONTENT

4.4 Evaluation of interventions

Throughout the process of this thesis, I faced a tension with my interventions feeling very related, but also being difficult to tie together. They seek to address similar needs of anchoring and presence, and share the particular ethos and approach I have developed as a designer. The Unravel Calendar enables me to participate in the passage of time, and gives me moments to reflect on my personal timescale and the larger timescales in which I'm implicated. The Compass Radio helps me feel more connected to people I care about who are far away from me and dispersed across the globe, bringing those places closer to me. *Sky Clock* offers a loose interpretation of time that enables daydreaming and connecting to strangers as much as scheduling.

Still, it has been challenging to put a finger on exactly what the umbrella is that brings them together. I have framed this thesis to link the interventions under the themes of seamfulness, and reconnecting with ecologies: systems of relationships with people and nature. In past iterations of the thesis, I framed the interventions as information artifacts dealing with time and space, as tangible interaction devices for mindfulness, and as tools for noticing. All these frameworks feel true, and yet they also do not sit quite right – mostly, they are too all-encompassing, dealing with abstract ideas that get so big that they lose meaning. And there are still more frameworks that might fit: for example, one common thread pointed out by JC is that all my interventions bring me to a particular place and time. This point of context in terms of space and time revolves around the same themes as in this thesis, but simply reframing the focus and way of describing the theme pushes the project in a slightly different direction.

Because the framing and elaboration of the goals of this thesis has been a moving target, it follows that the interventions do not cover all the same criteria or gaps. In that way, they cover more ground and reveal more strategies for anchoring than if they were more tightly coupled, but it also feeds back into the challenge of finding the right frame to explain them together! This seems to be the predicament of a thesis that follows this approach of creating work under a loose theme, and then making sense of it after: the work is difficult to explain together because it was not conceptualized under a single theme. Even so, this approach has resulted in a series of artifacts that reflect the experiences I've had, the circumstances I've been in, and the world-in-flux that I have navigated through the course of my thesis, both during and after the peak of the COVID-19 pandemic. In that way, it is a unique portrait of my responses to my context through critical making.

5. Conclusion

I view the three interventions described here as a slice of an ongoing body of my work on the theme of anchoring, noticing, and perception, that operates in both apparent tension and harmony between technology and ecology. My past work at Carnegie Mellon and previously feeds into this throughline, and I expect my future work to do so as well. This is a snapshot that I have taken as an opportunity to reflect more intentionally and analytically on how my work is developed, how it is received, and how to design interactions with technology that anchor us rather than taking us out of our context.

A clear direction for future work then, is to develop more projects that aim to create anchoring experiences, as further case studies to test this personal, autoethnographic approach, refine the Criteria for Anchoring Experiences, and expand the toolkit of design strategies to do so. As identified in the Background section, a number of designers and artists have been creating work for decades that relates to the goals of this thesis. However, recognizing them as such suggests a new way of analyzing them, and recontextualizes the work and what we can learn from it for the particular needs of our time. This reframing even of past work gives the approach of “Anchoring Experiences” more power and relevance. A similar strategy might be taken with other design philosophies, in addition to other projects. Approaches such as those described in Emotionally Durable Design and Calm Technology evidently have a great deal of overlap with Anchoring Experiences, and so it would be wise to further integrate the strategies and frameworks of these design approaches into my findings. Lastly, as these other design approaches also begin to do, future research should explore how Anchoring Experiences can relate to the market of consumer products and interactions, and how they can feed into the way we design experiences for a much larger audience.

References

Austin, Drew. (2020, April 27). Home Screens. Real Life Mag. <https://reallifemag.com/home-screens/>

Aylett, M. P., & Quigley, A. J. (2015, April). The broken dream of pervasive sentient ambient calm invisible ubiquitous computing. In Proceedings of the 33rd Annual ACM Conference Extended Abstracts on Human Factors in Computing Systems (pp. 425-435).

Bell, G., Gregg, M., & Seaver, N. (2015). Data, now bigger and better!. Chicago, IL: Prickly Paradigm Press.

Brand, S. (1994). How buildings learn: What happens after they're built. New York, NY: Viking.

Brand, S. (1999). The clock of the long now: Time and responsibility. New York: Basic Books. pp. 28-39.

Chalmers, M. (2003, October). Seamful design and ubicomp infrastructure. In Proceedings of Ubicomp 2003 workshop at the crossroads: The interaction of HCI and systems issues in Ubicomp (pp. 577-584).

Crawford, K. (2021). The atlas of AI. In The Atlas of AI. Yale University Press.

Crawford, K. & Joler, V. (2018). Anatomy of an AI System: The Amazon Echo As An Anatomical Map of Human Labor, Data and Planetary Resources (research report). AI Now Institute and Share Lab.

Drucker, Johanna. (2014). Graphesis : visual forms of knowledge production. Cambridge, Massachusetts: Harvard University Press.

Frayling, C. (1994). Research in art and design (Royal College of Art Research Papers, vol 1, no 1, 1993/4). https://researchonline.rca.ac.uk/384/3/frayling_research_in_art_and_design_1993.pdf

Haraway, D. J. (2016). Staying with the trouble. Duke University Press.

Hitchcock, Callie. (2021, September 9). Take Me Away. Real Life Mag. <https://reallifemag.com/take-me-away/>

Kimmerer, R. W. (2015). Braiding sweetgrass. Milkweed Editions.

Köerner, W. (2020, April 16). On using technology to outpace our adversaries. The Creative Independent. <https://thecreativeindependent.com/people/artist-activist-and-teacher-grayson-earle-on-using-technology-to-outpace-our-adversaries/>

Miller, D. (2021). A theory of a theory of the smartphone. International Journal of Cultural Studies, 24(5), 860–876. <https://doi.org/10.1177/1367877921994574>

Offenhuber, D. (2019). Data by Proxy -- Material Traces as Autographic Visualizations (Version 1). arXiv. <https://doi.org/10.48550/ARXIV.1907.05454>

Offenhuber, D. (2020, September 24). Data Autographies- Design and Evidence After The Digital Revolution [Recorded lecture]. YouTube. <https://www.youtube.com/watch?v=aAlcBvIYnQU>

Rogers, Y. (2020). Is remote the new normal? reflections on Covid-19, technology, and humankind. Interactions, 27(4), 42-46.

Sinders, Caroline. (2020, May 5). Rethinking Artificial Intelligence through Feminism. CCCBLAB. <https://lab.cccb.org/en/rethinking-artificial-intelligence-through-feminism/>

Smith, T. A. (2014). Bauhaus weaving theory: From feminine craft to mode of design. U of Minnesota Press.

Vertesi, J. (2014). Seamful Spaces: Heterogeneous Infrastructures in Interaction. Science, Technology, & Human Values, 39(2), 264–284. <https://doi.org/10.1177/0162243913516012>

Acknowledgements

So many beings supported me in so many ways throughout the thesis project. Let me try to name and appreciate them all.

Thank you for listening to me, helping me think, feeding me, having beers with me, putting up with me changing my mind, being late, and not having enough time.

(In truth, so many people support me throughout the life project, and thesis overlapped for a bit with life.)

Thesis Committee:

Daragh Byrne
Golan Levin
Mark Baskinger

MSCD Track Chair:

Daniel Cardoso Llach

Unofficial Advisors:

Andrew Edman
Jonathan Chapman
Jim McCann
Austin Wade Smith
Alex Heyison
The Earth

Kind & Important People:

Policarpo Baquera
Bay Byrne Sim
Tomas Cabezon
Jonah Conlin
Chris Costes
Hejing Fang
Danielle Freiman
Rob from PGC
Kat Giesa
Adam Holley
Jake Kapusta
Irina Khurana
Molly McBride
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Temple Rea
Ivan & Livvy Ruiz-Knott
Maximilian Sirtl
Josiah Stadelmeier
David Wu
Cat Yochum
& My peers in MSCD!

