

Exploring Intimate Communication Channels for Long-Distance Relationships

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Abstract

**Exploring Intimate Communication Channels
for Long-Distance Relationships**

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This thesis explores how design and technology might help to improve interpersonal connections between family members living far apart. *Scentie-Talkie*, a wireless prototype, uses scent to enable distant people to feel a shared presence.

With an abundance of explicit communication channels available, and even more in development, this research posits that to facilitate intimate relationships over distance, more implicit and abstract platforms also merit exploration.



Exploring Intimate Communication Channels for Long-Distance Relationships

Jooyeon Oh
Master of Design Documentation



Contents

Introduction	
Personal Motivation	7
Background	8–11
Research	
Related Works	12–14
Cultural Probes	15–23
Interviews	24
Personal Inventories	24–26
Research Findings	
Insights for Design Spaces	27–29
Design Principles	30
Scent as an Everyday Interaction	30–31
Design	
Technology Used	32–35
Hardware	35–38
User Testing	39
Findings	40–43
Reflections	44–48
Conclusions	49–50
Acknowledgment	51
Bibliography	52–54

Introduction.

Personal Motivation

My motivation for this thesis began from a personal history of living far away from my family members for more than half of my life. The advent of technology allows me to connect with my family more effortlessly, but it doesn't provide intimacy over distance or a feeling of togetherness. When I look at how we might communicate in the future, I find a great future for developments in efficiency and convenience, but not so much in creating the moment of being together in the distance. So, I started to question, "How can technology provide a sense of being together over distance? Is it possible to share everyday moments in a different way than is currently the norm? Can designing with technology move away from its norm of using digital screens but provide more tangible experiences?"

This personal inquiry arose while looking at my own experience with my family. Voice calling or video chatting seems quite temporary in time and limited to an interaction between a digital screen and a user. And since the interaction is limited to the digital device, it is difficult to have ongoing, frequent communication. Therefore, the goal of my thesis was to explore daily intimacy at a distance using design and technology. I wanted to investigate the topic of long-distance communication through my relationships with my family and seek out what design can provide to create faraway connections.

Background

Intimacy in our everyday conversations

Prager's research on intimacy in personal relationships (Prager and Buhrmester, 1998) argues that the expression of intimacy involves verbal and nonverbal behavior.

When we look at how we communicate in person, there are a lot of nonverbal factors that provide intimacy or togetherness. Examples include tactile experiences like holding hands, hugging, being close to one another or visual/olfactory experiences like looking at someone in the eyes or smelling someone close to you.

When it comes to long-distance relationships, people tend to rely on verbal and visual communication through mostly mobile (text messaging, face chat, voice call) or now increasingly through internet-of-things platforms (Facebook Portal, Amazon Echo Show). Most of these platforms require users' active participation when communicating. Verbal communication over digital communication tools often limits people to experience the feeling of togetherness fully. Guerrero and Jones argue, "Intimacy is experienced typically during interaction in close relationships in the presence of positive verbal and nonverbal behavior that reflects and creates feelings of warmth (Andersen, Guerrero, and Jones, 2006)." Positive verbal conversation could appear while using phone or video chat platforms with loved ones, but the presence of nonverbal behavior that reflects feelings of warmth is often missed out.

Research shows that people tend to express emotions such as warmth and affection through nonverbal rather than verbal cues (Burgoon, Buller, & Woodall, 1996; Planalp, DeFrancisco, & Rutherford, 1996). For example, affection could be delivered by saying, "I love you," but it might have a more significant impact if it is accompanied by facial expression and hugging. I posit that same applies to remote relationships. If technology can provide warmth and affection at a distance, the communication channel can become more intimate for remote users.

Everyday technology

As remote relationships strongly depend on constancy and frequency of connections, it is helpful to look at how long-distance communication can become suitable for our everyday lives. With different types of devices emerging, including wearables, internet-of-things, and AR/VR platforms, our daily lives will likely be surrounded by more computing devices in the future. Our interaction with current tools is mostly focused on using the sense of sight and hearing. Too much use of sight and sound in the interaction can become overwhelming. To have a better fit with these computing systems, we need to look at how it can be better integrated into our lives without disturbing users.



(figure 1) *Hyper-Reality*, a concept film where physical and virtual realities merge together <http://hyper-reality.co/>

Keiichi Matsuda's hyper-reality film (figure 1) illustrates how digital technology in the future could overwhelm our lives full of augmented visual interfaces. This film is an extreme and dystopian prediction of the future of computing in regards to augmented reality and physical spaces that we will live in. However, it is also plausible with current and future technology developments, mostly focusing on the sense of sight and hearing. In order to have the right fit into our everyday routines, devices that we use need to be more adaptable for one's own use.

Calm technology

The term "calm technology" was coined by Mark Weiser and John Brown in 1996 when they published "The Coming Age of Calm Technology" at the Xerox PARC. Weiser argued that ubiquitous computing would require a new approach to fit technology into our lives. His approach was "designing for calm using both the center and the periphery of our perception and the world (Weiser and Brown, 1997)." By this, he meant the use of technology should be hidden and integrated into people's everyday lives, and we should be able to "switch back and forth using both focus attention and the periphery of our attention (Weiser and Brown, 1997)."

For example, if we are watching a baseball game at the stadium, our focus attention would be at individual players, but we will still have attention for surrounding crowds, a sense of heat or coldness from the weather, and a smell of stadium food in the periphery of our attention.

A decade later, some started to analyze Weiser's views critically. Yvonne Rogers, a British psychologist and a professor of interaction design at University College London, argued that Weiser's ideas were no longer viable to people's lifestyles in her paper "Moving on from Weiser's Vision of Calm Computing." She posits that ubiquitous computing should focus on providing engaging experiences rather than merely calming people. And one of her main criticisms of the research was that computers should not "act on behalf of humans (Rogers, 2006)", but should engage in interactions with technology. With the advance of technology, Weiser's idea of the technology being invisible became intrusive for security reasons and placed humans into a passive state, which became less ideal. Rogers argued the interactions should be motivating, surprising, playful, and engaging (Rogers, 2006). As Rogers tried to redefine what the calm computing was, suggesting a new direction for previous research should be encouraged since people's lifestyles change overtime.

Peripheral Interaction

Most of our interaction with computing systems require "focused attention," such as clicking a mouse, typing, looking at screens, watching, and hearing. As we learn from how we interact with our environment and from the Keiichi Matsuda's film, it creates an interesting design space where technology can be designed to be in the periphery of our attention instead of focused attention but allowing the user to switch back and forth on their own.

The majority of current communication platforms are designed to require focused attention. Video chatting, text messaging, and voice calling require high focus attention.

Not many studies have explored designing for the periphery of our attention when it comes to communication platforms.

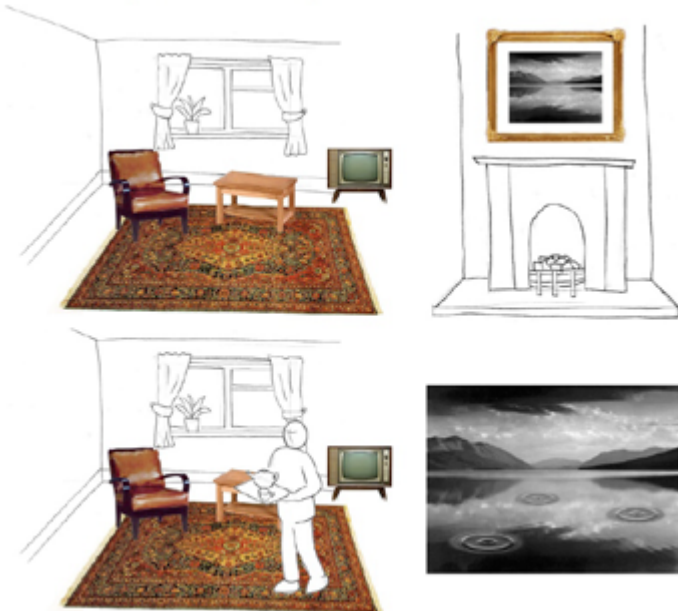
In Saskia Bakker's Ph.D. dissertation at the Eindhoven University of Technology, "Design for Peripheral Interaction (2013)," she claims that "the goal is to meaningfully embed interactive systems in everyday life routines, while the approach to enable them to shift between the center and periphery of attention is merely a means to achieve this goal (Bakker et al., 2014)."

The interaction should be used whenever users wish, and it is for them to make the interactive systems meaningful in their everyday routines.

Research.

Related Works

Many researchers have explored connecting distant others by using technology in the HCI field. Topics include promoting remote awareness, helping people to remember to reminisce, and improving the quality of interconnections. Some projects provide technical information about distant loved ones, whereas some act merely as an ambient device for fostering remote awareness.

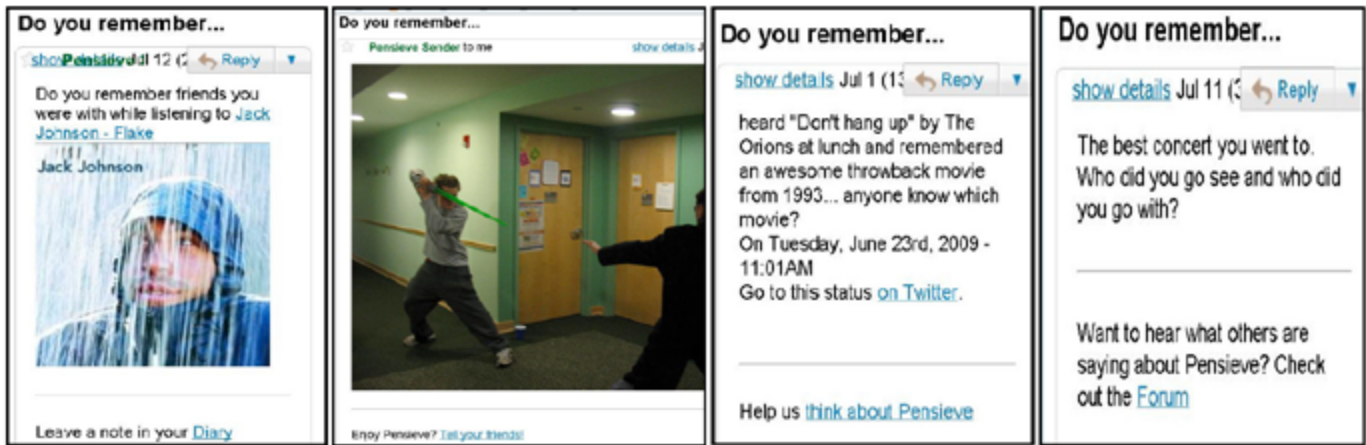


(figure 2) *Ripple Rug*, a conceptual design that uses a rug embedded with pressure sensors to send signals to a picture in a different household



(figure 3) *Jetty*, a photo frame that displays real-time weather data of distant family member's city and their presence in their home

Ripple Rug (figure 2, Bowen, 2009) is a conceptual design that uses a rug embedded with pressure sensors to send signals to a picture in a different household. For example, an older person's footsteps on the rug in his living room will be portrayed as ripples on the picture frame for family members who live far from the older person. Similar to the previous project using ambient display, *water lamp* (Dahley et al., 1998) uses shadows of water ripples on the ceiling to represent the heartbeat of faraway families. HP's Immersive Experiences Lab worked on a research project called *Jetty* (figure 3), which promotes social connectedness by providing a photo frame that displays real-time weather data of distant family member's city and their presence in their home.



(figure 4) *Pensieve*, a system that helps people remember to reminisce by sending them occasional emails containing “memory triggers.”

If *Ripple Rug*, *water lamp*, and *Jetty* were concerned with ambient and more evocative use of technology, some projects aim for a more efficient and direct way of connecting people. *Pensieve* (figure 4, Peesapati et al., 2010) is a system that helps people remember to reminisce by sending them occasional emails containing “memory triggers.” This actively engages users to participate in making connections. In the paper, researchers found that people value spontaneous reminders to reminisce as well as the ability to write about it. *Lover’s Cup* (figure 5, Chung, Lee, and Selker, 2006) uses technology to build a pair of physical cups to show if another user person is drinking by illuminating parts of the cups. This allows two remote people to enjoy a moment together by drinking together. Like the paired cups, *Lovebox Messenger* (figure 6) allows loved ones to connect in a more tangible and romantic way. This wifi-enabled box displays a message sent with the mobile app, therefore allows users to send messages anywhere from the world.



(figure 5) *Lover’s Cup* uses technology to build a pair of physical cups to show if another user person is drinking by illuminating parts of the cups



(figure 6) *Lovebox Messenger* allows loved ones to connect in a more tangible and romantic way

Above projects physically embed technology objects into people’s lives and create systems that enhance conventional communication interfaces such as text messaging, audio, or video calling tools. These works allow people to move away from directly engaging with technology, but technology resides in the background to provide emotional connections.

Cultural probes



(figure 7) a cultural probe kit consisted of three different activities

I created a cultural probe kit (figure 7) to gain new insights about communication dynamics in my family and potential desires for a new way of conversing. Cultural probes were developed by William Gaver, Tony Dunne, and Elena Pacenti in 1999 to provide more artistic ways of researching participants other than in a scientific way. By giving tasks using artifacts created by a researcher, it can elicit inspirational responses from participants (Gaver, 2004). The probe materials can be anything from postcards, maps, cameras to elicit inspiring responses from the research participants. I considered cultural probes would provide a great way to engage my family members non-intrusively. Through my probes, I aimed to get inspired and identify design opportunities to enrich the existing messaging technique that we use. I also participated using the probes kit so I could discuss my perspectives about the whole process and results.



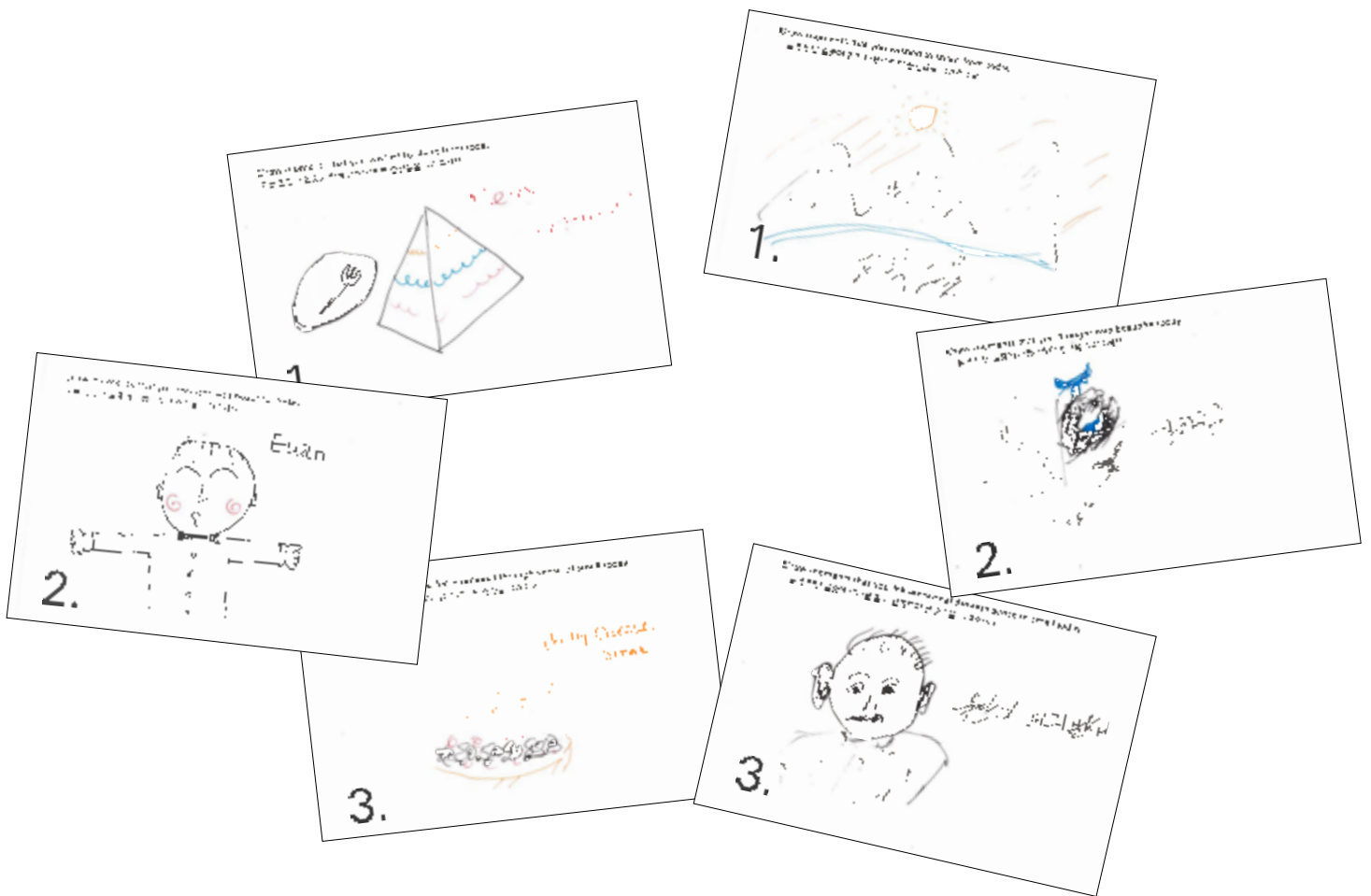
(figure 8) a box containing five probe kits to be send to Korea

The probes kit (figure 8) was sent to Korea to my family in early November. The kit contained three activities (figure 6): Sketch cards to draw moments that family members wished to share, an envelope to collect receipts to learn everyday routines, and a disposable camera to capture daily interactions.

The process of explaining the activities to research participants (my family members) was made through a video chat with all the members gathered around. First, I explained my thesis topic and how this form of research falls into the design process. Some hesitancy was shown when they were told to draw, but the participants seemed excited to document their daily activities with the provided artifacts. When I visited home for the holidays, I gathered the kits and talked about the finished artifacts with all the participants together (figure 9).



(figure 9) talking with family participants using finished artifacts



Sharable Moment Sketches

The sketching activity had four different prompts:

1. Draw moments that you wished to share from today.
2. Draw moments that you thought was beautiful today.
3. Draw moments that you felt emotional through sense of smell today.
4. Draw or write news that you wished to announce today.

One interesting finding from the sketching activity was that moments that my family members wished to share the most were related to their sentimental feelings toward certain moments or subject matter. This was somewhat surprising to find out since my family members are rarely explicit about sharing their emotions from their daily activity on the phone. Conversations usually don't go beyond "I did this, and I did that today." I believe these drawings revealed our family member's hidden urge for sharing deeper sentimental values from everyday lives.

Daily Interaction Photos

This activity with the disposable camera showed a somewhat straightforward result. I had specific prompts such as taking a portrait, a photo of an object or environment, or screen interactions from your daily interactions with other people. Most of them provided visual elements to things that we talk about on the phone. For example, I often talk about who I have met on the phone with my mom, and the photos revealed how my friends look. Photos of the environments provided some familiar places, such as my parents' apartment facilities, places that they work out every day, and my sister's workplace. Photos were a great conversational starter for having more follow up chats, but we felt that our follow-up conversations remained quite conventional. Our discussion with the photos didn't go beyond just briefly talking about what the people, environment, and the interactions were about. However, it was nice to get to know their daily interactions accompanied with the visuals.

Prompt 1.

With an interaction from today, take a portrait of someone you meet.

Prompt 2.

With an interaction from today, take a portrait of an object near you.

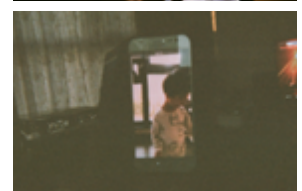
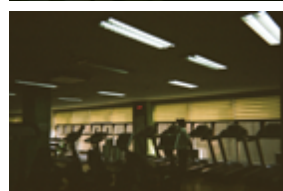
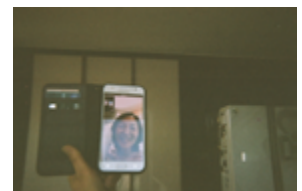
Prompt 3.

With an interaction from today, take a portrait of the environment.

Prompt 4.

Take a photo of screen interaction that you had with someone else today.

Mom's



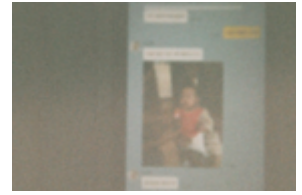
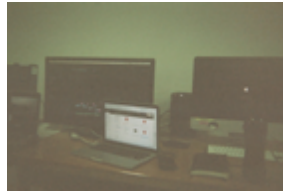
Prompt 1.

Prompt 2.

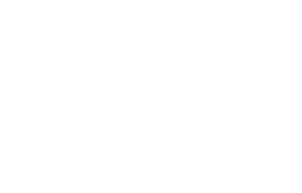
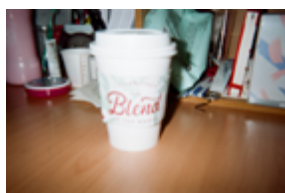
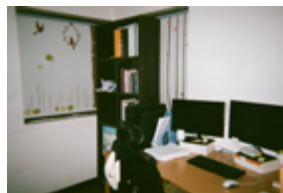
Prompt 3.

Prompt 4.

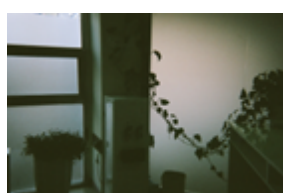
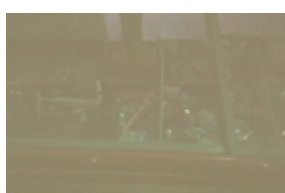
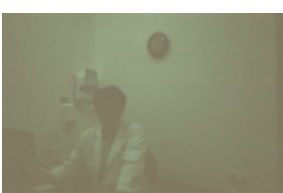
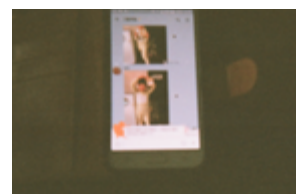
My photos



Sister's



Dad's



아버지 영수증

No.	영수증 (공급받는자용)		귀하
시번시 등록번호	134-87-06574		
상호	(주)시스탈론프를	점명업	김상기
사업장 소재지	경기도 인천시 단원구 광덕4로 B-102호 (고잔동 729-9)		
사업내 구분	건설업	중	자동제어, 유량개 조소매
작성년월일	2018.12.12 W 18:00		
공급내역			
품명	수량	단기	공과대기(공역)
제어기			
열동기			
인서도			
이체유량밸브			
정유량조절밸브			150,000
미스다조절기			
서브조절기			
에어코크			
카카오페이 (원 환) 333-04-2614064			
합계			₩ 150,000

부가가치세법규의 세외의 규정에 위 금액을 정해 명수(총구입)

(figure 10) a receipt from father

Everyday Receipts

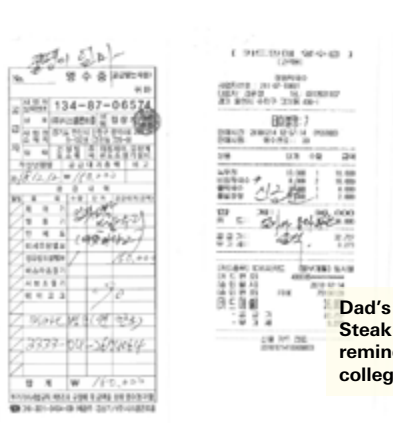
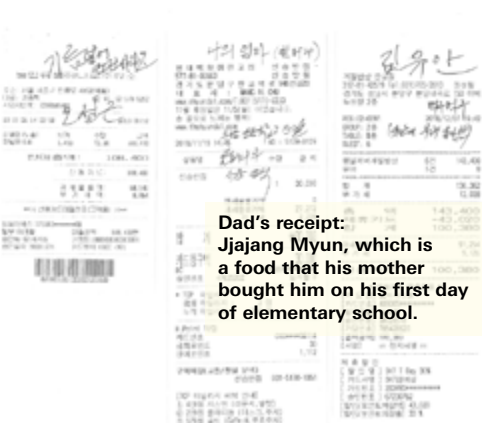
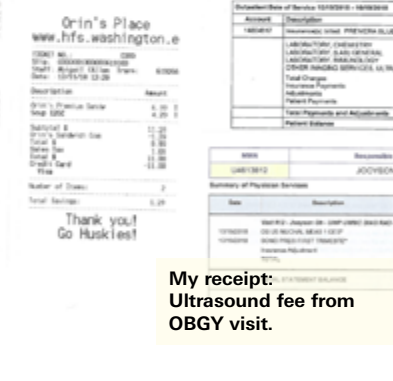
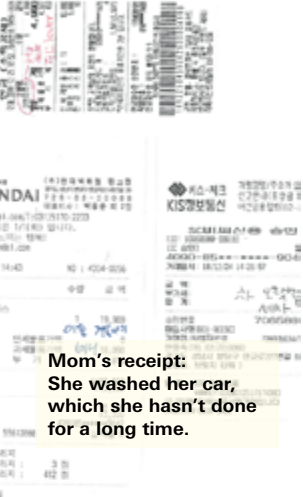
Collecting the receipt prompt allowed us to learn about a wide range of our daily activities. For example, it revealed places that we eat, stores we buy groceries at, and even how much gas/electric bills we pay and use. It was nice to know from a receipt (figure 10) that my dad fixed the heater for a room that I'll be staying for my visit. And he wrote down, *for Kkooltang's (my baby's fetal nickname) Mom*. Seeing my dad's handwriting on the receipt and thinking about his intention was a different experience than him saying "I fixed your room's heater." on the phone and me saying "Thanks, dad." Our phone conversations often stayed quite dry due to our restrained personalities, but the probe revealed that we could be more emotional and it was nice to be a little bit more sentimental sharing our mundane everyday activities.



Sister's receipt: Vanilla latte reminds of her husband, since he quit it for being on diet.



Sister's receipt: She bought dumplings at Shinsegae department store for dad.



Interviews

In addition to the cultural probe research, I wanted to interview people who are in long-distance relationships. I ended up conducting semi-structured interviews with three people who have either families or friends overseas or in a different state. I prepared interview questions grouping into three categories: about their values, methods, and chat possessions while doing long-distance communication. The goal of the interviews was to learn about different types of communication tools and methods and to seek out what they find valuable from the conversations.



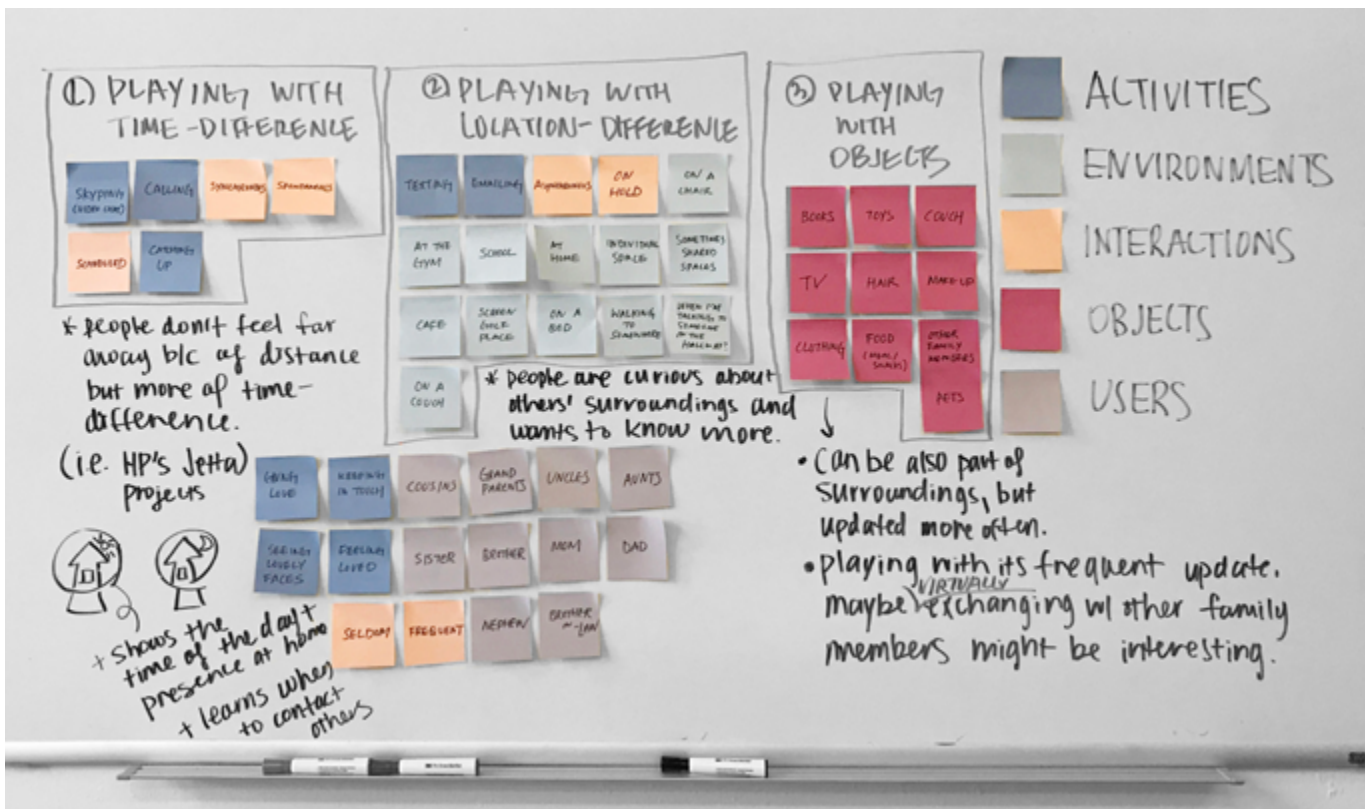
(figure 11) photos of objects that are personally meaningful to my family members in regards to their relationships with other people

Personal inventories

From the conversations with the interviewees about the chat possessions, I learned that all of them have difficulty

forming attachments to their virtual possessions (text messages, images, footages from video calls) from remote communication. I became interested in how people value and create attachments to their possessions in regards to relationship building. To explore this inquiry, I asked research participants to take photos of objects that are personally meaningful to them in regards to their relationships with other people.

The result (figure 11) was quite surprising that many of them sent either a photo of their mobile phones or computers. They felt that personal devices became a portal to connect to others and to build relationships for them. Another half of personal inventories were mostly objects that symbolize the relationships, such as wedding rings or wall displays at home. This made me somewhat worried that our conversations would become more temporal and virtual.



(figure 12) using AEIOU framework

After conducting semi-structured interviews and looking into personal inventories, I wanted to find a framework that might help me to organize my findings and observations.

I used the AEIOU framework developed by Mark Baskinger and Bruce Hanington. AEIOU is “a framework that guides designers in thinking through a problem or scenario from a variety of perspectives: activities, environments, interactions, objects, and users (Bella and Hanington, 2012).” Since my observations seemed to belong to these five categories, I used the framework to synthesize my research to find a design space (figure 12). The framework was useful to categorize my observation from the semi-structure interview, personal inventories, and the probe kit into the five distinct categories. From my research findings, I have determined opportunity areas that design can have valuable impacts on remote communication.

Research Findings.

Insights for design spaces

1.

People are looking for different ways to share moments rather than having informative conversations all the time

From the interviews and getting feedback from the Master of Design process poster show, people who experience long-distance relationships responded that aspects that they miss the most about their loved ones are having their constant presence in their daily lives or spending time together. This contrasts with a current preconception of 'keeping in touch,' which is usually explicitly updating on one's status. This brings an exciting opportunity where designing for shared moments for far away loved ones can become valuable.

2.

Designing for asynchronous communication while having a constant presence in a house supports a stronger sense of emotional connection over a distance

A frequent challenge that long-distance families face is finding time that works for them to get together. This becomes especially difficult for people living in different time zones. It's nice to have synchronizing activities such as eating together or watching something together while video chatting, but it is challenging to manage a schedule with the time difference. However, having a constant presence at home while designing for asynchronous activities allows remote family members to connect without time constraints.

3.

Spontaneous and non-verbal communication can provide unique ways of communicating with for families and friends living far apart

Our current popular platforms for remote communications (video chats, text messages, voice calls) tend to fall into a cycle of having somewhat repetitive and expected conversations. My assumption for why this problem

space emerges is that there is no stages of anticipation for conversations. Through my research probes, especially the one with the instant camera, having an expectation of receiving some non-verbal cues about your loved-ones sparked curiosity which led to follow-up conversations to find more about the photos that were taken. Adding anticipation for conversations provides unique ways of communicating transcending short-lived remote communications.

Design principles

Design to fit into everyday routines

Design to have follow-up conversations

*Design for peripheral interaction to provide
"space and time" moments to share*

Scent as an everyday periphery interaction

One of the interesting findings from the cultural probe research with my family members was the sense of smell is very closely tied to how we remember things. For example, a smell of food that brings you back the memories about certain relationships or locations, or the smell of someone reminding you of the time that you spent with the person. "Scent is supposed to conjure emotions and memories more profoundly than vision, and personally, significant scents might be chosen to enhance this effect (Strong and Gaver, 1996)." Since scent is very personal, it can be quite useful in creating intimate and evocative interactions. In Bill Gaver and Rob Strong's *Feather, Scent, and Shaker* (Strong and Gaver, 1996) paper, an aluminum bowl is used to dispense an essential oil to fill the home with scent when a user is away from home. *inStink* (Kaye, 2001) attempts to use the smell of cooking to connect two distant places. Spice jars are connected electronically, and when certain spices are used in one location, the smell of the spices is dispensed for the remote site. These projects attempt to create a space where it could become intimate for others when they are far away.

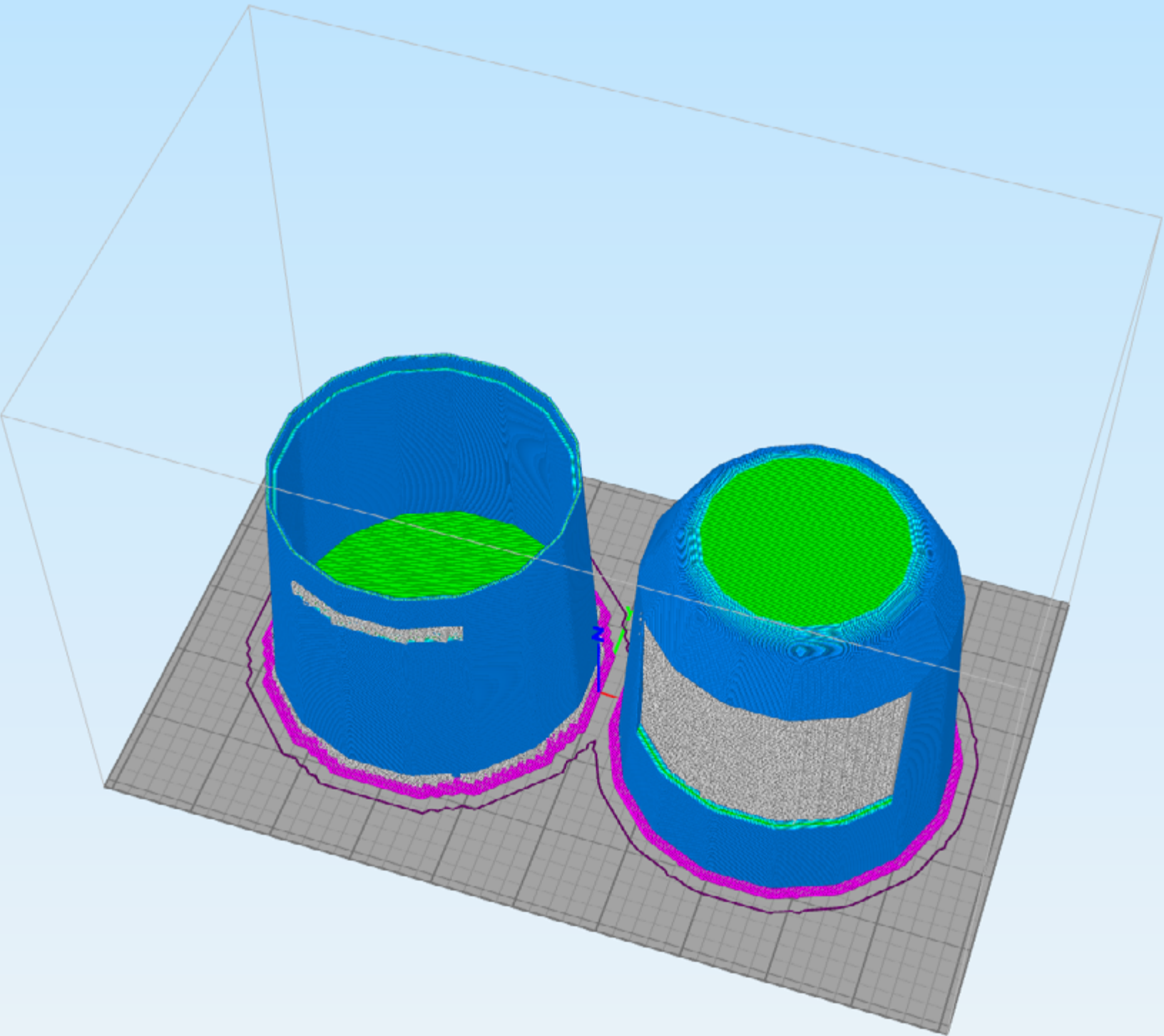
The scent is also a great medium for designing for everyday peripheral interaction. The ambient characteristics of smell could place the interface in the background of our focus, or the intensity of the scent could completely occupy the center of our attention. Also, the lingering impact of the smell could provide a space where our focus can be moved back and forth. For example, you smell a particular scent

at home that reminds you of specific childhood memories. You could end up calling your sibling who used to share that memory. This allows you to call your loved one (focus attention) while having the smell in the background of your attention.

Despite the benefits of using scent, the sense of smell has not been explored in human-computer interaction. Kaye (Kaye, 2004) describes the reasons for this. "Technical difficulties in emitting scent on demand, chemical difficulties in creating accurate and pleasant scents, and issues of research focus and direction." Creating accurate and pleasant scents is difficult not only because everyone has different opinions about certain scents, but also controlling quantity (the number of levels of intensity) and quality (the number of different smells) of the scent is difficult (Kaye, 2004).

With these benefits and difficulties in mind, I wanted to probe whether the olfactory interface could play a role in our communication methods. Though delivering accurate information is difficult with scent, there are benefits of using minimal and abstract communication in close relationships. I believe the smell has the potential to be used for interface and it can deliver a message in a more intimate way than other senses.

Design.



Drawing of the prototype in Simplify3D



(figure 14) a sliding door on the motion sensor was made to provide an option for manually activating the sensor if desired

The motion sensor is intentionally designed to be open-ended to detect the user's mundane everyday behaviors. For example, for someone who wants to know if her daughter arrived home, the sensor can be embedded under an entrance doormat. For someone who wants to use it to just send awareness of one another, they can waive in front of the sensor to activate the scent at the other location. A sliding door (figure 14) to the motion sensor was made to provide an option for manually activating the sensor if desired. Thus, the sensor provides both automatic inputs and manual inputs depending on the user's preference.

When the motion is sensed, the scent dispenser displays a short light animation using Neopixel strip and drops an essential oil onto a small plate placed underneath the dropper. This prototype went through a lot of failures before finding the perfect spot for the servo to squeeze the dropper, and also to drop only a certain amount of oil.

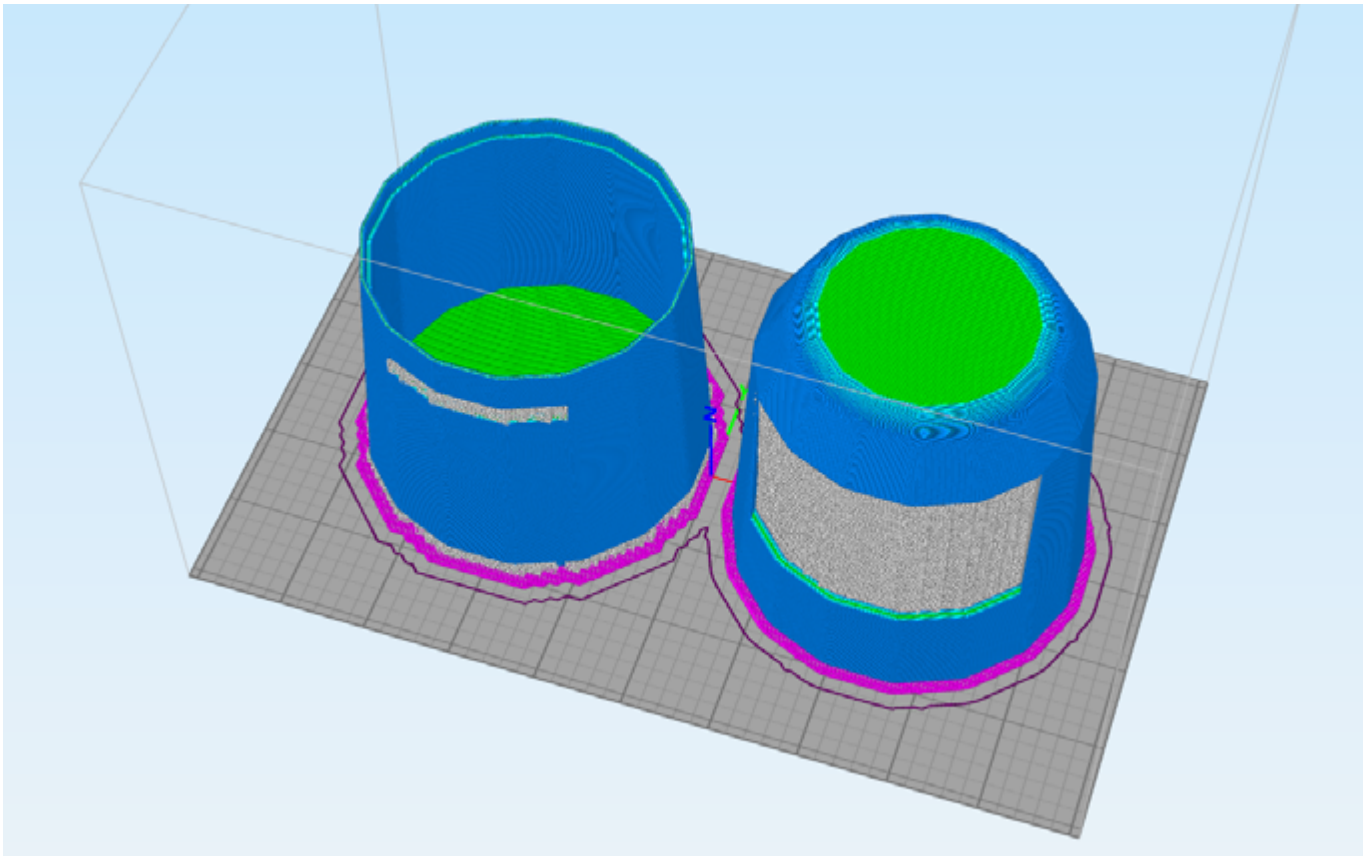
Prototype Video: <https://vimeo.com/345764204>

Hardware

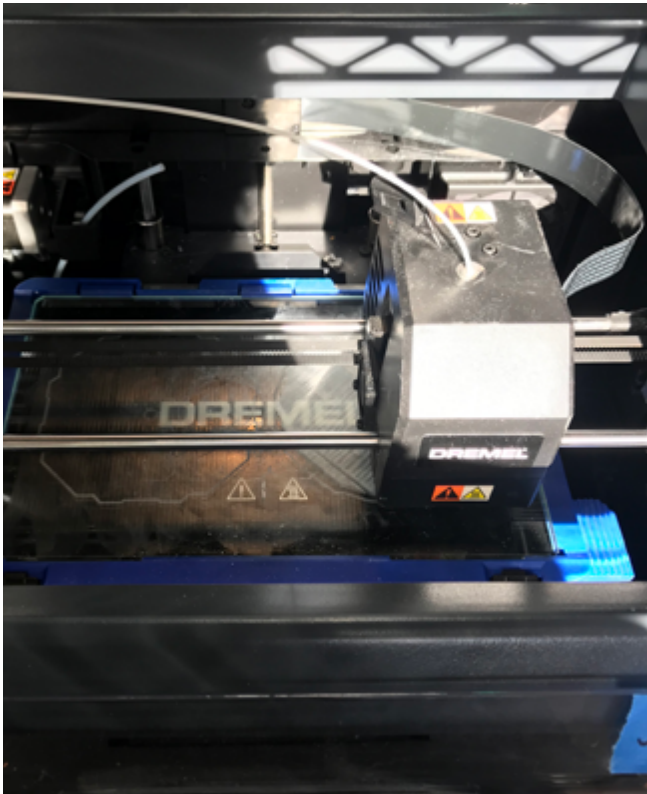
I wanted to find a quick way to build the hardware to encase the system that I created. 3d printing was a good way for me to translate my sketch into a three-dimensional form quickly. It also allowed me to create a round shape which is hard to achieve with laser cutting prototyping. Looking back at findings from the personal inventory research, I wanted the device to move away from the technology-with-a-screen look and also look less technical. I used Dremel 3d printer (figure 15) at the University of Washington's Maker Space to print the prototypes. Although making the round shape was successful, with the material (PLA filament) being used and grains from the 3d printing process, there was a limit to making it look organic and smooth.



(figure 15) Dremel 3d printer



Placing the drawing of the prototype in Simplify3D



Dremel 3d printer printing the base support for the prototypes



3d printed pieces with the support parts still attached



(figure 16) process of 3d ceramic printing

Thus, I tried a different material but using the same 3d printing technology. I chose ceramic, which is often used for scent-related products, like candles or scent diffusers. I also learned from Timea Tihanyi, a senior lecturer from UW School of Art+Art History+Design, that underfired ceramic can absorb color. This gave the prototypes the potential to show the quantity of the smell and uniquely visualize the scent. With the help of Jacob Foran (figure 16), Co-Founder of ForanSuon studio in Seattle, I was able to remake the device using 3d ceramic printing technology.



Pattern from ceramic printing after firing process



Opening for the scent dispensing part

User Testing



(figure 17) a kit (including a logbook, *Scentie-Talkie*, essential oil, a photo printer) made for user testing

With the two sets of the 3d printed prototypes, I wanted to deploy them in real-world scenarios to user-test informally. Since it was problematic to send the prototypes to my family members in Korea due to time constraints and technical difficulties, I decided to use it for myself when my partner was traveling for work for a week (from March 17 to 25, 2019) to Amsterdam, Netherlands and while I stayed in Seattle, Washington. I picked Bay Laurel scent to use for my prototype since it reminded me of my partner's regular habit of tea brewing at home.

My goal with the user testing was to observe how we would interact with these devices. I created logbooks (figure 17) to document desires, behaviors, and feelings while using and living with the prototypes. I was curious to see what the variables are for mundane behaviors when/how often we will activate the device, and where we would place each prototype. Eventually, I hoped to observe how the olfactory communication method affects our relationship while we are far away and how we appropriate the devices into our everyday routines.

Findings.



Abstract, but intimate way of communication

The *Scentie-Talkie* was too vague to deliver distinct information, but it was successful in facilitating an abstract, yet intimate awareness. When my partner was away for the business trip, just smelling the scent assured me of “Oh, he’s alive in a different country.” I didn’t have to actively engage with a conversation or follow up after he sent me a drop of smell, which I liked. This subtle notification of him returning to the hotel after the conference gave me an option to be just passively assured or actively engage with a conversation by calling him or texting him. Also, because of the scent that I picked, Bay Laurel, the system provided his existence in the house since it mimicked the smell of his rituals at home. This personally significant smell allowed the non-verbal communication to be more intimate and unique.



Screen-less interactions using different senses

The designed system provided a new and unique channel to communicate between remote loved ones. The interaction was unique because it not only moved away from a mainstream way of communicating using screen devices, but it also used a different sense that is not typically used in current HCI field. Using olfactory, screen-less interactions allowed us to move back and forth between our focus attention and background attention using our periphery.

Although the impact of living with the *Scentie-Talkie* could be very subtle, it's necessary to look into these minimal, subtle interactions. With our society increasingly being occupied with technology that entirely dominates one's attention, such as VR (virtual reality), AR (augmented reality) and a variety of application developments for screen-devices, the screen-less interaction that is able to switch back and forth between the background of attention and the focused attention becomes valuable.

Occupying everyday routines

The device allowed us to have a glimpse of each other's daily routines when we were separated. No details or technical information were provided, but we were able to know when each other was back home or returned to the hotel and therefore might be available to connect. It also, surprisingly, made us connect more often. We always texted or called each other when we noticed the scent in the room or when the device-dispensed the smell. This might be useful, especially for people who are in a long-distance relationship and trying to keep up with their frequency of communication.

Reflections.

Using scent as a communication interface

Using scent as a communication interface provided a scenario where conversations can be facilitated in a less technology-driven way. It allowed participants to discover and act on their own to connect in a quite minimal and abstract form. Some would question the design system's limit of delivering accurate information, but as I found out through research, always having face-to-face and explicit conversation is not what's needed in a long-distance relationship, especially in a close relationship. To facilitate intimate relationships over a distance, communication platforms need to be more romantic and evocative.

I hope this exploration is valuable with current communication platforms heavily relying on explicit communication. As Ju and Leifer put it, "Implicit interactions – those that occur without the explicit behest or awareness of the user – will become increasingly important as human-computer interactions extend beyond the desktop computer into new arenas (Ju and Leifer, 2008)." As more technology developments permeate into our daily lives, I hope there will be more ambient interfaces allowing people to be more flexible with the technology that they use.

Using cultural probes as a research method

Using cultural probes as one research method made my thesis process more exciting and personal. Incorporating my family as research participants seemed natural since my thesis question arose from my own experience and personal history. However, I only thought the probes would discover our needs in regards to communication platforms and never felt that it will allow us to find deeper desires. Elements such as the *Sharable Moment Sketches* reveal our family member's hidden urge for sharing deeper sentimental values from everyday lives and the *Everyday Receipts* allow us to

discover that sometimes we like to be more sentimental when communicating. The findings were inspiring and very personal for our family members. Using the probe method, I was able to generate these deeper insights which are difficult to uncover using traditional HCI research methods.



Thesis exhibition at Henry Art Gallery, Seattle, WA.

Presenting conceptual design

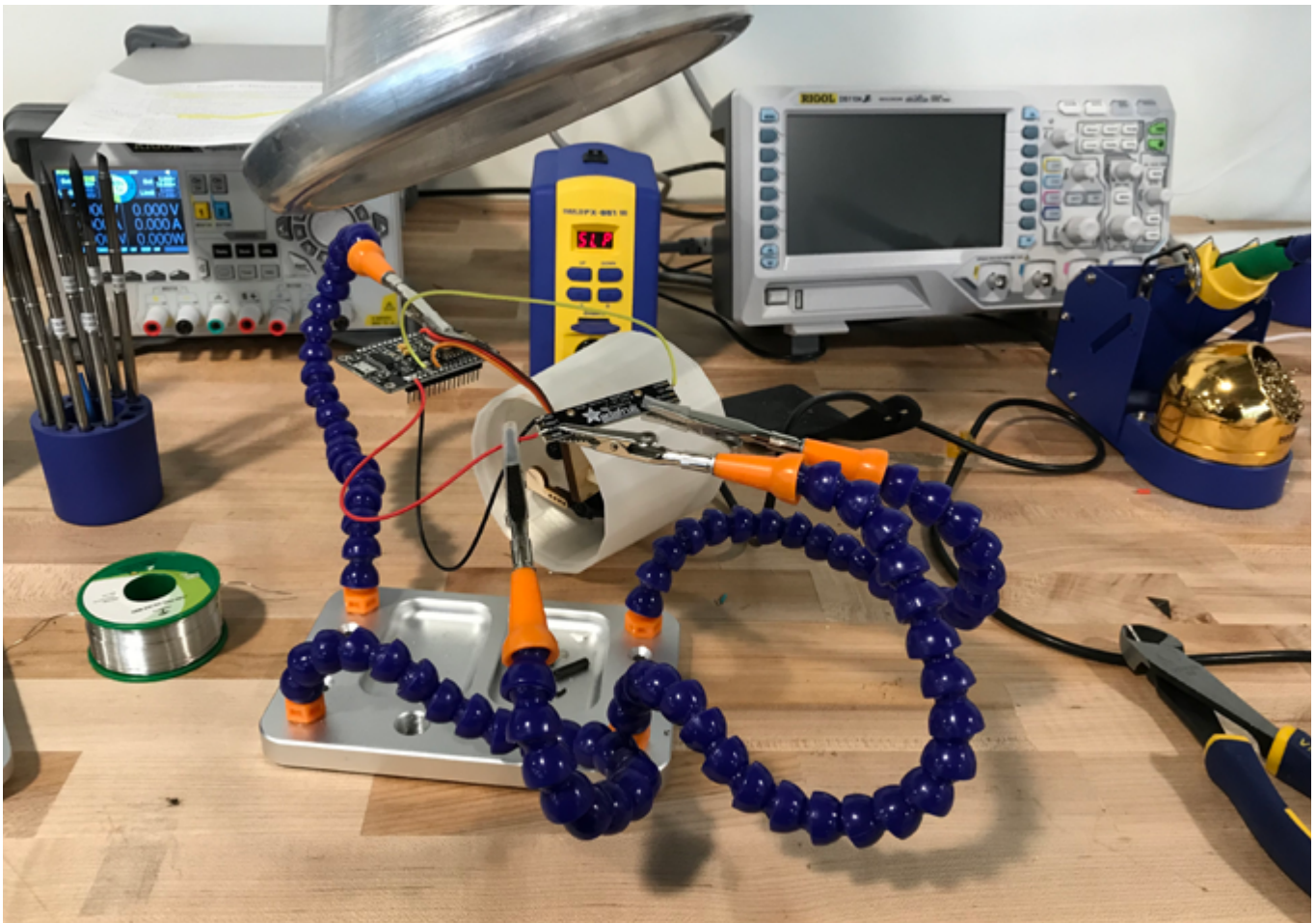
After getting feedback from the midterm review and starting to prepare for the thesis exhibition, I realized presenting a conceptual design to broad audiences is difficult. Some viewers received the prototypes as practical devices, whereas I wanted my design to be seen as conversation starters rather than being a practical proposal. Engaging the audience with the experiences and values seemed more difficult rather than introducing a product design and getting feedback on the final result. Since my concept dealt

with a sense of smell, it was more challenging to illustrate the scenario and expect audiences to elicit their feelings towards the proposed experiences. Putting the *Scentie-Talkie* into the real environment and letting the users live with it made it easier to make sense of the prototypes. There are limitations to understand or to fully experience conceptual design, but by using the working prototypes and living with it for a while, the users were able to fit the devices into their lives and elicit what it's like to communicate through olfactory interfaces.



What I learned through this thesis

This thesis enabled me to explore skill sets that I'm not familiar with, such as programming using Arduino, soldering, 3d printing, and using different types of HCI research methods. I learned how to make cultural probes, engage research participants, and synthesize research findings. Building a set of a working prototypes that can be communicated at a distance was challenging, but thrilling once it worked. I also discovered a lot of similar projects related to designing for long-distance relationships and also designing with scent while I was researching, which was surprising and helpful since I assumed my interest area was quite small. Personally, this project was super exciting along the way: from the research phase to the execution stage. I'm delighted that I was able to work on a very personal project which can be useful for the HCI industry as well.



A photo of soldering station making the scent dispenser

Conclusions.

This thesis explored how design and technology might help to improve interpersonal connections between family members living far apart. *Scentie-Talkie*, a wireless prototype, provided an alternative vision for remote communication enabling distant people to be more evocative and romantic using a sense of smell. The built prototype is not trying to be a solution to current remote communication platforms, but be a supplement to the existing platforms. I posit that by having both explicit and implicit interactions with far away from loved ones, it can foster more in-depth conversations and bring richer awareness of one another.

Inviting my family members to participate in the qualitative research phase made this project very personal, and the result very particular as well. Because technology is becoming more embedded in our daily lives, designers need to look at how technology can better fit into our everyday routine. Making the exploration participatory and living with the proposed system is a good way to start.

Acknowledgment

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