Miss Ü: KiKi & BoBo - A Design for Sharing Moods in Long-Distance Relationships

by

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Abstract

The thesis presents "Miss Ü: KiKi & BoBo," a prototype product to help couples in a long-distance relationship stay connected in a warm, tangible way. Nowadays, it is not uncommon for us to work or study all over the globe. With the distance and time difference, it is important for couples to keep the fire burning when they are living in different countries. Therefore, the goal of this thesis is to explore a product experience to strengthen long-distance relationships by using technology-enabled product.

In the thesis, through human-centered design process as well as emotional design strategy, Miss Ü: KiKi & BoBo was developed. KiKi & BoBo were designed to be a pair of cute monster-like characters. Each of the couple will have one with them. With wireless communication technology, KiKi & BoBo are able to help people with long-distance relationship to transmit their feelings in an emotional and not disturbing way. The thesis shows the whole product design and development process of Miss Ü: KiKi & BoBo.

Keywords: emotional design, human-centered design, design thinking process, user experience, long-distance relationship

Thesis Supervisor: Maria Yang
Title: Associate Professor of Mechanical Engineering

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Chapter 1 Introduction

1.1 Overview

What attracts people to a certain product varies from person to person. For some, the purchase decision may be influenced by the object's functions. For others, price or the aesthetic design may be of the top priority.

Sometimes, one may want to buy a product because it evokes a positive association with a memory or feeling, or triggers an emotional response. As you read this, it is likely that you are surrounded with examples of such purchases. Perhaps they are not the best products, but there is a sentimental attachment nonetheless. It may not be obvious, but those connections affect you subconsciously. While there are many factors that define a good product, a great user-experience is considered the most crucial. Every experience has an emotional component. Through the design thinking process, we develop products by figuring out human needs and re-framing the problem in human-centric ways; through emotional design, we further create products that appeal to humans on a more visceral level.

This thesis documents a case study of the development of a product meant to evoke an emotional response using a human-centered design process[1] that helps to enhance the connection between people in a long-distance relationship. Through thoughtful design[2], we hope to turn inanimate objects into evocative extensions of living relationships.

1.2 Motivation

As time progresses and technology develops, the world becomes a smaller community and more easily accessible by all. People can, with increasing ease, travel the world by a variety of means. However, while the physical distance between people seems shorter, the distance between hearts might not. In a growing trend, people tend to work or study overseas to explore new knowledge and expand their horizons. In doing so, they transform any in-person, local relationships to those of long-distance and with that transition comes the variety of complications.

With busy and varying schedules, especially with time differences, it becomes harder to keep in touch with friends and family as often as we would hope to. Nowadays, when people wish to chat with someone they miss, instead of making a call, they might need to consider if it is a good time to call. Are they still sleeping? Or are they at work or school or otherwise unavailable? One other situation is that sometimes we just miss someone but don't really have something to share with them. We simply want to send a gentle alert to let them know we miss them.

Even with the development of advanced technology, we can easily use a cell phone to solve this problem. However, a text message on the screen seems to lack warmth and it's easy to lose the feeling of love; sometimes the message might also be overshadowed by other information. Therefore, in this thesis, the author hopes to figure out a way to fill this gap and enhance a long distance relationship. Instead of technological approach, the author used Emotional Design[3] to develop a physical product that can improve the user-experience and emotional response.

1.3 Background and Literature Survey

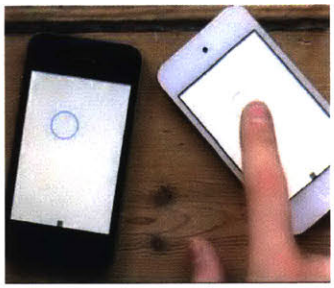
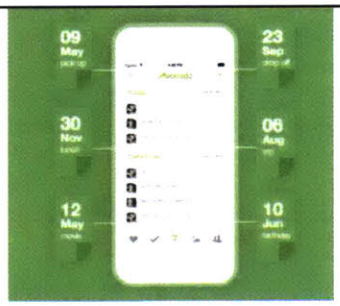
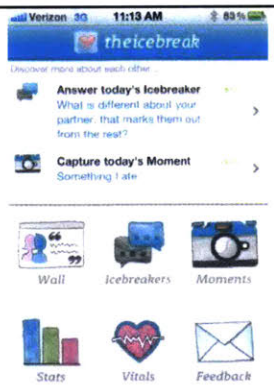
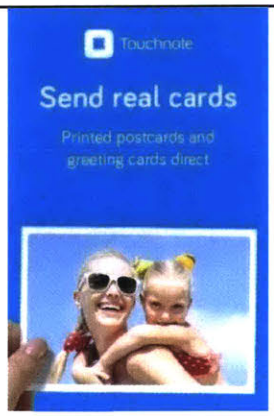
Emotion is the native tongue to most humans. Emotional experiences are crucial because they imprint deeply in our long-term memory.[4]

Emotional Design is a term that is popularized by Don Norman. In his book Emotional Design[3], he notes that, "Attractive products trigger our creativity and ultimately expand our mental processes, making us more tolerant of minor difficulties." That is why appealing things work better and why some products evoke our emotion. Therefore, while designing a new product, besides functions, the other crucial element is an understanding of how it can resonate consumers' hearts.

As more individuals participate in international work and education, more people are finding themselves in long distance relationships. To avoid losing the feeling of love that using cell-phones and computers might not be able to convey, some innovations have been invented to help long-distance couples feel more connected to each other. However, most of them are intangible applications on smartphones, such as Touch Room[5], Avocado[6], and The Ice Break[7]. Touch Room is an app that let you feel you are touching your loved one who is miles away from you. Couple allows you to share private information without signing into social media, and The Ice Break helps you find common topics with your partner.

Besides applications, there are only few of products are designed with a physical component. Pillow Talk[8] transmits heartbeats. Kissenger[9] convey the feeling of a kiss, and The Hug Shirt[10] simulates hugs. They all want to transfer and mimic the physical contact that normal couples will have during their daily lives. In the thesis, we hope to present a tangible way for couples with long distance relationship to pass on their emotions. Table 1-1 lists the existing products and their functions.

Table 1-1. LIST OF EXISTING PRODUCTS

Name	Figure	Description
Touch Room[5]		Touch Room is an app that let you feel you are touching your lover who is miles away from you. With this app, people can see which part of the screen their lover is touching, and it makes the distance between you and your lover becomes just like a piece of glass.
Avocado[6]		Avocado is a private app only between your lover and you. With the understanding that people only wish to be social with one another, it allows private photo and location sharing, chats, and scheduling.
The Ice Break[7]		The Ice Break is an app that helps to create topics for people in long distance relationships. By asking questions that help users get to know each other and keep their chats fresh.
Touchnote[11]		By selecting photos from your camera roll; add a message and your partner's address, Touchnote will print it out and send real, tangible postcards off to your partner.

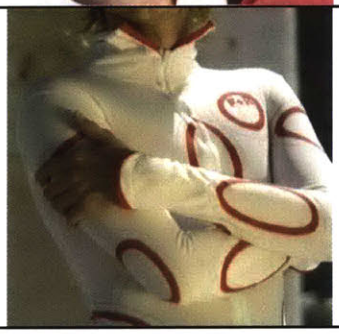
Pillow Talk[8]

Pillow Talk helps people with long-distance relationship to feel their significant other's heartbeat. With a wristband that can sensor heartbeat and sends it the lover's pillow speaker in real time, it seems like you are sleeping on the chest of your lover and feeling your lover's heartbeat.

Kissenger[9]

Kissenger is a long-distance kissing machine. How it works it that when you kiss the device, and it will transmit your lip movements to the other one. So that your lover can feel your lip movements like you're kissing him/her.

The Hug Shirt[10]



The Hug Shirt is a product for people to get the feeling of hugging. It replicates the pressure, warmth, and a heartbeat of the sender, and recreate the feelings to their lovers.

Frebble[12]

Frebble is a design that allows people to hold hands with someone at a distance. By squeezing the product, the other one will feel the squeeze. It provides a new common tactile experience for users.

1.4 Goals of Project

The goals of this thesis project are detailed below.

(i) Develop a platform for a long-distance couple to enhance their relationship by using tangible products with functions such as wireless communication and lighting effects to transmit feelings and messages.

(ii) Describe a product design and development process with human-centered design and emotional design strategies.

(iii) Design two monster-like characters, KiKi & BoBo, to improve human to human and human to robot interactions.

1.5 Organization

The structure of the thesis is organized as follows. Chapter 2 briefly introduces the design concepts and functions of the platform –Miss Ü: KiKi & BoBo. In Chapter 3, the design process of KiKi & BoBo is introduced. A step-by-step process is proposed to show how KiKi & BoBo were developed. At the end, Chapter 4 concludes this thesis and addresses future recommendations.

Chapter 2 Miss Ü: KiKi & BoBo

2.1 Introduction

This thesis describes the development of a platform for people in long distance relationships. The goal was to create a simple but authentic way to send the message of "I miss you" across borders in a non-invasive manner without bothering the recipient of the message. "Miss Ü: KiKi & BoBo" was developed using a design thinking process. Since Miss Ü was designed to be a medium that channels emotions, its appearance was also a crucial element that would could affect the feelings of users[13]. In Chapter 2, the design concepts of Miss Ü: KiKi & BoBo will be discussed, and the functions and components of them will be introduced.

The structure of this chapter is organized as follows. In Section 2.1, the platform, Miss Ü, is introduced. Section 2.2 shows the functions and how they work of KiKi & BoBo.

2.2 Design Concept

Miss Ü: KiKi & BoBo was designed to be a two-way device for individuals in long-distance relationships to send messages to one another in a beautiful and non-obtrusive manner. Miss Ü is positioned to be emotional, fun and special. Since Miss Ü is designed for users with a wide range of different values and characters, Miss U was designed and built to be cute yet neutral.

Figure 2-1. CHARACTER DESIGN

Generating different possible appearances of Miss Ü was the first step. Two characters called KiKi & BoBo were created at the end. KiKi & BoBo are a pair of two small monsters with different sized eyes, and a big red nose.

KiKi is mint green. It has a Mohawk and yellow hair and a heart-shaped nose; BoBo is light yellow with two antlers and a big red nose. The reasons why these colors, size, and material were be used are listed below:

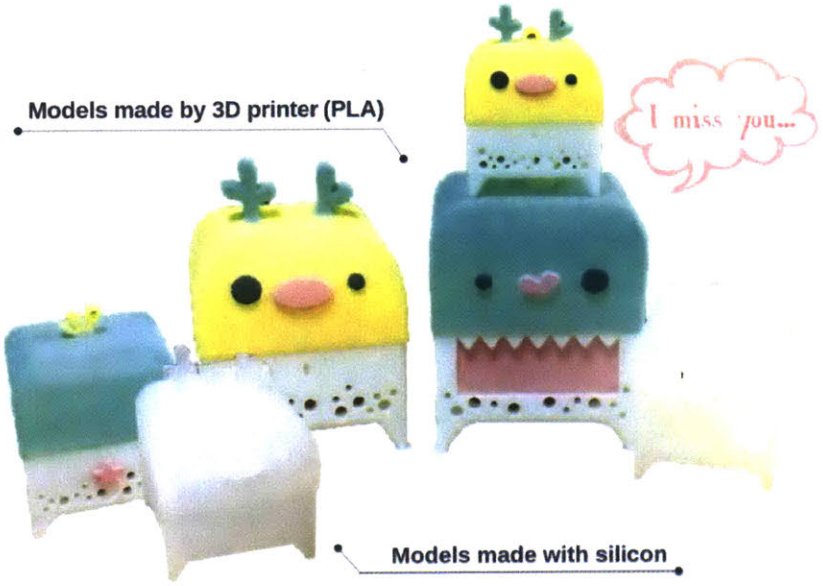


Figure 2-2. KIKI & BOBO

a. Color

KiKi and BoBo are semi opaque white for subtle light penetration. While their main color mint green (KiKi) and light yellow (BoBo) are designed according to color psychology[14].

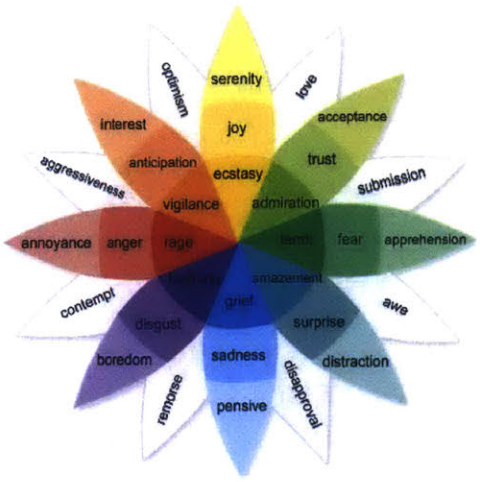


Figure 2-3. COLOR PSYCHOLOGY[15]

Different colors can evoke psychological reactions and are often thought to have an impact on moods and emotions.[16] When designing a product, colors can influence people's minds and

feelings. Green, for example, is often connected with the sense of nature and represents tranquility, health and good luck[13]. Green is also considered to have restorative properties since studies have shown that it is the most restful color for human eyes to view.[17] KiKi, which was designed to heal a lonely soul and soothe lovesickness, is mint green to provide a sense of healing but still appear cute and relatively neutral.

To pair with KiKi, BoBo was made light yellow. Yellow induces feelings of sunshine, hope, and happiness. Studies show that the color yellow is associated with warmth and cheerfulness. [18] As a character aimed to represent nostalgia, BoBo exhibits characteristics of warmth and comfort. As mint green and light yellow creatures, KiKi & BoBo's comforting and delightful characters are meant to elicit sentiments of, "I miss you".

b. Size

Items of different sizes might evoke different feelings in people. Two products with the same shapes and functions but disparate sizes might also lead to different user experiences. For instance, smaller products might make people feel cute and adorable, while larger products might seem more imposing.

What dimension should KiKi & BoBo be? And what kind of imagery can KiKi & BoBo evoke for users? KiKi & BoBo were tested and modeled with different sizes to determine the appropriate size. The dimensions also depended on where KiKi & BoBo would be used. There were a couple of initial thoughts about their conceptual form: key rings, decorations, dolls for hugging, or even embedded furniture. KiKi & BoBo were 3D printed in different sizes and tested with the users. The idea of key rings that users can bring with them anytime and anywhere seemed particularly exciting.

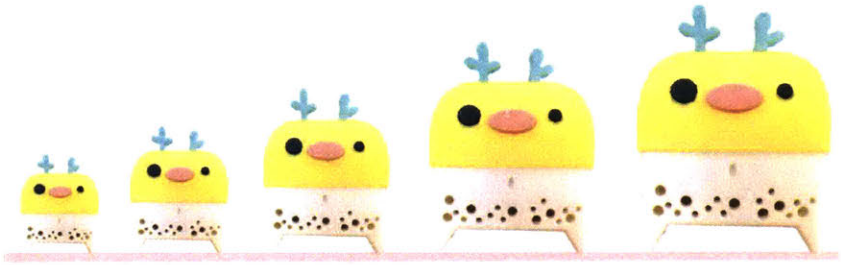


Figure 2-4. DIFFERENT SIZES OF BOBO

c. Soft Material

Tactile sensation is also one of the crucial elements of a product. Sometimes people buy a product because of its sense of touch. For example, over the past few years, there has been a popular product from Japan that won warm praise from customers called "Squishy."[19] (Figure 2-5). It is a special kind of squeezy toy. It looks cute and feels soft and users consider Squishies to be healing.

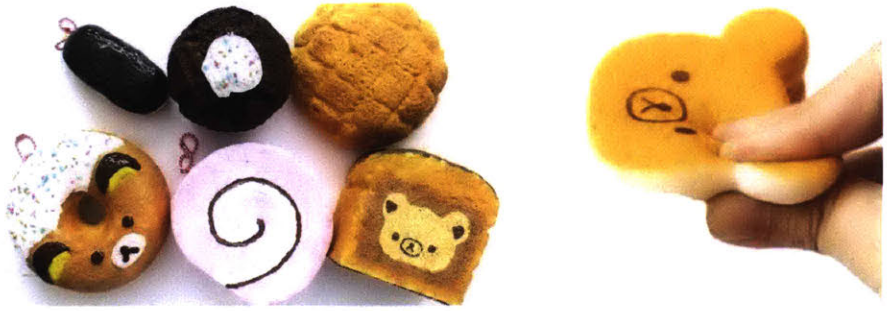


Figure 2-5. SQUISHY

Miss Ü: KiKi & BoBo as a product that transfers emotion and it is also hoped to heal lonely hearts. Being soft and squeezable might enhance the interaction between user and product and better convey people's feelings. Therefore, instead of using hard materials, a soft material such as silicone was chosen for KiKi & BoBo.

2.3 Functions

The main idea of Miss Ü: KiKi & BoBo was to send out warm signals without being a nuisance. Physical contact is one of basic needs for couples; however, for people in long distance relationships, it is difficult because they cannot physically reach out to their loved one. Instead, they rely more on emotional sustenance. With time differences and conflicting schedules, it might be hard to find a workable time to talk with each other. Moreover, with many messages in the phone, people might just ignore the ones from their loved ones.

Miss Ü: KiKi & BoBo is positioned to be a simple and easy-to-use device. Contrary to the non-tactile aspects of today's information era, KiKi & BoBo can bring back physical touch and convey emotions in a unique way. They only belong to couples with the paired devices. The interactions of this product can be divided into two ways: users to KiKi or BoBo, and KiKi to BoBo / BoBo to KiKi. The user experience of the first one depends more on the design of KiKi and BoBo, discussed earlier. In this section, we describe how KiKi and BoBo represent the users to interact with each other.

KiKi & BoBo are synced as pairs, with each individual in the relationship "owning" the other. Through real-time wireless communication, they are able to transfer yearn and feelings to the partner in real time. When one is squeezed, the other will light up i.e. if KiKi is squeezed, BoBo will light up and vice versa. Light was chosen as output because light is a universal symbol of warmth. By adjusting the lighting frequency, brightness, and colors, combinations of symbols can be recombined to convey different feelings. The following describes two main functions of Miss Ü: KiKi & BoBo.

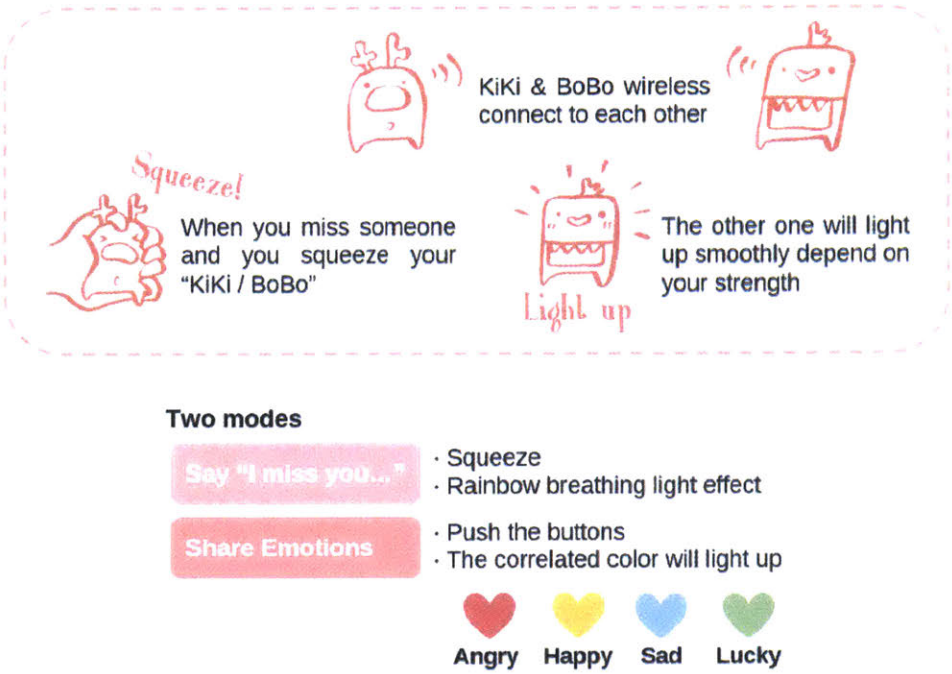


Figure 2-6. ILLUSTRATION OF HOW MISS Ü: KIKI & BOBO WORKS

a. Say "I miss you"

This function is the basic mood for the product. When the user squeezes one of KiKi & BoBo, the other one will gradually and smoothly light up while color changing with a "breathing" light effect. The effect is to signal their partner "I miss you" in a more emotional but not intrusive way.

Figure 2-7. SCREENSHOT OF THE LIGHTING EFFECT

To achieve this effect, RGB LEDs were used as the output. With pulse-width modulation (PWM) technique, analog results can be achieved with digital means. Varying voltage outputs at different frequencies controls the brightness of each LED. To get the effect of "breathing," the

LEDs lighting is designed to fade in and out. By changing PWM duty cycle, the effective value of the output is changed, and it responds to the brightness of the LEDs. The glow will last 5 seconds, or until the other one squeeze theirs.

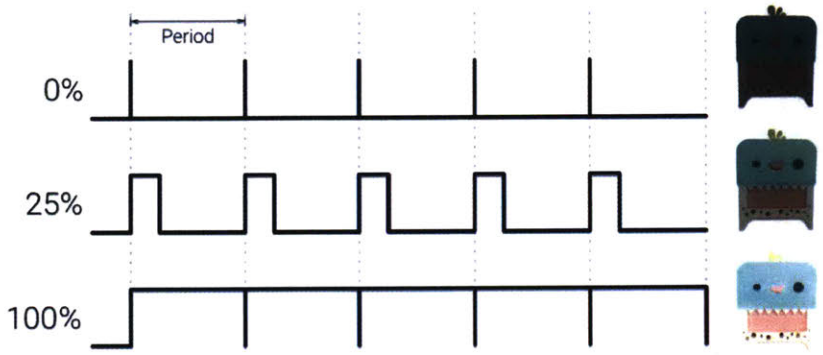


Figure 2-8. ILLUSTRATION OF PWM

b. Sharing Emotions

Besides sending the message "I miss you." KiKi & BoBo are also able to share users' emotions with their loved ones. By pushing different buttons on KiKi or BoBo, the other one will light up with the corresponding color: yellow, red, blue and green, and they respectively represents happiness, anger, sorrow, and luck. In this way, users share their current feeling with their partners. The "breathe" effect was also applied in this mode but with single color.

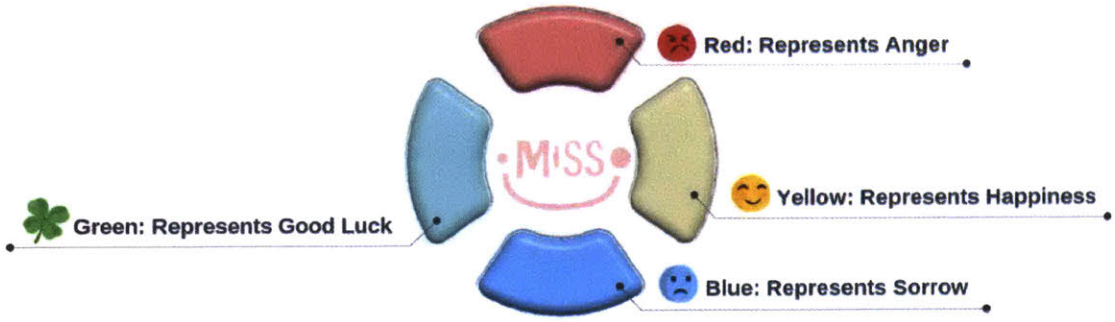


Figure 2-9. BUTTONS AND THEIR REPRESENTATIVES

Chapter 3 Design Process

3.1 Introduction

Design thinking refers to a creative strategy that designers utilize during the design process.[20, 21] It is a design methodology that solves problems and creates possibilities with innovative solutions by understanding the human needs involved. The process of design thinking is generally considered to be a five-stage model proposed by Hasso-Plattner.[22] The five stages are as follows: Empathize, Define (the problem), Ideate, Prototype, and Test. This Chapter is going to introduce the design process of KiKi & BoBo based on these five stages.[23]

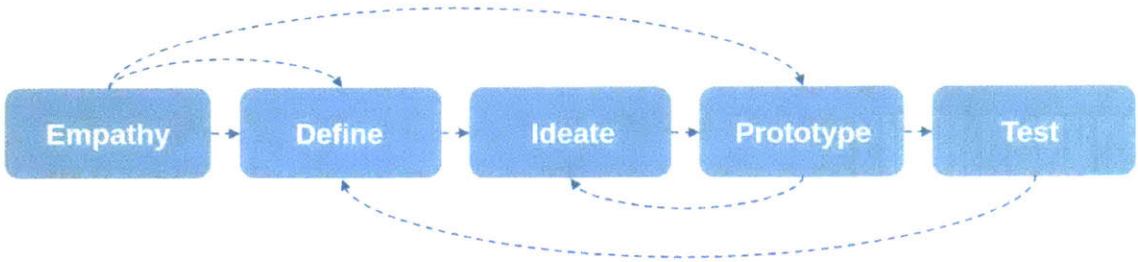


Figure 3-1. FIVE STAGES OF DESIGN THINKING PROCESS

The structure of this chapter is organized as follows: In Section 2.2, user needs were identified and a needs list was created by doing user research. In Sections 2.3, the ideas were generated and prioritized according to the needs list. Section 2.4 presents the process of prototyping. Then, the feedback of user testing is discussed in Section 2.5.

3.2 User Research

User Research is a very crucial part while developing a new product. By understanding user behaviors and needs, a problem space for which solutions are proposed can be identified. There are a couple of ways to learn how users think, such as via surveys, interviews, preferences and grouping tests.[24] In this thesis, the users were understood by observing and conducting user interviews. This section presents the statements and needs gained from user interviews.

More and more people are leaving their countries of origin in hopes of pursuing a brighter future. As a result of these increased international communities, long-distance relationships are becoming a lot more common. Lots of people are forced to leave friends and family and suffer the pain of any long-distance relationships. As an international student, the author understood the pain to be apart from love ones. Therefore, the author hopes to develop a product that can help long-distance couples enhance their relationship. To identify the origin of the emotional distress of the users, we interviewed about 15 people who are in long-distance relationships and assessed their needs. The followings are some of the statements from the interviewers.

Table 3-1. USER NEEDS

User#	User Statements
1	*I feel lonely in a long distance relationship*
2	*If we can't meet each other often, it's easy to lose the feeling of love.*
3	*I wish my boyfriend could hold me every night.*
4	*I miss my girlfriend, but I don't have anything special to share with her.*
5	*It's hard to find a time to chat with my girlfriend.*
6	*I wish he could stay somewhere where I could meet him whenever I want to.*
7	*I want to share my feelings with my boyfriend right when they happen.*
8	*The destination of my vacation is always wherever she is, however, sometimes I want to visit somewhere else.*
9	*It becomes a pressure every month when he visits me because I need to empty my day to accompany him.*
10	*We can't do anything that regular couples can do, for example, having meals together.*
11	*With different living and social circles, it's hard to find something to talk about.*
12	*I can't tell where my girlfriend actually is.*
13	*I miss him but I don't want to disturb him.*

From the interviews and the statements that we got from the users, the reasons why maintaining a distance relationship is difficult could be defined and classified into the following reasons:

- **Time difference:** With divergent schedules and different time zones, it is hard to find a proper time to chat with each other, besides, cannot share things in real time could be very annoying.
- **No common topic:** With dissimilar environments and interpersonal relationship, finding a common topic for a conversation might be difficult.

- **Uncertainty:** Since they are not around with each other, what they can do is believe in what the other tells them. However, it might cause insecurities to emerge.
- **No physical contact:** This might be the most painful part for a distance relationship. Since they are not with each other, feeling and touching each other become nearly impossible. However, having physical connection might be one of the most important things in an intimate relationship.

Also, from the user interviews and the statements, a needs list can be converted and the need can be prioritized.

Table 3-2. NEEDS LIST

Needs#	User Needs	Statement	IMP(1-5)
1	*The product can help to connect each other.*	1,2,5,6,10,11	5
2	*The product makes warm feelings.*	1,2,3,10	5
3	*The product can keep the feeling of love.*	1,2,8,10	5
4	*The product is tactile.*	1,3,6,10	4
5	*The product can share feelings.*	1,7,13	4
6	*The product can conquer time differences.*	5,7,13	4
7	*The product can bring common topics of conversation.*	4,11	3
8	*The product can send messages.*	4,7	3
9	*The product can send messages in real time.*	7	2
10	*The product is quiet.*	13	1
11	*The product helps to build trust.*	12	1

3.3 Concept Generation & Prioritization

3.3.1 Idea Generation

Idea generation is the brainstorming stage after the users and their needs are understood, and after creating a needs list with human-centered problem statements through previous stages. At the beginning of the Ideation phase, it is important to get as many ideas or solutions as possible, no matter how crazy or unreasonable the ideas might seem. The goal for this stage is to stimulate free thinking. Figure 3-2 shows the ideas that were generated around how to enhance the long distance relationships.

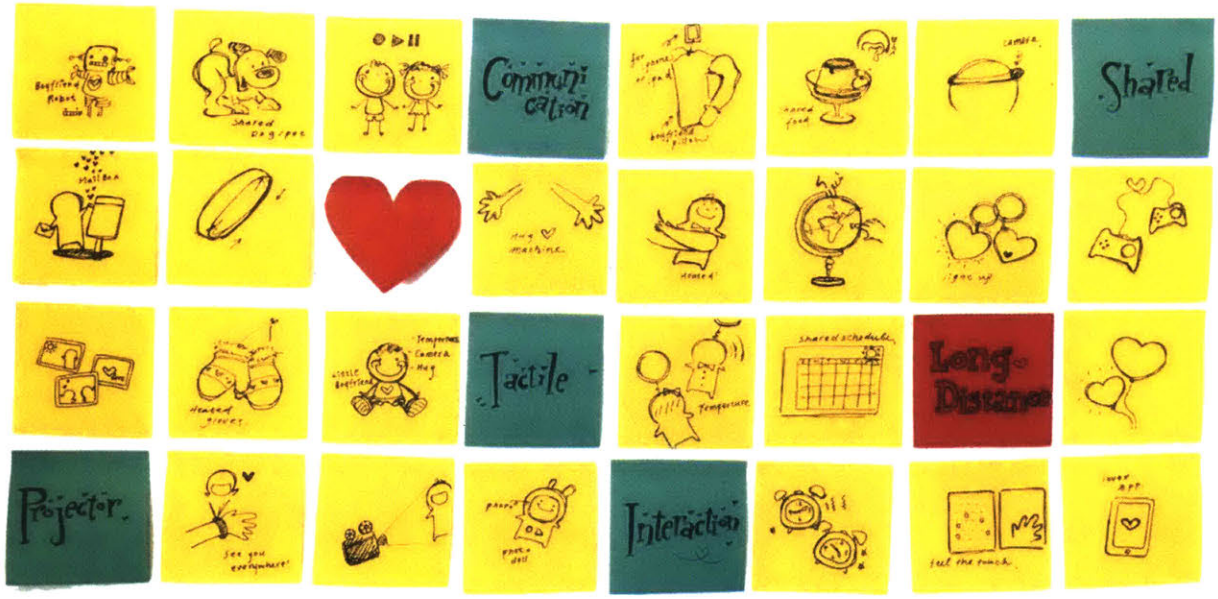


Figure 3-2. IDEA GENERATION

3.3.2 DFV Evaluation

There are a couple of techniques used to evaluate the generated ideas. One of them that is often used during design process is DFV evaluation.[24, 25] DFV stands for Desirability (Do people want it?), Feasibility (Can it be made?) and Viability (Should it be made? Or, is it profitable?) During the product design and development process, rather than just considering personal preferences, reviewing the ideas from these three different perspectives enable the ideas to be evaluated in a more objective way.

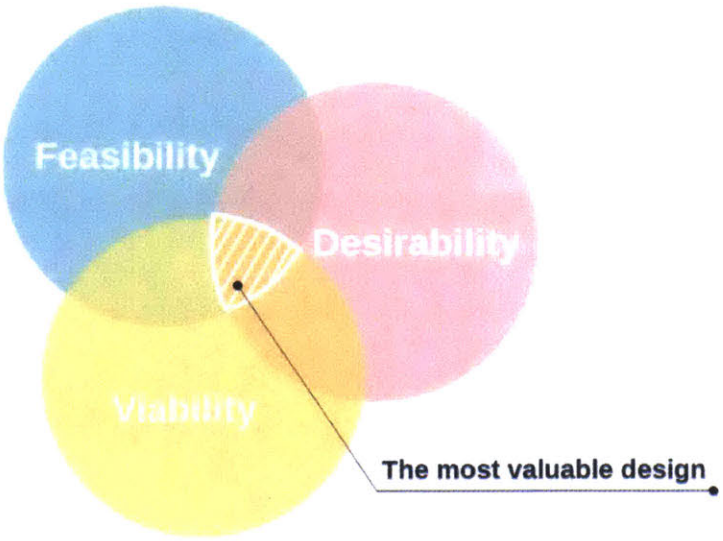
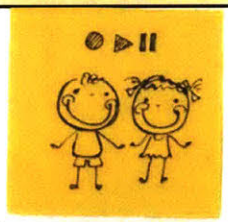


Figure 3-3. DFV CHART

The ideas generated were preliminarily sorted into categories, and through a simple user survey, six of them were selected. The DFV method was used to evaluate and select the most valuable design. The result suggested a twin device that could help transmit emotions.

Table 3-3. DFV EVALUATION

Ideas#	Figure	Desirability	Feasibility	Viability	Total
1		5	1	4	**9**
2		4	3	5	**12**
3		4	5	4	**13**
4		4	4	4	**12**
5		5	2	4	**11**
6		3	5	2	**10**

3.4 Character Design

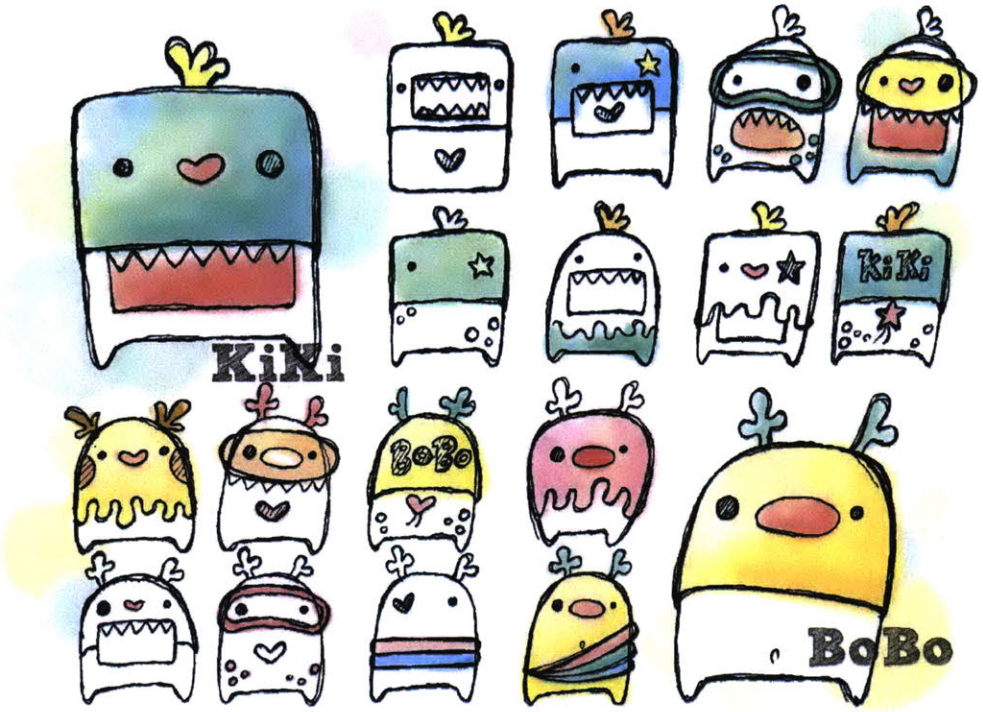


Figure 3-4. DIFFERENT VERSIONS OF KIKI & BOBO

After the direction and function of the product were decided, the objects appearance will definitely influence the feeling it brings to the users. We have explained the design concepts of KiKi & BoBo in Chapter 2, and Figure 3-4 shows the idea generation part of different versions of KiKi & BoBo.

3.5 Prototyping

Prototype, by definition, is "an original model of a product."

After one great idea is generated, before it is being manufactured and goes to the market, prototyping is an essential step to see how the idea actually works in real life and if it indeed fulfills the needs of users. Prototyping is a critical part of design process. It is a process of developing the

closest approximation of the product as the best way to test the idea with customers and users. Prototyping is also an integral step in the production process.

A good prototype can physically demonstrate the idea, help understand the user in a short time, and save time and money to avoid creating something that does not work. A successful product is bound to go through many phases of prototyping, testing and modifying. Usually before getting into our final prototype, some phases would be gone through, such as sketch models (very rough prototype, just for gaining information regarding ergonomics, form and size), renderings, and testing the appearance and function respectively - looks-like model and works-like model. A works-like prototype is developing a piece of technology that can function to accomplish your vision; while a looks-like prototype looks great but doesn't function. It helps to learn the perception of the product besides the functions. This Chapter is going to show the prototyping process of KiKi & BoBo.

3.5.1 Sketch Model

Sketch models are "quick and dirty" prototypes that let designers concretize the ideas in a very rough way. It is an early stage of prototyping process. The main purpose of this stage is to test the size and form of the product. In this thesis, Model Magic[26], a lightweight modeling compound, was used for the sketch models.

Figure 3-5. MODEL MAGIC

3.5.2 3D CAD Model & Rendering

3D computer-aided design models have become more popular as they are an easy way to visual a design. By building a CAD model and rendering, the appearance of different colors and materials on the model can be tested, and photorealistic images can be created to better understand the details and appearance of the design. Moreover, based on feedback, revising the models becomes easy and the final physical properties can be analyzed from the model. Besides, 3D CAD modeling is also the initial step for mass production.

After testing the size and form with different users, based on the received input, KiKi & BoBo were built in 3D with Soildworks[27].

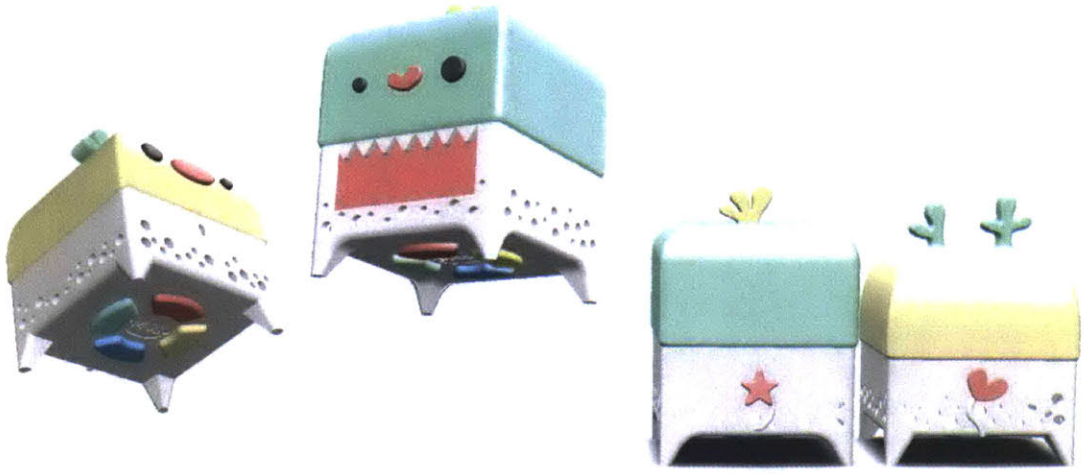


Figure 3-6. RENDERINGS OF KIKI & BOBO

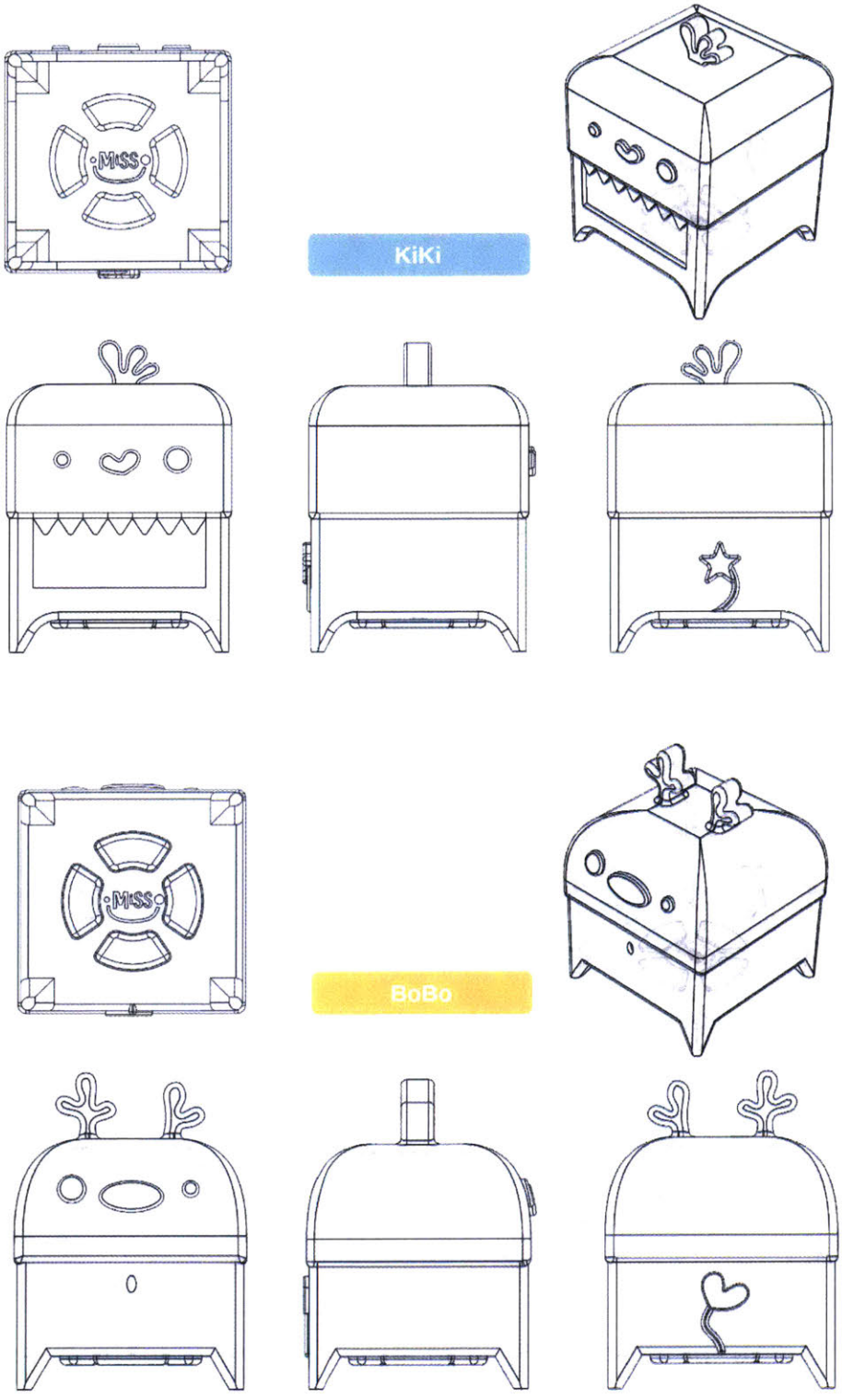


Figure 3-7. 3D CAD MODELS OF KIKI & BOBO

3.5.3 Looks-Like Prototype

Looks-Like Prototypes, as the name implies, focus on the appearance of the product, and might just be a non-working shell of the design. Since the appearance of KiKi & BoBo is one of the important elements, because it would affect the feeling of human-robot interaction, a looks-like prototype was prioritized to be made first to ensure the character design of KiKi & BoBo was well received by the users.

Thanks to 3D printing, rapid prototyping has become less difficult when one wants to realize ideas. With the CAD models that were built in the previous stage, it is easy to adjust different sizes of KiKi & BoBo and print them out. The bigger one was more like an ornament that can be put on the table, while the smaller one could be a key ring to let the users bring with them everywhere. However, limited by the current size constraints of the PCBs that were designed in the thesis, 40mm*40mm*60mm were the smallest dimensions that KiKi & BoBo could be manufactured. In the future, the even smaller size is hoped to be made so that the users could carry it with them.

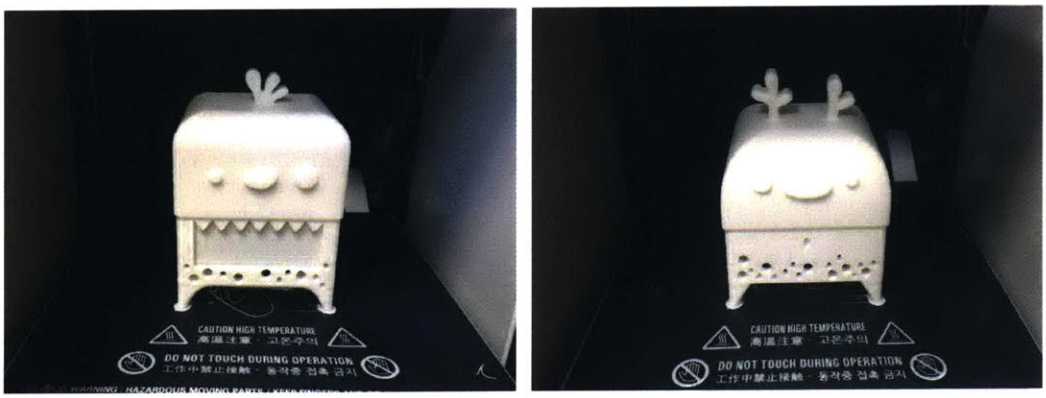


Figure 3-8. 3D PRINT KIKI & BOBO

After being printed, KiKi & BoBo were colored with Acrylic paint to gain a sense of how the final product might look.

Figure 3-9. COLORED KIKI & BOBO

Soft materials were decided to be used to increase the interaction between users and Miss Ü and to make the final prototype more emotional. By using soft material, instead of sending a signal by just pushing a button, users can squeeze the whole figure to transmit their messages. Therefore, KiKi & BoBo were ultimately molded and cast in silicon. Mold Star T20[28] was the material for prototyping because it is transparent enough for the light to come through. Figure 3-9 shows the process of how KiKi & BoBo were molded and cast.

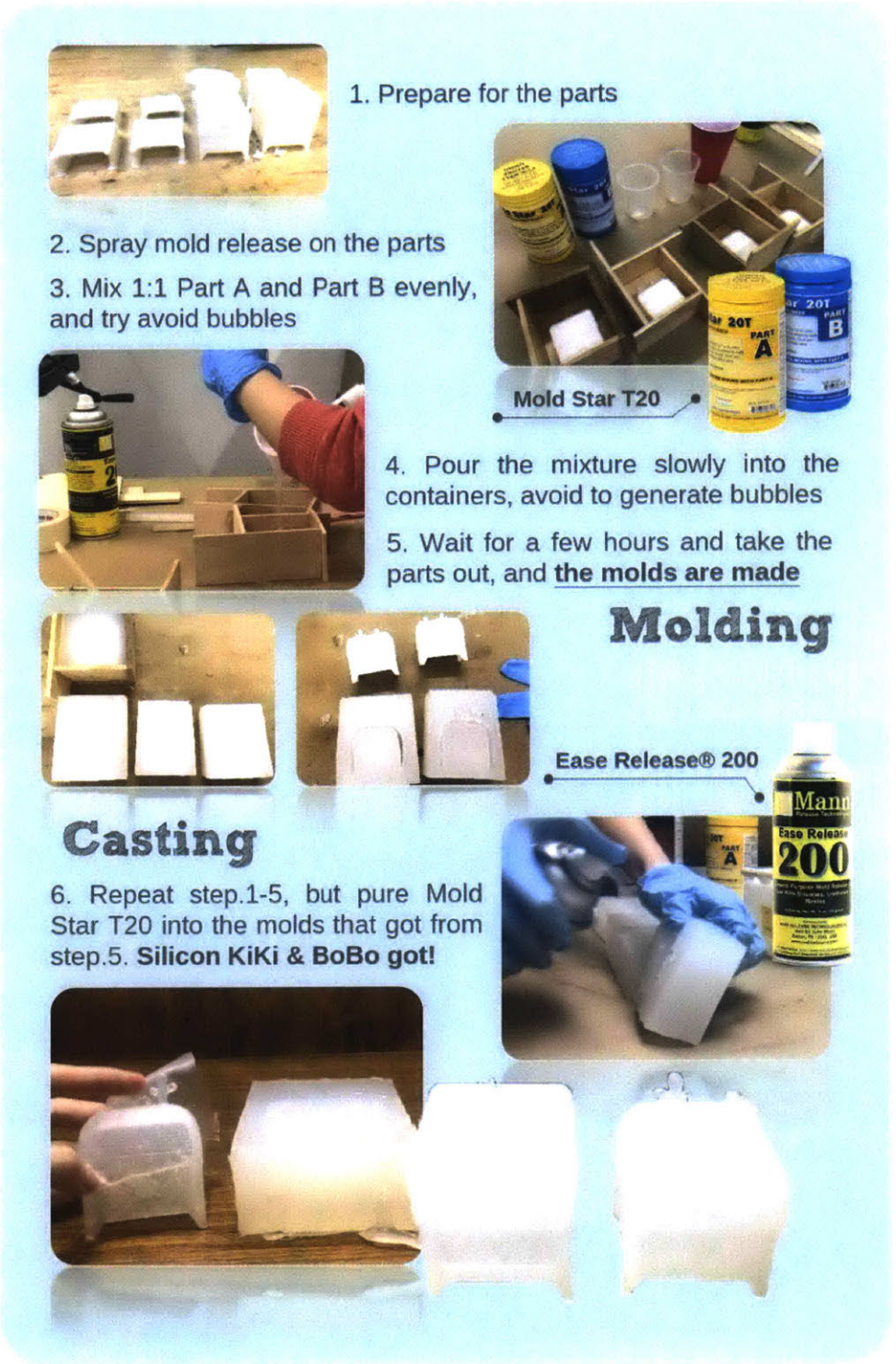


Figure 3-10. PROCESS OF MOLDING & CASTING

3.5.4 Works-Like Prototype

Works-like prototype is made to figure that whether the technology would work to accomplish our visions and goals. Works-like prototypes, contrary to looks-like ones, are focused on the functionalities of the prototype instead of the appearance. For Miss Ü, although the goal of this product was not concentrated on technology approaches, different versions of PCBs (Printed Circuit Board) were still developed to test out if the idea was feasible. The following paragraphs show different versions of PCBs that had been designed for Miss Ü.

a. Version 1: Control LEDs with Button

How to make Miss Ü more emotional? What kind of input and output can enhance the interaction between user and Miss Ü and make it more attractive? From the idea generation stage, two popular ways of interaction became apparent: the ability to squeeze and the temperature of the product.

For the first version, a simple layout of a PCB that can control LEDs with a button was created. It was made with a push button as an input, a SMD single color LED as an output, and ATtiny44A[29] as the microcontroller. The function of this board was very simple – when user pushes the button, the LED will light up; when the button is released, the LED turns off.

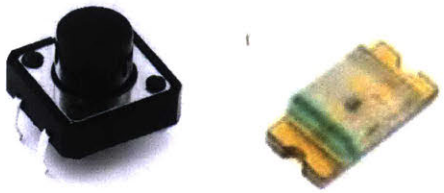


Figure 3-11. PUSH BUTTON, STANDARD LED - SMD

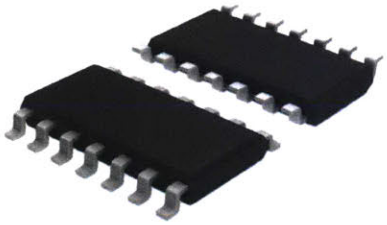


Figure 3-12. ATTINY44A

Table 3-4. SPECIFICATION OF MICROCONTROLLER

ATTINY44A-SSU	
Categories	Microcontroller IC
Core Size	8-Bit
Speed	20MHz
Program Memory Size	4KB (2K x 16)
Program Memory Type	FLASH
Package / Case	14-SOIC
Number of I/O	12

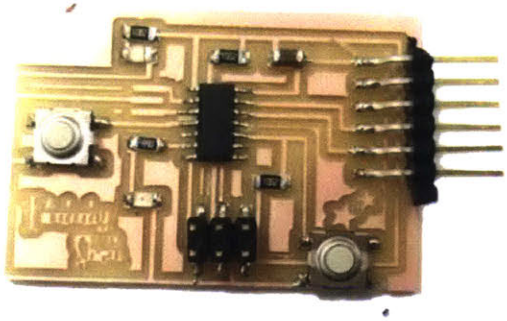


Figure 3-13. PCB OF FIRST VERSION

b. Version 2: Control LED with Temp sensor

For the second version, a PCB prototype, which used a temperature sensor as an input to light up the LEDs (output) was made. The microcontroller that was used on this board was ATtiny44A. The sensor was Negative Temperature Coefficient (NTC) thermistor - a type of resistor whose resistance is dependent on temperature. That is, when temperature changes, the resistance decreases as temperature rises.

Figure 3-14. TEMPERATURE SENSOR

The board eventually accomplished our goals, however, since the hand temperature for one person is different from others, and as silicon was decided to be used as the skin of KiKi & BoBo, it is hard to transmit temperature through the silicon skin, so the idea of using temperature sensor as the input was ruled out

c. Version 3: Test with Arduino[30]

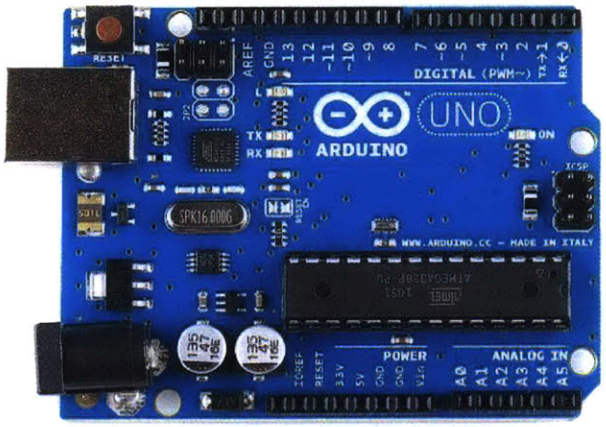


Figure 3-15. ARDUINO UNO

Arduino is an open-source prototyping platform based on easy-to-use hardware and software. Since KiKi and BoBo communicate with each other wirelessly, adding a wireless module on the board was needed. ATtiny44A, with only 14 pins and 12 I/O was not enough to accommodate the components needed. Therefore, changing the microcontroller was necessary. The new microcontroller that was chosen was ATmega328P[31], which was the same as the one on Arduino UNO. It had 14 digital input/output pins (of which 6 can be used as PWM outputs) and 6 analog inputs. Also, with PWM outputs, adjusting the brightness of LEDs makes the breathing light effect possible.

Figure 3-16. ATMEGA328P

Table 3-5. SPECIFICATION OF MICROCONTROLLER

ATMEGA328P-AUR	
Categories	Microcontroller IC
Core Size	8-Bit
Speed	20MHz
Program Memory Size	32KB (16K x 16)
Program Memory Type	FLASH
Package / Case	32-TQFP
Number of I/O	23

Since Arduino is an off-the-shelf board, the circuit can be tested on it first to make sure the design. In this way, time was saved and the bugs from the printed board are avoided.

d. Version 4: Wireless Communication

There are a lot of networking modules that can be used for wireless communication, such as Wi-Fi, RF, and Bluetooth. For prototyping, Bluetooth Module-HM10 was chosen.

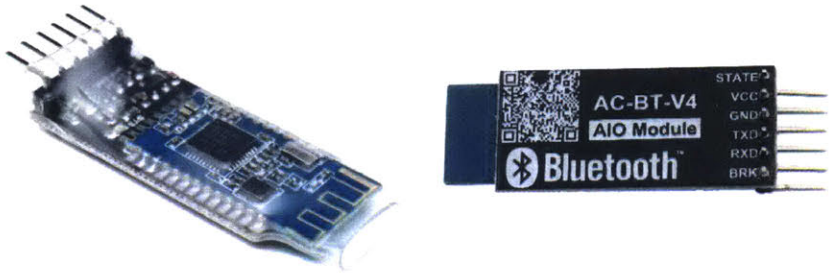


Figure 3-17. HM-10 BLUETOOTH 4.0 MODULE

HM-10 is a Bluetooth module for embedded systems to enable Bluetooth wireless communication with Bluetooth capable devices. The Bluetooth 4.0 HM-10 is basically a breakout board for cc2541; it broke out the LED pins, RX/TX and also added the voltage regulator that transforms 5V to 3.3V.

e. Version 5: Final Version

The most important part of this version is networking. The idea of Miss Ü was to make a twin-device that one can communicate with the other and allow people in a long distance relationship to easily transfer their emotion and say "I miss you" without bothering the other. Because of the distance, using Bluetooth might not be the best solution since it can't operate over long distances; however, it is a good way for prototyping the idea.

For this version, ATmega328P was used as the microcontroller, and by simplifying the circuit that was tested on Arduino, a smaller PCB that can fit into KiKi & BoBo was customized. In addition, a smaller LED board was designed for strengthening the brightness.

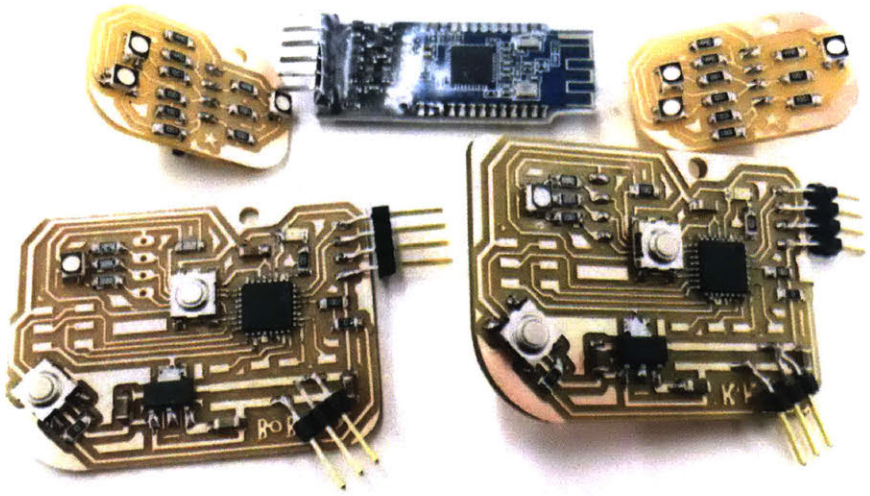


Figure 3-18. PCB OF FINAL VERSION

3.6 User Testing

User testing often takes place between different phases of the different prototypes. By testing the prototypes with potential users, one can better understand whether the product that was developed truly meets their needs. The final prototype usually is developed and modified by iterations with the feedback from various stages of user testing. During the user testing, approximately 20 people: 12 females and 8 males aged from 20-30 years old had been tested with the prototypes. In this section, the feedback that was got from different versions of prototypes was we classified and summarized.

a. Appearance of Miss Ü: KiKi & BoBo

As mentioned in the Chapter 1, sometimes, the reason why people decide to buy something is not because of how it works, but how it looks. People tend to buy a product that is less functional or more expensive just because the product looks better or links to some personal experience in their mind. Therefore, to test if our users found the appearance of KiKi & BoBo attractive was very important.

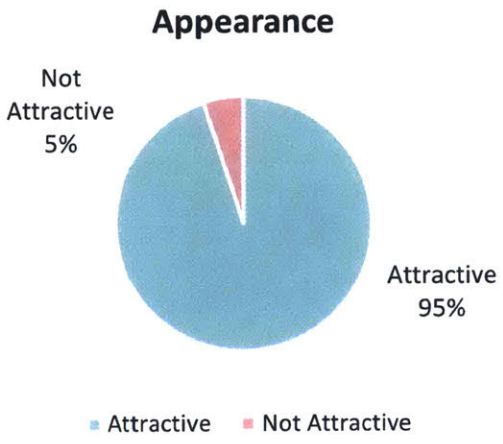


Figure 3-19. CHART OF APPEARANCE

"I love how KiKi & BoBo look - They are adorable! Besides, by squeezing it, I feel some of my emotions come out." This encouraging feedback was given by a 22-year-old female, who is a fresh graduate. There were various appearance design concepts before getting to the current version. Nevertheless, only the feedback for the current version is discussed here. Surprisingly, 19 out of 20 subjects like the appearance of KiKi & BoBo because they think they are cute and healing. For males, although some of them felt KiKi & BoBo are a little bit too cute for them, since KiKi & BoBo are designed are for couples, the appearance is acceptable.

b. Size of Miss Ü: KiKi & BoBo

The size of a product affects the feeling that people think of it. Although for the final prototype KiKi & BoBo were positioned as key rings, during user testing of three different possible sizes for KiKi & BoBo: key rings, decorations or furniture were also considered. The goal was to test which size was appropriate for users.

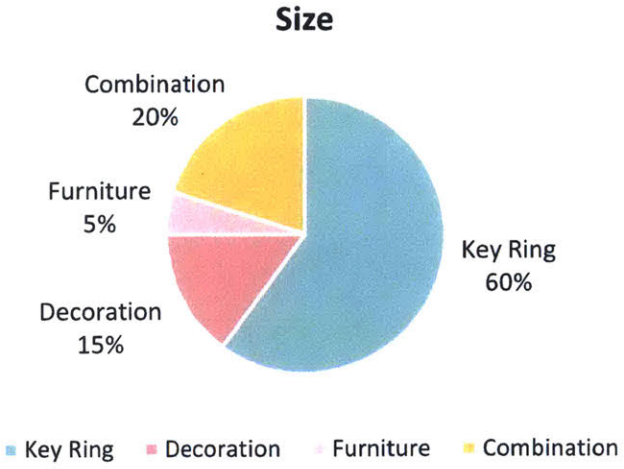


Figure 3-20. CHART OF SIZE

Twelve subjects liked the size of key rings, because they hoped they could always carry KiKi or BoBo with them. However, five out of 12 thought the size we designed is still too big for them.

Three subjects liked them to be sized as decorations on the table, so they can see it while they are working, and one subject liked them to be sized as furniture. In addition, 4 subjects mentioned that they hoped KiKi & BoBo could become a system that combines a key ring, decoration and furniture, so that they will never miss the message from their significant other.

c. Feedback on the Functions

"I like the way it uses lighting to express my emotions. It's cute and warm." Said by a 26-year-old PhD student. At the beginning, the goal of creating KiKi & BoBo was very simple - to send out a message of "I miss you" without bothering the other. However, from the feedback from user testing, a concern was raised: although the idea is appealing at first, its over-simplicity may cause people to lose interest of it after a few weeks.

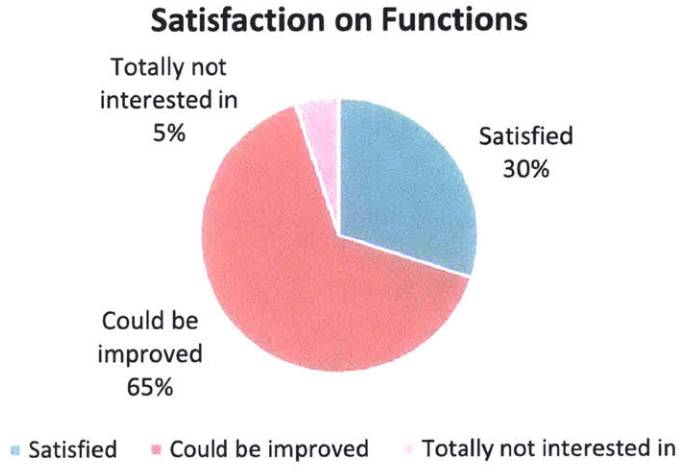


Figure 3-21. CHART OF SATISFACTION ON FUNCTIONS

"I think I'll buy it because it's cute, however, I might get tired of it soon because I can't get more messages from it." Based on the statement, 4 buttons for expressing more different feelings were added. Some subjects also suggested adding some random effects on KiKi & BoBo, so that the random effects could be a topic for them to discuss-- as if they had a shared pet. While some

male subjects considered the consequence if they missed the signal from their lovers and didn't send something back, their lovers might get angry. Only six subjects out of 20 fully satisfied with the current functions.

d. Market Value of Miss Ü: KiKi & BoBo

From DFV evaluation, the sweet spot of a successful product is the intersection of Desirability, Feasibility and Viability. Instead of the preference value, for business, if customers want to pay for it and how much they are willing to pay are relatively important. To further understand if KiKi & BoBo have market value, the subjects were asked if they are willing to buy KiKi & BoBo, 14 out of 20 said yes, but also depends on the price of them. The acceptable price range reported was $20-50.

Figure 3-22.CHART OF WILLINGNESS TO BUY

e. The position of Miss Ü: KiKi & BoBo

During user testing, the opinions of possible targeted users were discussed. The question was about expanding Miss Ü to be a product that is not only one to one, but one to many. That is to say, instead of just sending messages to the only one person, KiKi & BoBo could become a product that everyone has one, and the users could send the message to anyone who is in their network. In that way, Miss Ü could also be used for friends and family. However, only five people liked the idea.

"I have more than 100 friends on my WhatsApp, and the reason I like KiKi & BoBo because this product is unique for only two of us," A 25-year-old female said.

Chapter 4 Conclusion and Future Works

4.1 Conclusion

This thesis proposes the whole process of how a product be designed and developed and suggests an emotional way to use tangible figures to enhance the intangible connections for couples with long-distance relationship. Through a human-centered design process and a prototype application, Miss Ü: KiKi & BoBo, was built to explore this vision. The goal of the product is to assist and help the communication between long distance couples. By interacting with tangible figures to exchange feelings and messages, Miss Ü helps to fill the gap for those who can't meet and talk often because of distance.

The design of the platform can be classified into two parts: the appearance design and function design. For appearance design, in order to fulfill the emotional needs of the users, we applied emotional design strategy and followed color psychology to design two small monsters in light yellow and mint green. With cute and healing looking, KiKi & BoBo are able to attract users at first glance; the soft tactile impression made them even more emotional.

With Miss Ü: KiKi & BoBo, users can express and convey their feelings quietly but warmly without actually bothering their lovers. With wireless communication, and lighting effect, the functions of Miss Ü: KiKi & BoBo can be referred to two parts: transmit the message of "I miss you", and share emotions. By squeezing KiKi or BoBo, the other one will light up and change color smoothly. The effect is defined as "I miss you." Furthermore, there are four buttons with color red, yellow, green and blue at the bottom of KiKi & BoBo, and each of them represents an emotion. When pushing them, the other KiKi or BoBo will light up the corresponded color.

The evaluation of Miss Ü: KiKi & BoBo affirmed the idea and design of KiKi & BoBo, but also shed light on its flaws and offered direction for future improvements. The idea of sending feelings by squeezing and lighting a physical object gained the popularity among the test subjects. It started a new and fun way of communication, and made the interaction more interesting. However, with only two functions and monotonous lighting effect, users might get tired of it. After successfully attracting the users to buy the product, how to make them keep passionate about it might be a challenge for next steps.

4.2 Future Works

There are still areas where improvements can be made in this product. In this section, we provided some suggestions and directions for the next generation of Miss Ü: KiKi & BoBo.

(i) Shrink the size of current KiKi & BoBo. The current size of KiKi and BoBo is determined by the size of PCBs inside. However, from the feedback we got from user testing, the size is still too big for them to bring with them everywhere. By redesigning the PCBs and rearranging the circuit, we might able to make smaller KiKi and BoBo.

(ii) Add more functions for KiKi & BoBo. There are only two functions for KiKi & BoBo now, although the intention of Miss Ü is to use a simple way to transfer emotions. However, with only two functions, users might get tired of them easily. Therefore, in the future, it might be a good idea to add some random effects for KiKi & BoBo to make it more interesting.

(iii) Change the method of wireless communication. The prototype of Miss Ü: KiKi & BoBo is now using Bluetooth module to communicate with each other. However, there is a limitation for Bluetooth signals. As Miss Ü is designed for long distance relationship, it's necessary to change the type of wireless communication.

(iv) Customization. There is a standard "look" of KiKi & BoBo now. However, we could find a way for the users to customize their own KiKi & BoBo, so that Miss Ü could be unique, existing for only two of them.

(v) Integrated Miss Ü: KiKi & BoBo from a small device in the user's hand to an entire room decoration. That is to say, when the customer presses or squeezes their KiKi or BoBo, not only will the other light up, but an entire room will light up as well.

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