

SOUNDMOTION

Designed for long-distance couples:
A streamlined way of companionship.



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CONTENT

00 Executive summary	4
01 Introduction	6
02 Related works	8
2.1 From awareness to intimacy	9
2.2 Tangible approaches	10
2.3 Current Music sharing service for intimate	11
2.4 Implications from author’s previous work	12
2.5 Summary	13
03 Emphasize and refine the scope	14
3.1 Music-sharing workshop	15
3.2 Semi-structured interview	19
04 Design guidelines	22
05 Design process	24
5.1 Ideation	26
5.2 Iteration	30
5.3 Final design concept	32
06 Final design	34
07 User test & Evaluation	50
7.1 Methodology	51
7.2 Findings	52
7.3 Limitations	53
7.4 Discussions	54
7.5 Future work	56
08 Conclusion	57
Acknowledgement & Reference	62
Appendix A - ERB and Consent form	54
Appendix B - User test materials	54

EXECUTIVE SUMMARY

This project started with the *M2.1 design proposal. During the graduation project, my ideas underwent a transformation influenced by research findings and the progression of insights. Consequently, the research focus and design objectives were redefined. In this section, I will provide a concise overview of the project's motivation, the reasons behind the shift in the project trajectory, and the subsequent process.

In my second year of master's study, I opted to explore the realm of physical product design and interaction in line with my design vision, with a specific emphasis on the subject of music sharing experience based on my personal interests. In the *M2.1 project, my attention was directed toward exploring the values and needs associated with music sharing experience and related social activities in the era of streaming media. This was accomplished through the design of physical interactive products integrated with streaming platforms. During this phase, I conceived and fabricated

an artifact named "Music Linker," which yielded invaluable design insights through user research. However, it also brought certain interaction intricacies to the fore. To advance the product into a market-ready, commercially viable state, I embarked upon the FMP project with the primary aim of iterating upon the interaction details of Music Linker.

In the initial stage of the FMP project, I organized a workshop to delve further into the music sharing experience within intimate relationships and explore the aspirations, values, and requirements of users. While analyzing the data derived from the workshop, I discerned notable disparities in the sharing experience contingent upon the recipient of the music, particularly between couples and other categories of intimate relationships, such as parents and friends. After the workshop, I invited couples who love to share music to conduct interviews in the hope of finding out more clues about how music works in intimate

relationships. The results of this phase of the interview analysis led me to discover that music sharing helps to maintain intimacy between couples from a number of angles, and that this feature is of particular value in long-distance couples. Within long-distance relationships, music sharing assumes a focal point, encompassing not only the sharing of music itself but also the ensuing conversations and interactions sparked by the shared musical experience. This is especially pronounced when synchronously listening to music, as the songs themselves function as a conduit for conveying the presence of one's significant other and fostering emotional connections. Consequently, the insights gleaned from the workshop served as a turning point, prompting a shift in design direction to concentrate on enhancing intimacy within romantic long-distance relationships. However, the previously identified values pertaining to music sharing and physical interaction were not disregarded; they were integrated as the primary technologies

underpinning the development of novel devices aimed at fortifying long-distance relationships.

Based on the conclusions drawn from the aforementioned user research and relevant studies, I have designed a music-sharing system called SoundMotion for long-distance couples. The core functionality of this system is to enhance the intimacy between couples through synchronized music playback, combined with physical interaction and an emoji feedback system. Evaluation of the product has shown that it provides a more lightweight communication experience for long-distance couples. By integrating implicit interaction cues with explicit information presentation, SoundMotion offers a channel for couples to simultaneously listen to music and express their emotions without imposing significant communication burden.

*M2.1 design project thesis: https://issuu.com/home/published/m21_dfpm210_pang_z.p_report_and_reflection

*M2.1 proposal: https://issuu.com/poohbearoooh/docs/m21_dfpm210_pang_z.p_fmp_proposal

INTRODUCTION

With the development of economic globalization, an increasing number of individuals are living in different cities due to reasons such as education and work, resulting in long-distance relationships (LDRs) becoming a common phenomenon [19]. In typical circumstances, couples can maintain and improve their intimate relationships through routine non-strategic activities, such as allocating tasks or having meals together. Unfortunately, for couples in long-distance relationships, physical separation poses a significant barrier to most fundamental relationship maintenance activities [3], presenting considerable challenges in maintaining emotional connections for LDR couples. Research by Gregory Guldner revealed that over 40% of long-distance relationships end in separation [25].

While the internet has provided increasingly convenient channels for instant communication, such as text messages, phone calls, video chats, and various social media platforms (computer-mediated communication tools) [21], these technologies focus on explicit information transmission and overlook the emotionally rich communication and subtle nuances typical of intimate relationships [12]. Over time, the limitations of these communication mediums, which heavily rely on digital platforms, accumulate and weaken the power of intimate connections [1]. Recognizing these gaps, researchers in the

field of human-computer interaction have started exploring how haptic sensations, wearable technologies, hybrid interactions, and ambient media can create a sense of connection and foster intimate experiences for LDR couples [3]. Overall, these technologies have demonstrated potential in facilitating emotional communication for long-distance couples. However, most designs and studies have focused on imitating communication modes within intimate relationships from a technological standpoint. In reality, the lives of long-distance couples are often accompanied by complex emotional changes and needs, which necessitate a user-centered approach in research and design processes. Exploring the use of music to facilitate implicit emotional communication between long-distance couples has emerged as a new design exploration space.

In the context of intimate relationships, music has been found to effectively foster emotional connections and enhance intimacy due to its unique power to evoke emotions, trigger memories, and create shared experiences [11]. Studies have shown that listening to music can help individuals regulate their emotions and evoke specific memories, often social memories related to friendships or romantic relationships [14]. Music shared between couples often conveys positive emotions such as happiness and love, evoking memories of specific events.

Moreover, the infectious nature of music's emotional impact provides a means for self-expression. Sharing music helps couples create meaningful moments, synchronize their emotions, and establish a shared musical identity. Additionally, from a biological perspective, listening to music with close others influences the secretion of neurochemical substances in the brain, including endorphins, which play a significant role in intimacy and communication within relationships [26]. Specifically, listening to music together with a partner has been shown to effectively alleviate stress for both individuals through the neuroendocrine mechanisms involved in marital interaction [23]. Currently, research and design related to music sharing experiences for long-distance relationships are quite limited. While the development of digital platforms and streaming services has made music sharing easier, they often lack the emotional communication and responsive interaction required for sustaining intimate relationships.

Considering that music can effectively trigger memories and establish positive emotions, it has the potential to regulate long-distance intimate relationships. This paper aims to design a music sharing experience for distant couples, addressing the limitations mentioned earlier and exploring new ways to maintain and enhance intimacy in remote relationships. Understanding and fulfilling users' needs

and emotional experiences are crucial in long-distance intimate relationships. Therefore, the design process of this project primarily follows the five-stage design framework provided by the Design Thinking method, emphasizing user-centered design through in-depth insights, observation, and listening to users' actual needs and challenges [4]. The specific design process follows this basic framework: initially understanding user needs and defining design directions through workshops and focused interviews, generating creative ideas and continuously iterating and evaluating designs based on these insights. Ultimately, a tangible artifact named SoundMotion was designed and tested in a simulated home environment laboratory. This design creates a new way of communication for distant couples, using music exchange and interactive physical actions to create an invisible emotional connection, combined with explicit feedback mechanisms using expressive emoji symbols, emphasizing the creation of abstract and immersive interactive experiences.

02 RELATED WORKS

In this session, I primarily reviewed four aspects of relevant technologies and design research cases in hopes of exploring and integrating them into my own work.

In the first part, I investigated technologies that can enhance the intimacy of long-distance couples. In the second part, through the analysis of tangible interaction design, I aimed to uncover how physical features of tangible products contribute to user experience. This exploration would then guide the design process to leverage these tangible interaction features and compensate for the emotional communication gaps present in current remote communication technologies. In the third part, by examining people's

experiences with sharing music in the digital age, I sought to learn from how long-distance couples currently utilize mainstream music streaming platforms for music sharing. The goal was to identify any unmet user needs and areas that require optimization within this process.

Finally, I reflected on my previous project experiences related to music exploration and extracted design implications that could contribute to this project. Ultimately, these conclusions will inform the design of a new tangible interactive device that facilitates emotional communication through shared music experiences.

2.1 FROM AWARENESS TO INTIMACY

In the field of human-computer interaction, a significant amount of research and design has focused on developing technologies to enhance intimate relationships, particularly in the context of long-distance relationships [29]. Hassenzahl et al. conducted an analysis of 143 articles that explored artifacts designed to foster relatedness in long-distance intimate relationships, and they identified six broad strategies to address the feeling of relatedness: awareness, expressivity, joint action, gift giving, memories, and physicalness. These strategies are often combined and applied in the design of various artifacts.

Among these strategies, awareness is the most widely employed, encompassing three sub-strategies: presence (conveying a sense of presence through everyday objects), activity (sharing information about daily activities to help both parties identify deviations from regular patterns), and mood (communicating the partner's emotions through interpreting body language or using external indicators such as music) [12].

Designs based on awareness emphasize users' awareness of their surroundings, as well as the presence and activities of others. "Ambient" design, closely tied to awareness, aims to create a rather peripheral and implicit experience, one that is suitable for everyday life and does not draw attention [22]. Compared to electronic communication technologies like phone calls and text

messages that convey explicit information, artifacts that continuously convey implicit information are more effective in fostering a sense of relatedness. The advantage of this indirect communication approach is that it can create a sense of presence and enhance the intimacy of the relationship without disrupting users' daily activities [6].

For example, Jina Kim et al. designed an artifact called BreathingFrame, where remote couples engage in physical inflation movements on the surface of a digital frame [16]. In this process, the abstract and subtle intention of breathing is designed as a form of remote communication in daily life. Elham Saadatian et al. proposed the concept of virtual cohabitation, conveying a sense of living together by sharing items from the home or daily life [19], which, to some extent, also applies the awareness design strategy. Dey and De Guzman introduced a concept called Presence Displays for remote interaction, aiming to convey the online presence of both individuals in an intimate relationship through physical, peripheral awareness displays. The artifacts they designed, such as PictureFrame and AugmentedMirror, which are associated with people's daily family activities, strongly demonstrate how awareness-based design helps enhance connectedness in intimate relationships[30].



Fig.1 BreathingFrame



Fig.2 AugmentedMirror

2.2 TANGIBLE APPROACHES

Currently, most products designed to sustain long-distance relationships and facilitate music sharing between couples are predominantly non-physical applications. People commonly use text messages, phone calls, and various social media platforms to communicate and check each other's status. Music sharing activities primarily occur through streaming music applications such as Spotify and Apple Music. Although these mainstream communication technologies offer a cheap and convenient way to engage in remote communication, they primarily focus on functionality and fail to provide value in terms of emotional connection [31].

Tangible interaction plays a pivotal role in enhancing the experiential aspects of affective products, encompassing sensory, emotional, and cognitive dimensions [5]. Physical interaction amplifies users' sense of engagement during product usage, which is a significant factor influencing consumer attitudes, behaviors, and decision-making processes. Particularly in hedonic consumption products that emphasize aesthetics and subjective experiential pleasure, a heightened sense of involvement often triggers greater emotional investment [32]. In the context of music sharing and emotional communication, which are inherently hedonic experiences, many aspects of the consumer experience cannot be effectively conveyed through dematerialized means [32]. Touching physical objects can enhance users' perception of services, especially when the objects possess high aesthetic appeal. Tangibility aids in establishing a stronger psychological connection between users and the corresponding service [32]. Therefore, for experiences involving knowledge sharing and emotional communication, physical media is more effective than electronic media in deepening

the emotional connection between users and the content being shared. For example, Yi-Tung Shen designed a tangible product named KiKi & BoBo, which encourages users to convey emotions through squeezing and illuminating the physical artifact. This tangible digital interaction enhances the intangible emotional connection between geographically separated couples [33].

Furthermore, research indicates a positive correlation between people's preference for tangibility and their level of musical engagement [32]. Numerous studies have demonstrated that the materiality of music provides users with a more immersive audiovisual experience. Skågeby used cassette tapes as an example to illustrate how physical attributes such as appearance and size contribute to their genuine aesthetic value [20]. Magaudda compared iPods, external hard drives, and vinyl discs to explain how the materiality of music assists consumers in cultivating meaningful auditory habits [18]. In addition, research is also exploring ways to integrate the physical properties of tangible music media with streaming music to create enhanced music experiences. Choi and Ha Yeon investigated the application of weighty tangible interaction elements in the electronic music realm through their design of a model called MuScale [32].

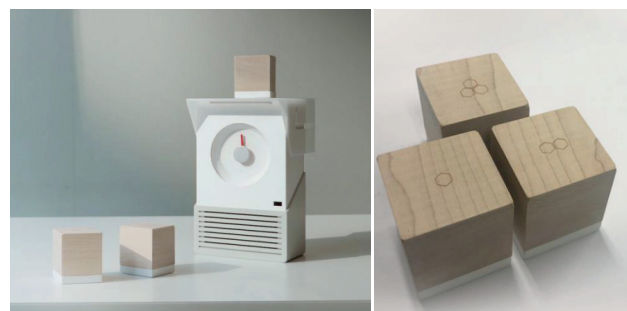


Fig.3 MuScale

2.3 CURRENT MUSIC SHARING SERVICE FOR INTIMATE RELATIONSHIPS

Although numerous studies have provided evidence of the beneficial effects of music sharing in maintaining and enhancing intimacy, and it has become a common practice for communication among long-distance couples [11], there is a limited availability of specialized designs and

research dedicated to music sharing specifically tailored for such couples. Based on our online research, we have identified three primary approaches commonly employed by long-distance couples for engaging in music sharing activities.

2.3.1 COMMUNICATION TOOLS-BASED APPROACH

Utilizing remote communication tools for music sharing has become a prevalent method among couples. The latest iOS 15 release introduced the SharePlay feature, enabling synchronized video calls and chats with music. This means that couples can listen to music and watch movies together during FaceTime video calls, enhancing interaction and shared experiences. Additionally, Apple supports the ability to invite friends to synchronously share music from supported music apps during FaceTime calls [34]. The introduction of this feature provides a more immersive

way for couples to interact in long-distance situations, strengthening their sense of intimacy.

Furthermore, couples often utilize various video conferencing platforms such as Zoom, Skype, and others to engage in music sharing activities by watching movies or listening to songs together. These platforms offer real-time audio transmission and video sharing capabilities, allowing couples to simultaneously enjoy music and collectively experience the emotions and memories it evokes [2].

2.3.2 MUSIC SHARING FEATURES ON STREAMING MUSIC PLATFORMS

Currently, numerous streaming music platforms, including Spotify, Apple Music, and Last.fm, have begun integrating social features. Although most attempts to socialize streaming music have faced challenges, it is undeniably an area with great potential, warranting further exploration to identify the right direction for development [13]. For individuals in long-distance intimate relationships, particularly couples, the social attributes of current streaming music platforms, albeit limited, already provide a gateway for their music

sharing and communication.

Sharing Music on Social Media Platforms

Presently, the preferred method for most users to share music is by sharing songs from streaming platforms on their own social media platforms.

Co-Playlist

Couples can create and share playlists together on platforms like Spotify, Apple Music, or YouTube Music. They can collaboratively curate playlists, adding songs that hold personal significance

or reflect their shared experiences. This approach allows real-time music sharing and offers a convenient way to discover and enjoy music, regardless of the distance.

Synchronized Listening:

In China, streaming applications such as NetEase Cloud Music and QQ Music already allow two users to listen to music

synchronously. These tools enable synchronized music playback across devices, ensuring both parties listen to the same song simultaneously. This creates a shared listening experience and can be enhanced through simultaneous chat or interactive feedback using emojis.

2.4 IMPLICATIONS FROM PREVIOUS WORK

In addition to the secondary data obtained through literature and online research, design implications from two other projects I conducted in the past two years can contribute to this current project. Driven by my personal interest in music and a design vision for tangible interaction, I began exploring how tangible interaction can enhance music-related experiences during my first-year graduate course on Constructive Design Research. During

this period, our elective course group designed an artifact called Vinylify, which was placed in participants' homes for a one-week diary study. This research demonstrated that rich interactive elements in physical interaction enhance participants' user experience and relationships, and products with personalized functions and interactive features encourage more active engagement with the product.



Fig.4 Vinylify

Vinylify primarily investigated how tangible interaction can enhance personal music appreciation experiences. Inspired by this, my M2.1 project also explores tangible music interaction, but with a focus on how tangible interaction can facilitate music sharing between individuals. The design aims of this phase were to improve users' music sharing experience by creating physical forms of music sharing interactions. As a result, I designed the Music Linker artifact as the initial iteration of the design. As a physical design to help people share and receive music information, Music Linker's interactive form and shape incorporate a number of thematically relevant retro physical product features in an attempt to provide a richer and more interesting user experience and to inspire people to share music more often. Through user test and semi-structured interviews (n=8), Music Linker received much feedback and helped to derive design insights in three directions: 1) It helped to reveal the importance of how information is

presented in the process of sharing music information; 2) Music Linker showed us the potential of combining physical interaction features with the benefits of streaming in the age of dematerialization; 3) Music Linker captures user-initiated needs and expectations for feedback mechanisms through the white space left at the feedback function. The contents of this section have been partly derived from the previous work of M2.1 project thesis, October, 2023.

(*M2.1 design project thesis: https://issuu.com/home/published/m21_dfpm210_pang_z.p_report_and_reflection)



Fig.5 Music Linker

2.5 SUMMARY

This section explores various aspects of technology and design research relevant to the project, aiming to provide valuable insights and inspiration. It encompasses the following key areas: enhancing intimacy in long-distance relationships, tangible interaction design, music sharing in relationships, and design implications from previous projects.

By reviewing related literature and research, I gained valuable insights into the role of awareness in fostering a sense of relatedness. Creating awareness through presence, activity, and mood has shown to

be effective in enhancing connectedness between individuals. Additionally, the exploration of tangible interaction design highlighted the significance of physicality and tactile experiences in deepening emotional connections. This understanding laid the foundation for my own design process, where I aim to combine explicit and implicit interactions to create an interactive device that enhances emotional communication, which would also consider combining the physical features as a catalyst.

03

EMPHASIZE AND REFINE THE SCOPE

As mentioned in the Preface section, the FMP project initially aimed to deepen the interaction process and design details of the Music Linker artifact developed in the M2.1 project. However, after conducting the first user research and analyzing the data during this semester, the conclusions influenced a narrowing down of the target users and a shift in research focus towards enhancing long-distance couples' intimacy through music and physical interactions. In this chapter, I will provide a detailed account of the first user research conducted

to fulfill the purpose of deepening the M2.1 project. I will explain how the findings from this study inspired adjustments in the design research direction and describe the subsequent second user research based on the new design approach.

Both user studies obtained photo data and audio recordings, and participants were informed and gave their consent prior to the tests, adhering to the ethical guidelines of the Industrial Design Department's Ethical Review Board (ERB) (seen in appendix A).

3.1 MUSIC SHARING WORKSHOP

The research on Music Linker confirmed the positive impact of physical interactions on people's enthusiasm for music sharing and highlighted the importance of effective feedback mechanisms in establishing a positive music-sharing cycle. To further investigate the specific feedback mechanisms required during music sharing and gain deeper insights into real-life experiences of sharing music within intimate social groups, a role-playing game-based workshop was planned and conducted.

Methodology

Role-playing game is a technique where participants assume specific roles to engage in experiential activities, providing practice opportunities and feedback [15]. This workshop employed role-playing to involve participants actively in the research process, enabling an interactive and immersive exploration of the influence of music sharing and feedback mechanisms on user engagement. By creating a simulated environment for music sharing within intimate social circles, the workshop with role-playing provided a unique opportunity to understand how individuals engage with music within their social networks. This approach, integrating elements of gaming and social interaction, enhanced our understanding of the complex dynamics involved in music sharing and feedback

mechanisms. Specific activities, such as card games and emoticon feedback, were incorporated into the workshop to investigate feedback mechanisms (to be discussed in the later section on the discussion). The following section describes the participants and the experimental procedure.

Participants

A total of 8 young volunteers aged between 20 and 30 participated in the workshop. Recruitment was conducted through social media platforms such as WhatsApp and WeChat. Participants were selected from four different countries to minimize potential nationality-related biases and capture diverse perspectives on music sharing and intimacy. To ensure participant privacy, the ID was conducted using the names of the roles chosen by the participants during the game.

ID	Age	Nationality	Gender
Sam	24	Japanese	Male
Nico	24	Chinese	Female
Bence	24	Chinese	Female
Lily	25	Chinese	Female
Nancy	26	Dutch	Female
Dillon	27	Chinese	Male
Cathy	23	Dutch	Male
Nancy	24	Dutch	Male

Table 1: Participant demographics

Procedure

The workshop lasted for 1 hour and consisted of two main parts:

1) Card Game:

- Each participant drew a character card and briefly introduced themselves, interacting with others related to their character on a family tree to familiarize themselves with their identity.
- During the game, each person took turns performing a simple task based on the number on their character card. For example, the person with number 1 drew a song card, and the host played that song on a Bluetooth stereo. The person then decided whom to share the song card with and explained their choice.

- The recipient of the song card had the option to take an emoji and stick it on the card, expressing how they felt about receiving it.
- After each person completed their task of sharing a music card, there was a small discussion session allowing participants to exchange their observations and thoughts.

2) Brainstorm:

- Based on the reflections from the game and the discussions, each participant had five minutes to generate a design idea for music sharing and took turns presenting their ideas.



Fig.6 Music cards, emoji cards, and character map design



Fig.6 workshop outcome

Analysis, findings, and discussion

The workshop employed engaging game design to encourage active participation from all participants and generated a substantial amount of valuable data. To facilitate better analysis of the collected audio recordings, I first transcribed them. Thematic Analysis was used to code the transcribed texts, music card sharing streams, corresponding emoji feedback, and observations of user behavior during the experiment [27]. Three major thematic codes emerged during the analysis: Feedback and Engagement, Social Relationship and Music-Sharing, and Tangibility and Engagement. To ensure participant privacy, the analysis was conducted using the names of the roles chosen by the participants during the game.

Feedback and Engagement: The provision of emoji cards for feedback significantly influences music-sharing behavior.

In this workshop, emoji cards were provided to participants as a means of expressing emotions during the music-sharing process. The choice of emojis as a feedback mechanism stems from the user testing phase of my M2.1 project, where users emphasized the importance of conveying emotions during music sharing. Emojis, as a widely recognized visual communication form in the digital era, allow people to easily and intuitively express their emotional states. Research has shown that the use of emojis can greatly enhance user engagement on social media platforms [35]. During the workshop, each participant actively selected different emoji cards

to provide feedback and explained their choices. Most users mentioned that the use of emojis made the interaction during sharing more engaging. On one hand, they needed to listen to the music carefully to select the appropriate emoji feedback for the other person. On the other hand, compared to traditional rating systems, the more expressive nature of emoji feedback made the sharing process more enjoyable. People were curious about the emoji expressions received from others, which sparked new opportunities for communication. Nancy said, "It is also that when you need to give an emotion to it, you will listen to it more. Do I really like this it?" Sam mentioned, "We used to just rate the music with stars, but now it's like a lot of different spectrums." Furthermore, there were suggestions from multiple users for a broader selection of emojis. Dillon suggested, "I think it's also a factor that there was a limited amount of emojis to choose from, but I feel like there were very strong feelings."

Social Relationship and Music-Sharing: Music-sharing behavior is closely intertwined with social relationships.

Several manifestations of the participants in the game pointed to the connection between music-sharing and social relationships, which can be analyzed from two main aspects:

1) Music-sharing as a means to establish and enhance social connections.

The contribution of music-sharing to strengthening social intimacy was primarily evident in romantic relationships during the game. All participants were given the opportunity to share two music cards, and they all chose to share the first card with their romantic partners, even if their musical tastes differed significantly. They inclined towards sharing and communicating with their partners. Feedback records also indicated their tendency to provide positive feedback to their partners. Sam said, "I should, of course, share with my girlfriend."

Sam was initially concerned about sharing a purely instrumental track that most people might find uninteresting. However, his partner Lily provided rather positive feedback with the "👉".

Music-sharing and feedback between parents or friends differed significantly from the behavior observed in romantic relationships. Most participants did not consider parents as suitable recipients for music-sharing due to substantial differences in musical preferences. As for music-sharing between friends, participants provided relatively honest feedback based on their personal preferences and considered the genre of the song before deciding whether to share it.

2) Music-sharing can facilitate the expression of emotions and convey care.

Participants often selected music to share based on the specific emotional states they wished to communicate to the recipients. For instance, Cathy stated, "I am going to give it to my best friend Sam because it is a mutually energizing song, which I think Bence needs due to his demanding work schedule." Numerous studies have extensively examined the relationship between music and emotions, highlighting its ability to evoke particular memories and induce emotional changes by influencing dopamine levels in the brain [36]. The findings from this workshop further support the notion that music-sharing can serve as a conduit for transferring emotions and fostering emotional connections with others.

Refining the target user

In summary, this workshop introduced an innovative interactive format for sharing music and explored the interplay between music-sharing and social connections through role-playing. Throughout the process, the significance of music-sharing within romantic relationships and its associated characteristics became apparent. The experiment yielded notable

observations regarding participants' prioritization of sharing music with parents, friends, and romantic partners, as well as the divergence in behavioral expressions and feedback associated with music-sharing. Many individuals perceive sharing music with their romantic partners as an inherent obligation, as it signifies a desire for communication, interaction, love, and care that extends beyond the act of sharing

music itself [11]. This discovery has unveiled a potential avenue for future research, investigating how music-sharing influences intimacy among couples and exploring strategies to leverage music-sharing to enhance emotional connections between romantic partners.

3.2 SEMI-STRUCTURED INTERVIEW

To investigate the influence of music sharing behaviors on intimacy among couples, I employed the semi-structured interview method, commonly used in qualitative research within the social sciences [28]. This approach allowed participants to express their perspectives and share experiences related to music sharing in their daily lives, extending beyond the act itself.

Methodology

Five individuals, aged 20-30, participated in interviews lasting approximately 20-30 minutes each. The interview questions can be found in Appendix B. The interviews focused on two main aspects: 1) motivations and factors influencing music sharing between couples, and 2) the nature and requirements of music sharing in both long-distance and non-long-distance relationships.

Analysis, findings, and discussions

Thematic Analysis was applied to transcribe the interview recordings and extract meaningful information. Three major themes emerged from the analysis.

Daily music sharing behaviours

A notable finding was that all participants mentioned engaging in music sharing activities during periods of long-distance

relationships or temporary spatial separation. For instance, P1, who experienced a year-long long-distance relationship, described music sharing as their most common form of daily communication. They enjoyed exchanging recently listened tracks during video calls or while sharing updates, as well as listening to music together over the phone. Similarly, P2 has been in a long-distance relationship with their partner for a year and still maintains that status. They appreciate using the music-sharing feature on Netease Cloud Music because "even with the time difference in typing messages, when it comes to music, no matter how far apart you are, you're listening to the same melody at that moment." Similar remarks were made by P3, who revealed that they and their partner had been synchronously listening to music using Netease Cloud Music for a continuous period of 100 days before the interview date in 2023. They described the experience as follows: "When we are not in the same place, we listen to music together. For example, you're working, and suddenly you realize, oh, the other person has stopped their own song, and you can still feel a sense of interaction. But at this time, both individuals have their own tasks, so it's more of occasionally disturbing each other, that kind of feeling. It's the feeling that they are there, which gives a sense of companionship."

Emotional Expression and Feedback

Some participants mentioned that music served as a medium for expressing emotions during their long-distance relationships. "I know what kind of emotions he's experiencing at this stage, and I feel that this song would bring him comfort or cheer him up, so I share it. I use music as a healing tool for sharing." — P4. Additionally, music was seen as a means to enhance the atmosphere and emotions. "When the two of us are chatting and listening to music together, it can better express the current atmosphere and emotions between us." — P5.

However, several participants highlighted a significant drawback of long-distance communication compared to face-to-face interaction: the lack of emotional expression and feedback. In terms of music sharing, this limitation could lead to a lack of positive interactive responses. P1 said, "If it were face-to-face, you could sense the changes in their emotions through their feedback. But in a long-distance relationship, you're limited to the words you see on WeChat, so you miss out on many communication details." Furthermore, participants expressed a preference for simplified interactions during shared music experiences. P4 mentioned, "I think simple emoji interactions are enough, so you don't need lengthy explanations. I can feel that he understands this feedback from his few words and expressions."

In addition, simple physical interactions seemed to offer a new way for daily communication. P1 mentioned purchasing an interactive device called the "Love Box" during their long-distance relationship. They placed the devices in their respective workplaces, allowing them to exchange simple expressions or messages. When a message was received, a heart on the outside of the box would rotate as a reminder. She said, "I think it's quite nice as it adds a little bit of fun to our daily lives."

Refining the Context

Through interviews with users who enjoy sharing music with their partners, I discovered further connections between music sharing and intimacy in romantic relationships. Listening to music together strengthens emotions and the atmosphere when couples are in the same physical space, enhancing their enjoyment of each other's company. However, the value of shared music appears to be even more pronounced for couples in long-distance relationships. Therefore, I narrowed the focus of my study to couples who are physically separated.

04

DESIGN DECISION

Based on the initial user research and analysis of technologies and products aimed at enhancing intimacy between long-distance couples, it is evident that music sharing has an impact on their relationship. Consequently, the design theme focuses on the music sharing experience for long-distance couples, and three specific design directions have been refined.

4.1 CREATING A SENSE OF PRESENCE

The findings from the user research highlight that synchronous music listening has the potential to offer users a sense of presence from their partners, albeit to a certain extent. This signifies that even when couples are physically separated, the act of sharing music enables them to perceive each other's companionship and existence. The significance of this shared music interaction is further emphasized by the participants who regarded it as a crucial mechanism for fostering emotional connection between partners. Moreover, drawing upon the insights gained from the previous literature review on presence as a technology for providing the remote couples with the sense of conscious, it is evident that incorporating physical interaction gestures can amplify the strength of emotional bonds. The user interviews revealed that physical interaction indeed enhances the communication experience between couples. Expanding upon these discoveries, there is an opportunity to explore a novel design direction that integrates music sharing with tangible interaction gestures, thus establishing a profound sense of presence for couples within their everyday lives.

4.2 EMOTIONAL COMMUNICATION AND FEEDBACK MECHANISM

The importance of feedback and communication mechanisms in the context of music sharing has been emphasized in the M2.1 design project. During the initial workshops, the use of emoji cards as a feedback mechanism was explored, and participants showed a positive inclination towards this approach, expressing a desire for a wider range of emoji options. Subsequent interviews conducted in the second phase of user research highlighted the specific needs of couples, especially those in long-distance relationships, in terms of emotional communication and expression during music sharing activities. Due to the spatial limitations, the inability to perceive each other's emotional changes during synchronous music listening was evident. Hence, there is a clear need to provide intuitive mechanisms for expressing emotions, facilitating communication, and enabling long-distance couples to share their moods while synchronously enjoying music. However, it is essential to ensure that these feedback mechanisms are simplified to avoid disrupting the overall music experience.

4.3 STREAMLINED INTERACTIVE COMMUNICATION

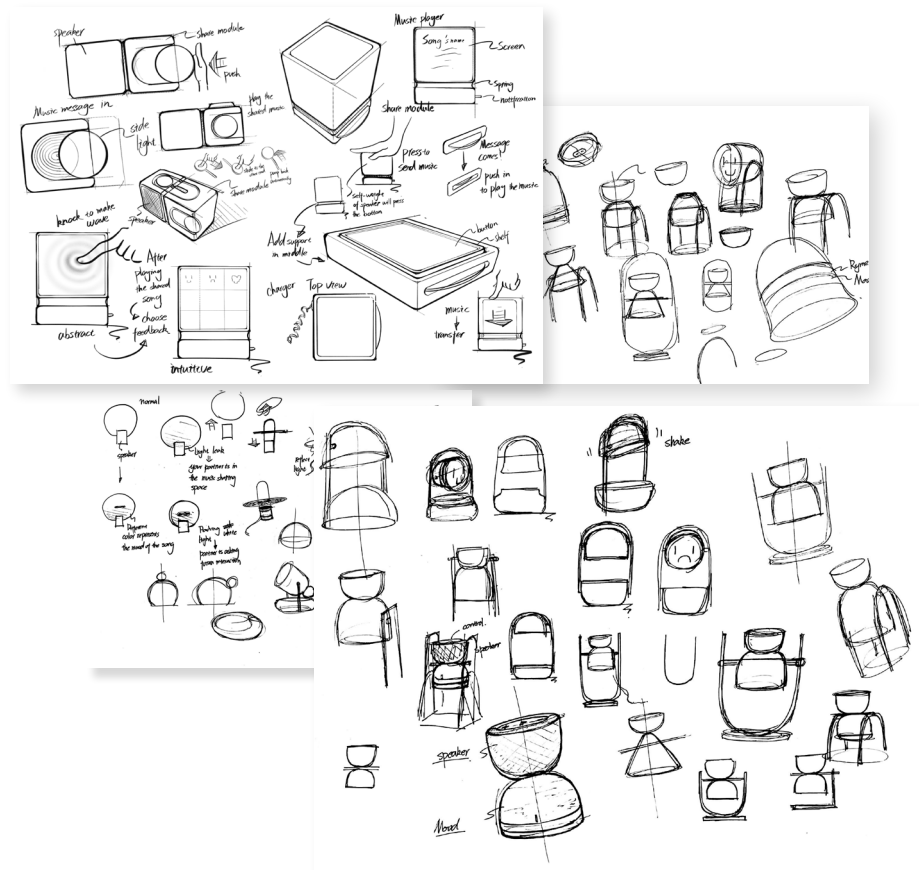
Currently, long-distance couples primarily rely on text messaging and video calls for communication. However, these modes of communication are predominantly designed to serve functional purposes, lacking in-depth emotional communication and immersive interaction. Additionally, the constant need to confirm each other's schedules for interaction creates an additional burden on the couples' communication process [6]. Therefore, there is a demand for innovative interactive devices that offer simple and intuitive interactions, with limited information transfer. Such design solutions aim to alleviate the social burden experienced by couples in their daily use, while also addressing concerns about interrupting each other's schedules.

05

DESIGN PROCESS

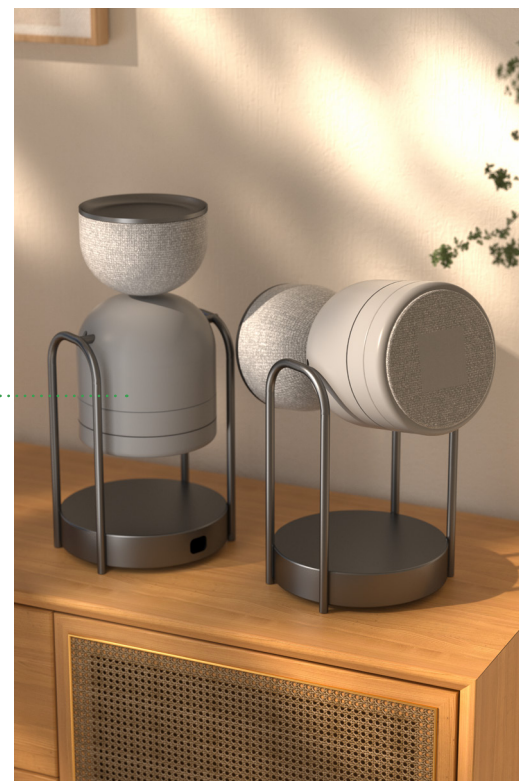
5.1 Ideation

Rapidly generate a large number of concept solutions to explore different user journeys and physical interactions



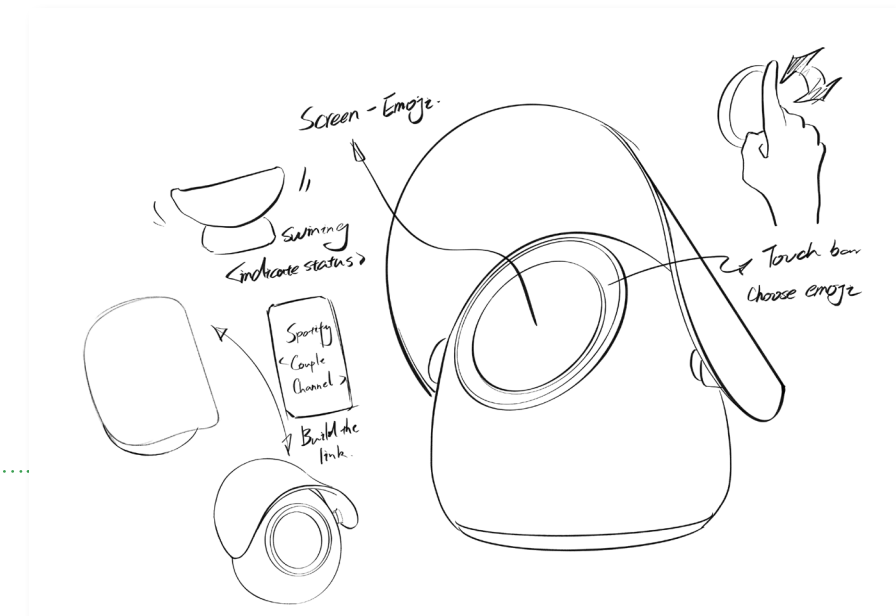
5.2 Iteration

Refinement of the shape and physical interaction of the selected design



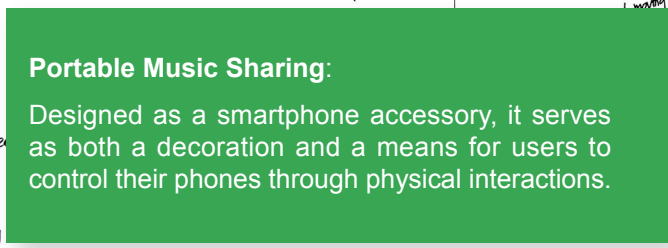
5.3 Final design concept

Following a preliminary evaluation of the design proposals, the final design solution was formulated, encompassing enhancements in the physical interaction form as well as the overall aesthetics.



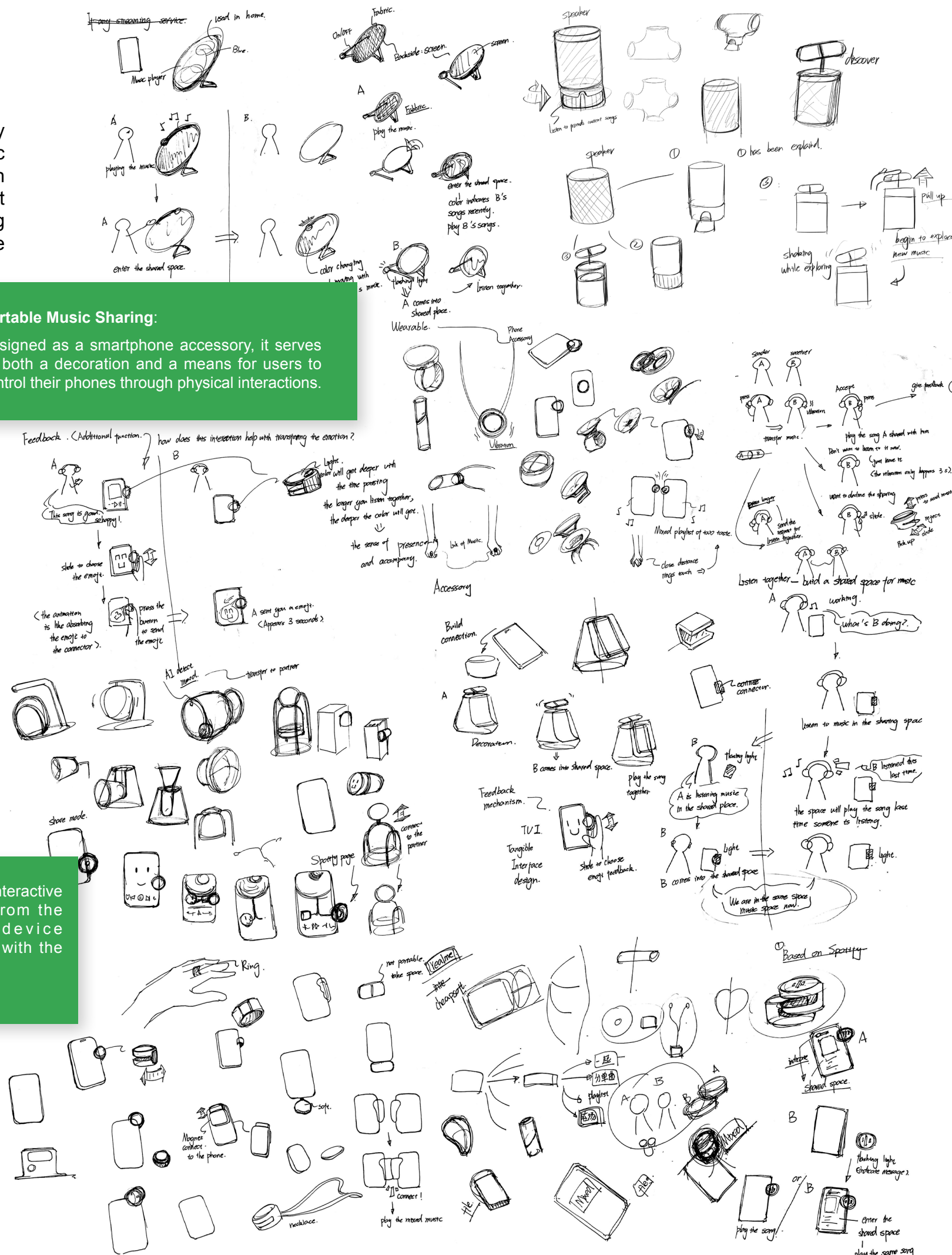
Once the design direction was established, I embarked on a brainstorming process to generate initial design concepts. I began by gathering a collection of images to create an inspiration board, with a focus on themes related to fostering connection, music, physical interaction, and emotional attachment. This collection served as a

source of inspiration. Next, I extensively sketched various ideas to explore specific design solutions. At this stage, each concept encompassed unique product forms and interaction styles, while aligning with the design guidelines outlined in the previous chapters.



Portable Music Sharing:

Designed as a smartphone accessory, it serves as both a decoration and a means for users to control their phones through physical interactions.



Extracting interactive elements from the physical device associated with the music

Fig.7 brainstorm sketch overview

Through discussions with my coach and fellow designers, the design concept was tentatively determined to involve the integration of physical devices with a streaming service, aimed at creating a bespoke music sharing channel for couples. The physical interaction would afford users a sense of their partner's presence, while also serving as a means of message notification and a switch for the Couple Channel. The establishment of the Couple Channel and access to music sources would be realized within the framework of Spotify.

Regarding the specific physical product design, swinging was chosen as the primary means of physical interaction. This motion, derived from the movement of a swinging bell, would signify the arrival of new messages. Furthermore, the swinging

action would serve as an indicator of the partner's online status, akin to a vibrant pet playfully rolling on its owner's desk, striving to capture their attention. To address the challenge of potential disruption in communication due to divergent schedules, a switch was incorporated to allow users to actively express their status and exercise control over their willingness to engage in interaction. Additionally, emojis were chosen as a means of conveying emotional expression during the music sharing process due to their simplicity and intuitive nature. The initial product design envisioned suspending the main device body on a stand, with the screen for sending emoji messages situated at the base. Upon observing the swinging motion, users could flip the product to initiate the Couple Channel and partake in emoji-based interaction with their partner.

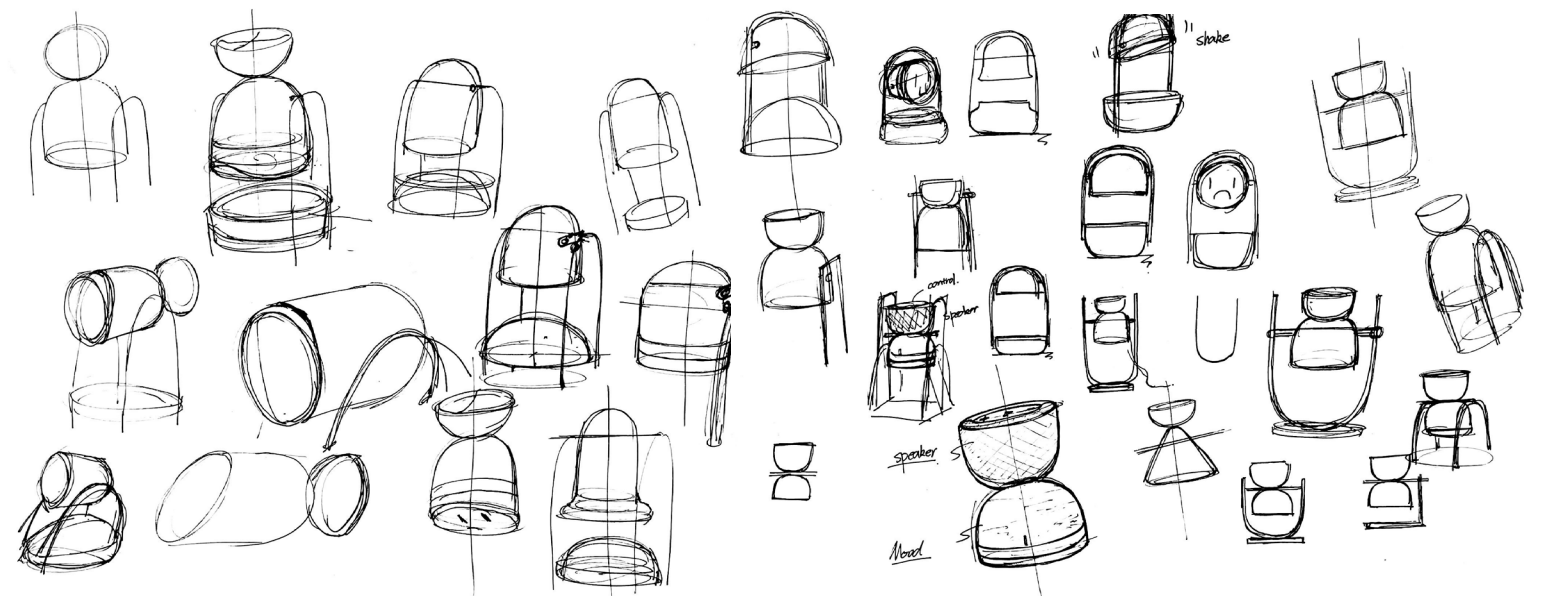
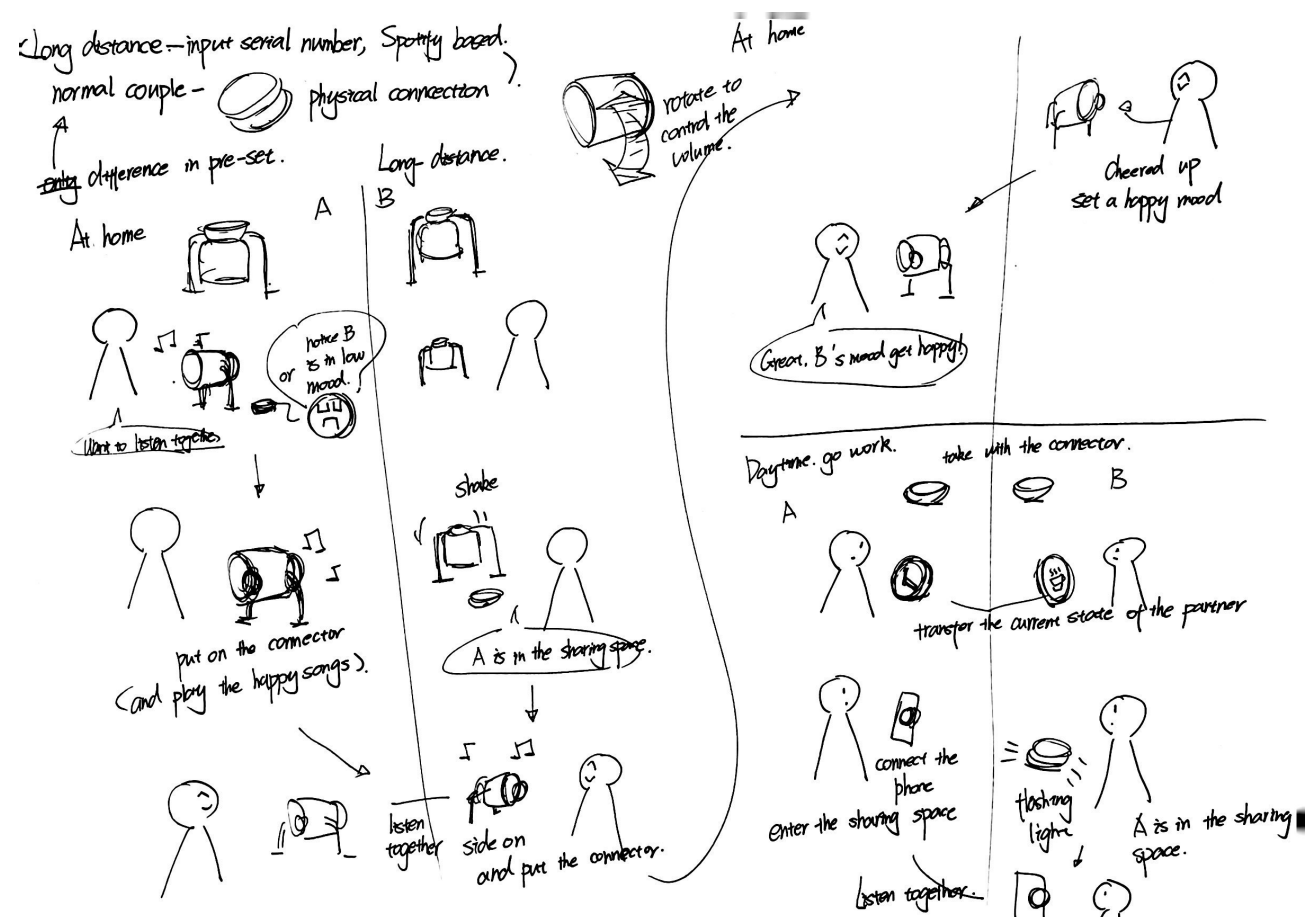
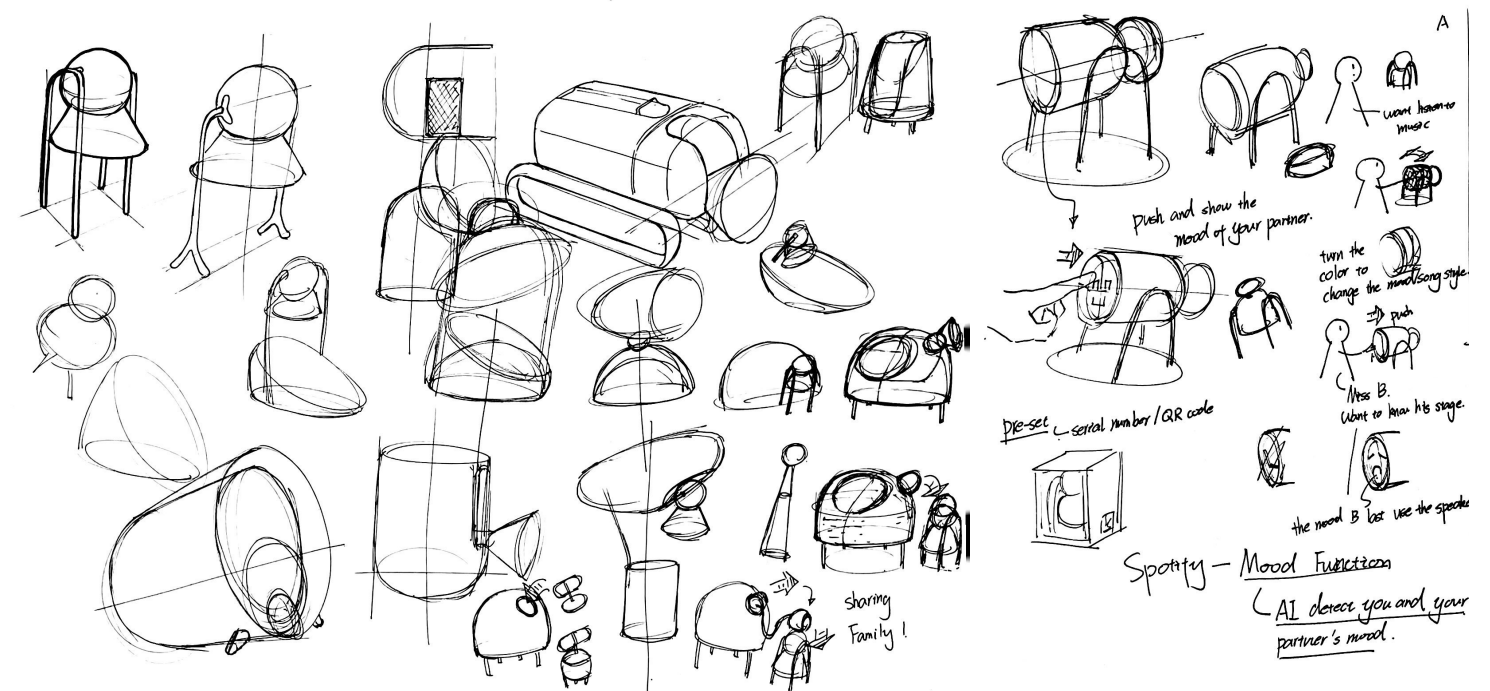
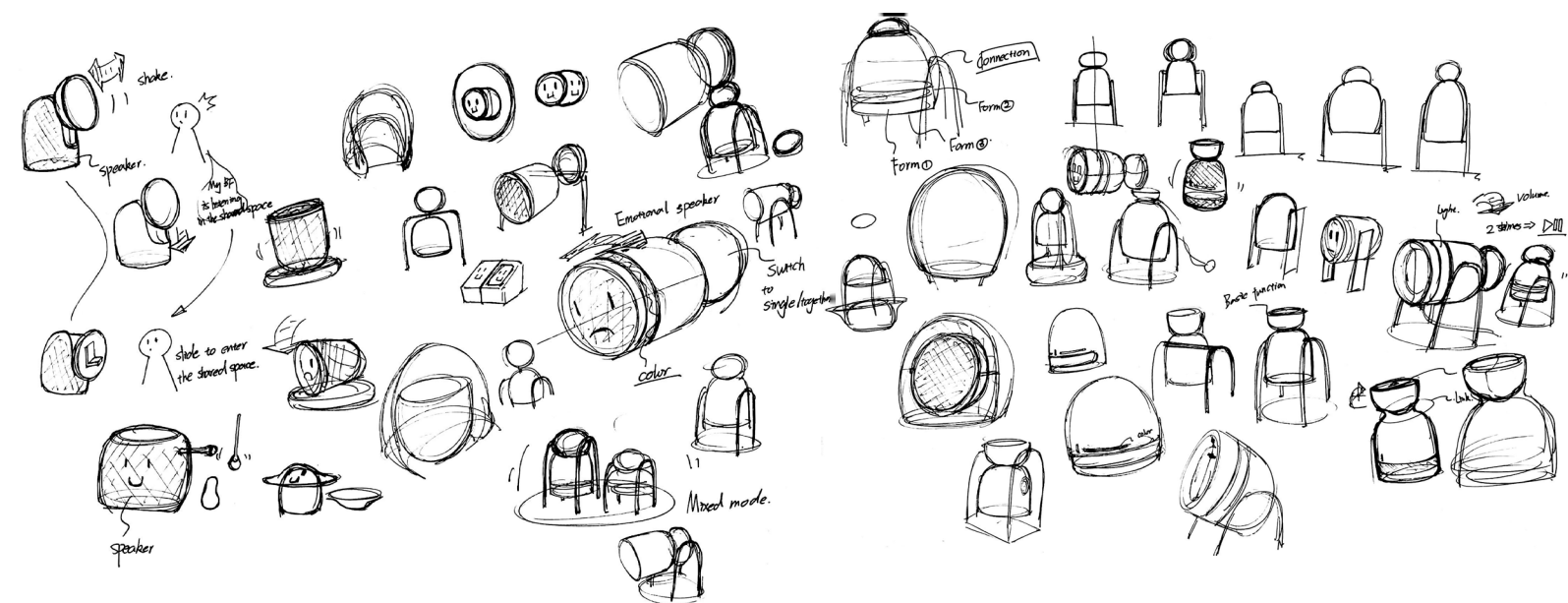


Fig.8 iteration sketch overview

5.2 ITERATION

To delve deeper into the design details, I utilized UG NX to quickly create several 3D models. These models were then 3D printed to provide tangible prototypes for visualizing the overall appearance, dimensions, and human-machine interaction. During this process, the 2D graphics software Illustrator was also employed to sketch the product's aesthetic design by creating orthographic views. This combination of 3D modeling and 2D visualization allowed for a more comprehensive exploration of the product's form and aesthetics.

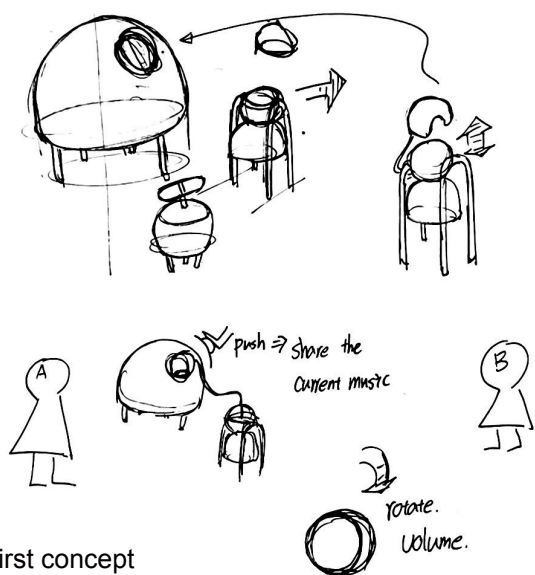


Fig.8 first concept

INITIAL CONCEPT

The initial product design aimed to suspend the device's main body on a stand, with a screen positioned at the bottom for users to send emoji messages. When users observed the model shaking, they could flip the product, thereby activating the "Couple Channel" and enabling emoji interaction with their partners.

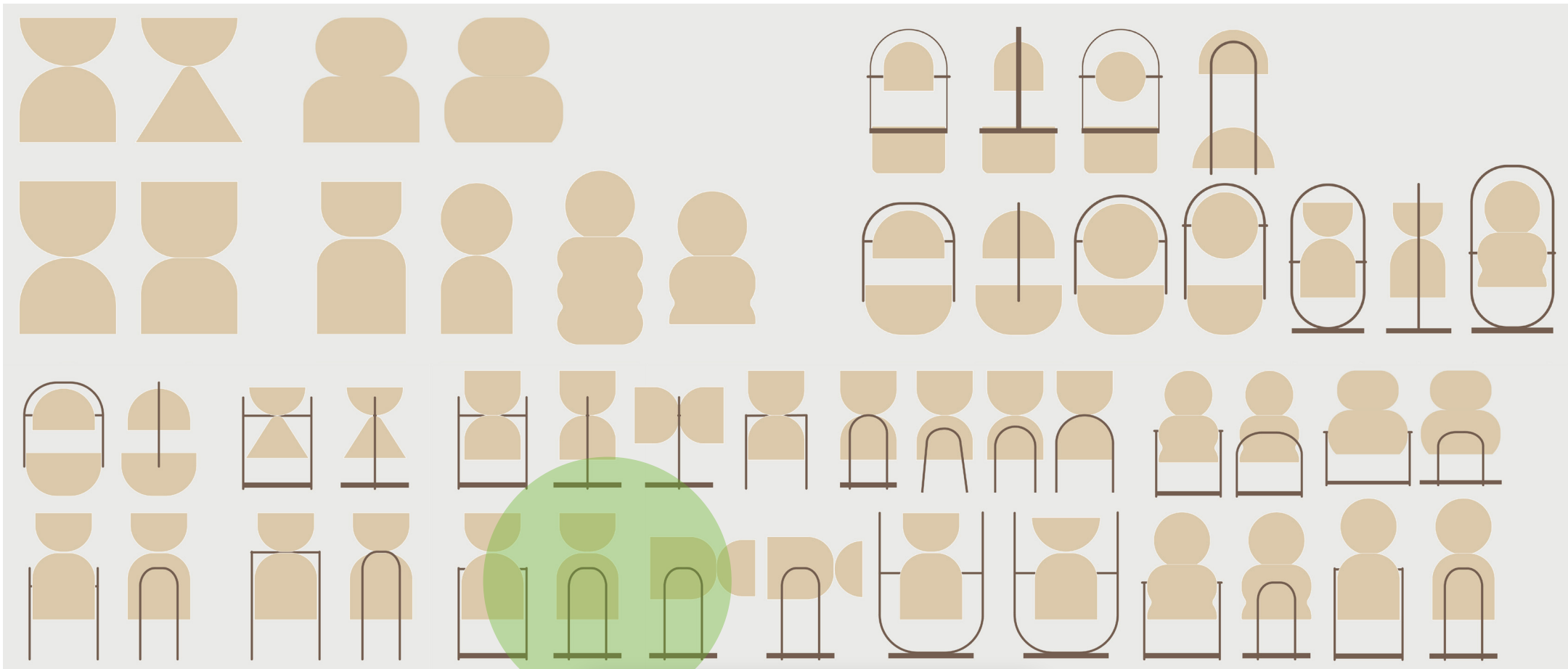


Fig.9,10,11,12 sketch&3d iteration

5.3 FINAL DESIGN CONCEPT

Following discussions with the coach, it became apparent that placing the screen at the bottom of the main body design might conflict with users' expectations, thereby increasing their cognitive load. Consequently, the final design solution opted to position the screen in a more intuitively visible location. Furthermore, drawing inspiration from cuteness and personification, the design aimed to strengthen the sense of companionship between partners through the tangible product and anthropomorphism[17].

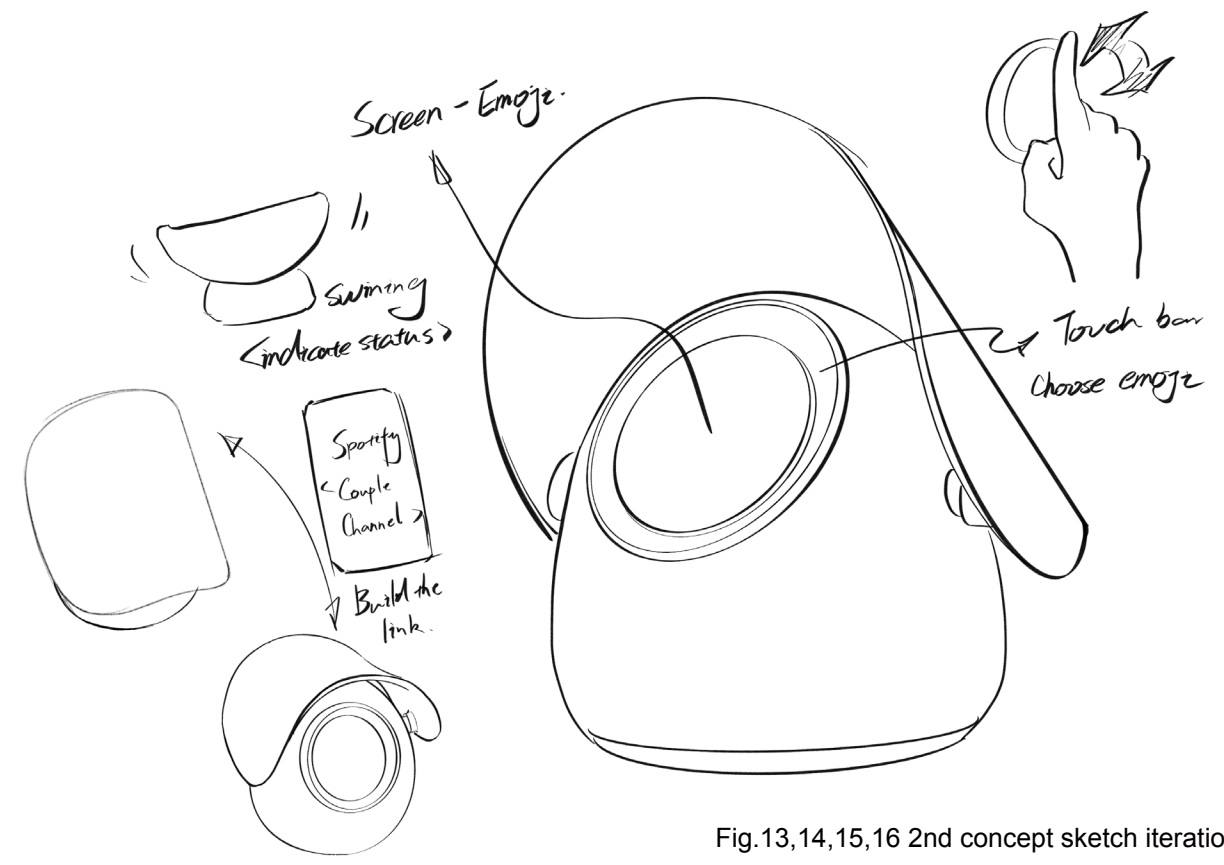
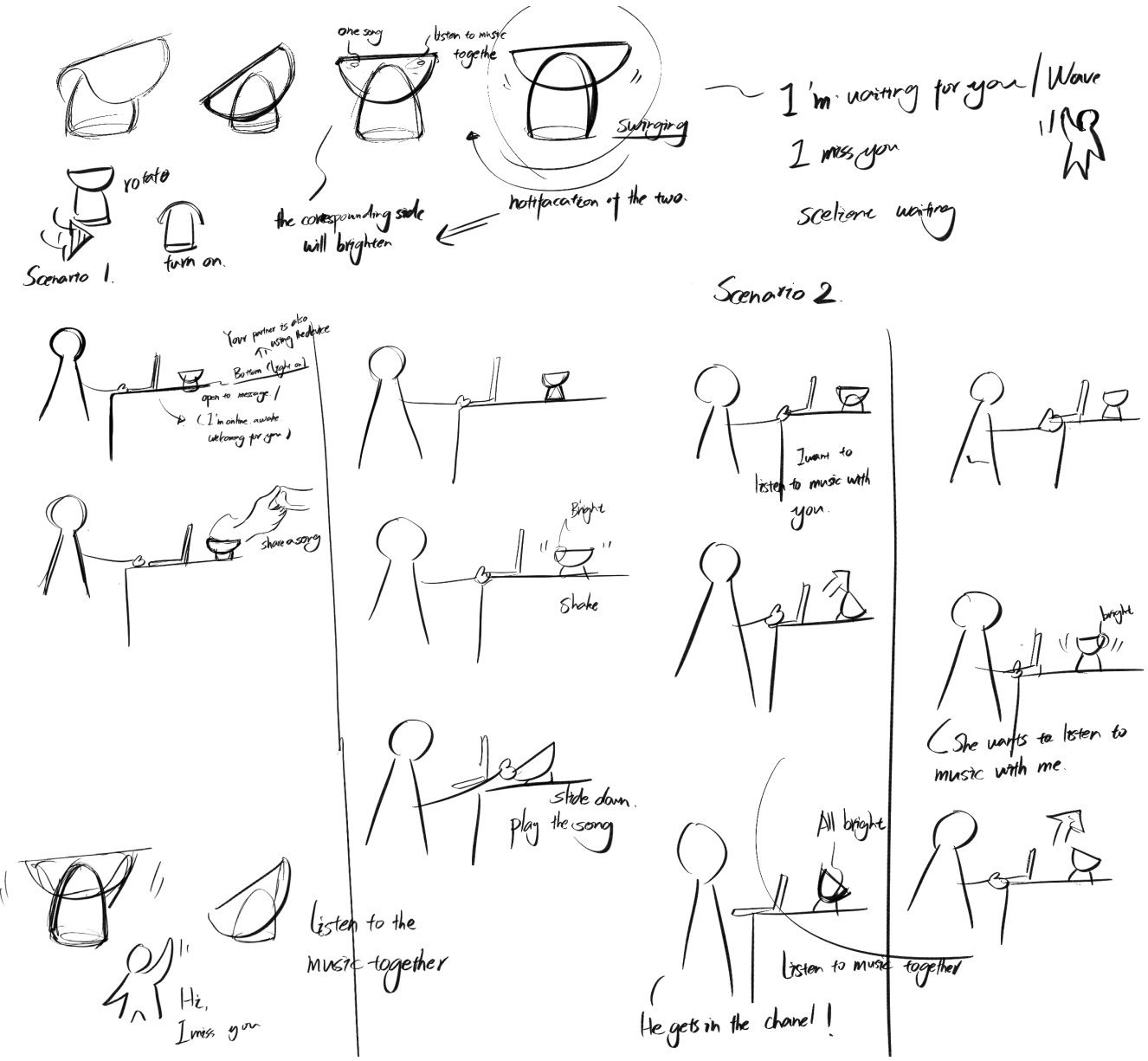
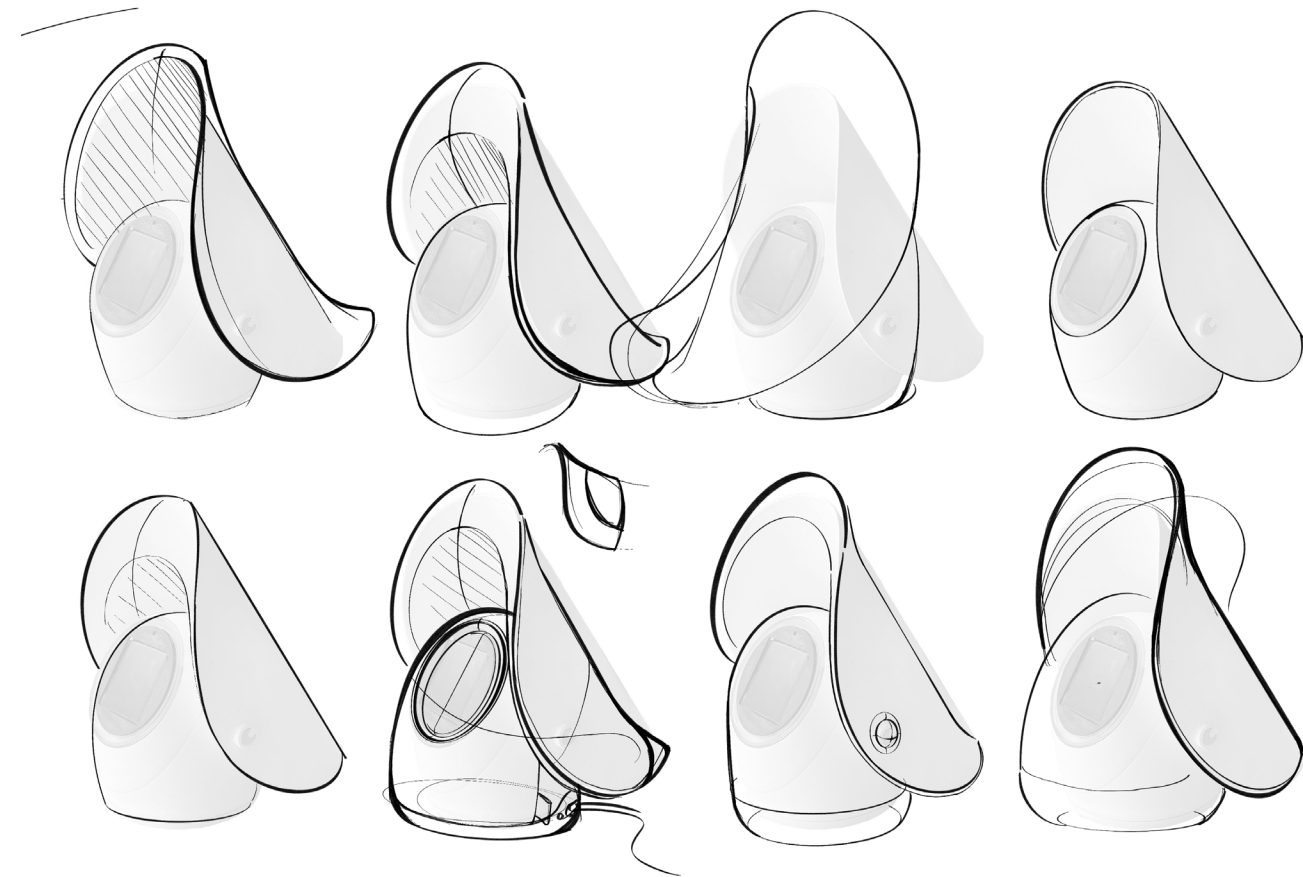
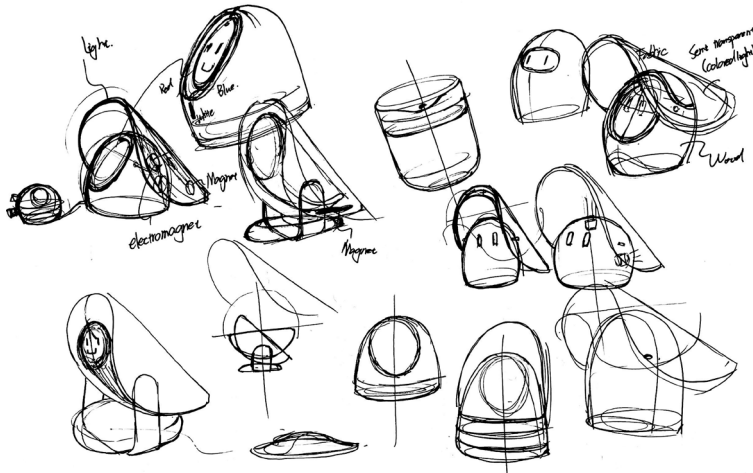


Fig.13,14,15,16 2nd concept sketch iteration

06

FINAL DESIGN



Fig.17 final design presentation

6.1 SOUNDMOTION SYSTEM

SoundMotion was specifically developed as a communication system aimed at facilitating seamless interaction between long-distance couples by combining synchronized music listening and physical engagement. Each couple is equipped with a dedicated device known as SoundMotion, which enables music playback and basic physical interactions. This device

is seamlessly integrated with the user's individual Spotify account, allowing them to access personalized music feeds and communication data provided by the Spotify server.

INTERACTION LOGIC

SoundMotion utilizes the ESP8266 as its hardware platform to control the product's hardware and establish a connection with the Spotify server. This enables the transfer of emoji feedback data generated during user interaction, allowing Spotify to analyze the data using the Spotify Web API and provide personalized music recommendations for couples.

Hardware control: ESP 8266 NodeMCU
SoundMotion uses the ESP8266 as its hardware platform to control the device and connect to the Spotify server. This enables the transfer of emoji feedback data generated during user interaction, which Spotify analyzes using the Spotify Web API. Through the API, developers can access Spotify's functionalities and data, facilitating the exchange of information between SoundMotion and Spotify servers. This integration allows for music content transfer, playback control, and data analysis, leading to personalized music recommendations for couples.

Software control: Spotify Web API
The Spotify server communicates with the ESP8266 via the Spotify Web API to transfer music content, control playback, and provide recommendations. User data, including actions like switching the Couple Channel and emoji feedback, is collected by the ESP8266 from the physical device. This data is then analyzed using Natural Language Processing (NLP) techniques [10], which focus on the interaction between computers and human language. NLP enables the processing and understanding of user-generated data, such as emoji feedback, by extracting insights from natural language or textual information. The analyzed data is transmitted to the Spotify server in JSON or CSV format. This analysis helps Spotify understand user preferences and tailor music recommendations accordingly, optimizing the personalized music experience provided by SoundMotion. by SoundMotion.or CSV format. The analysis helps Spotify's data processing models understand user preferences and tailor music recommendations accordingly.

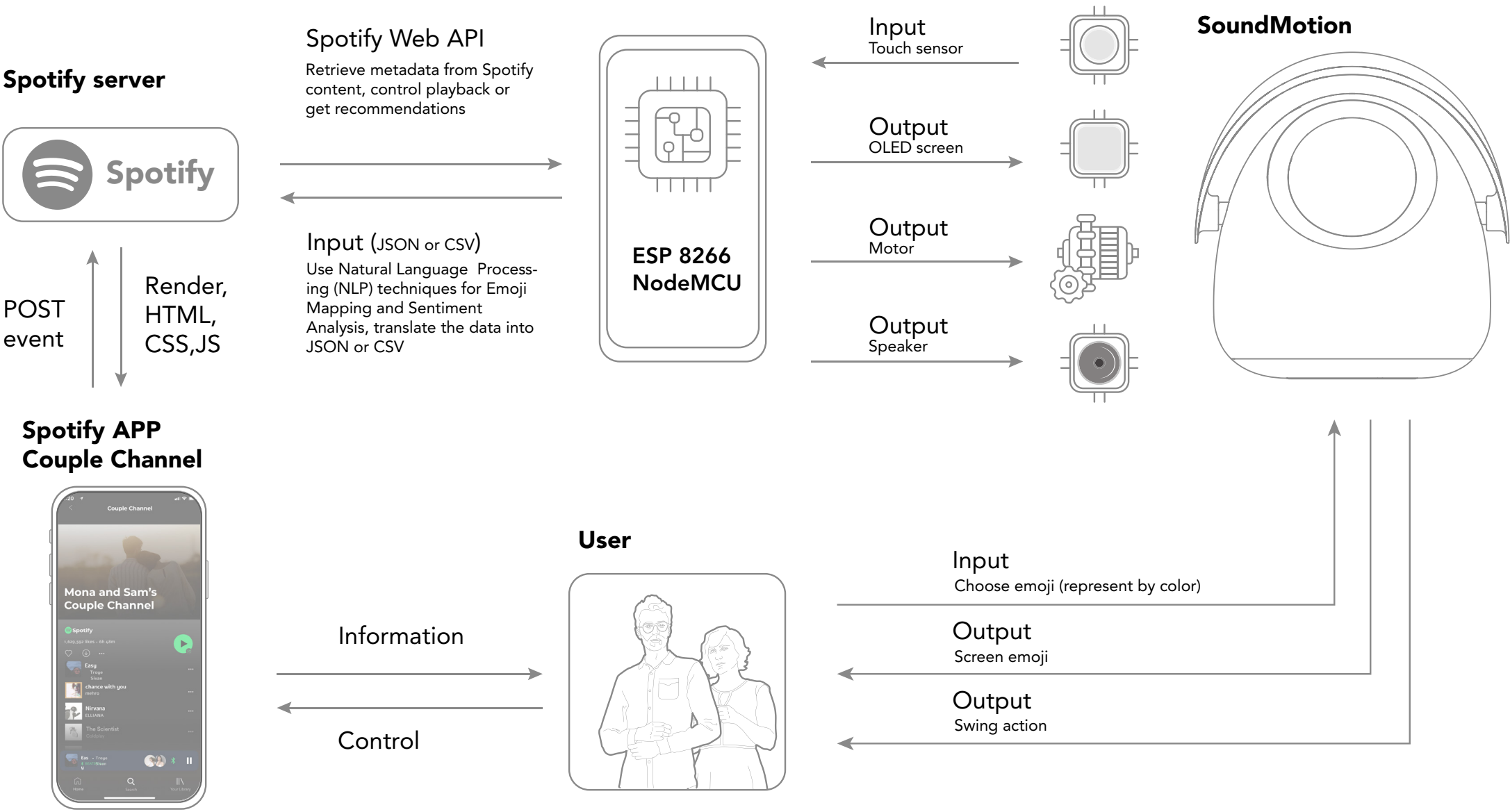


Fig.18 interaction logic

CONNECT DEVICE TO SPOTIFY
& BUILD COUPLE CHANNEL

The online component of the SoundMotion system provides simple yet essential functionalities. Its main purpose is to guide users in connecting their device to Spotify and facilitate the creation of a Couple Channel for couples. Users can easily associate their device by scanning the QR code on the product packaging, which leads them to the device linking process. They can then invite their partner to join and create a shared Couple Channel. Spotify utilizes the Spotify Web API to analyze users' music preferences and curate a playlist that combines the musical tastes of both partners. This playlist is added to the Couple Channel, where it recommends ten songs to users daily. Even when users are physically separated from their device, they can still engage in synchronous music sharing activities with their partner through the Couple Channel.

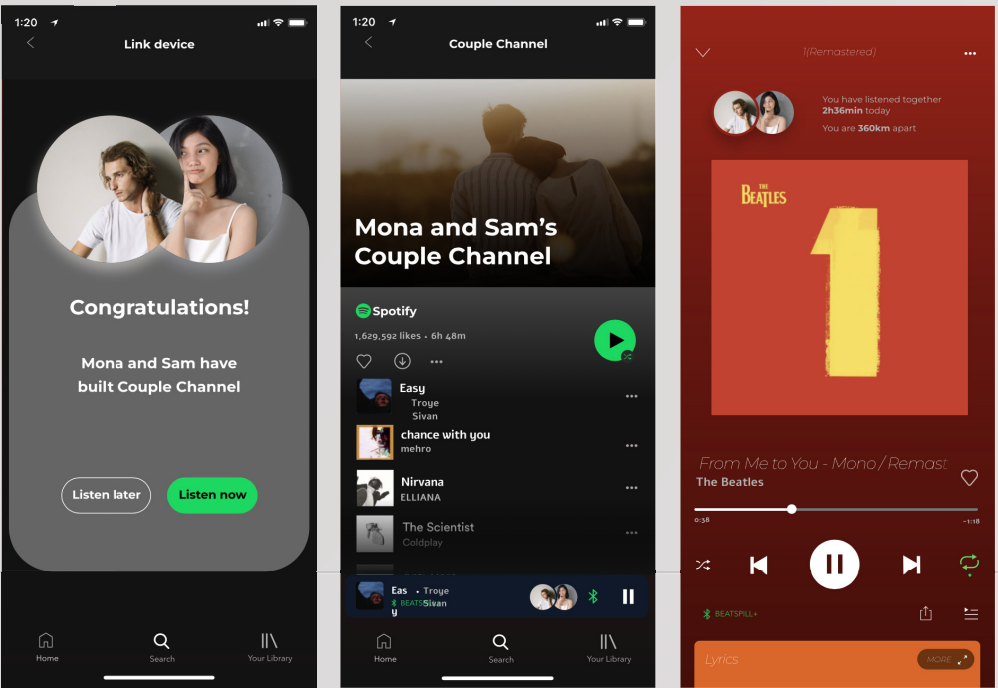
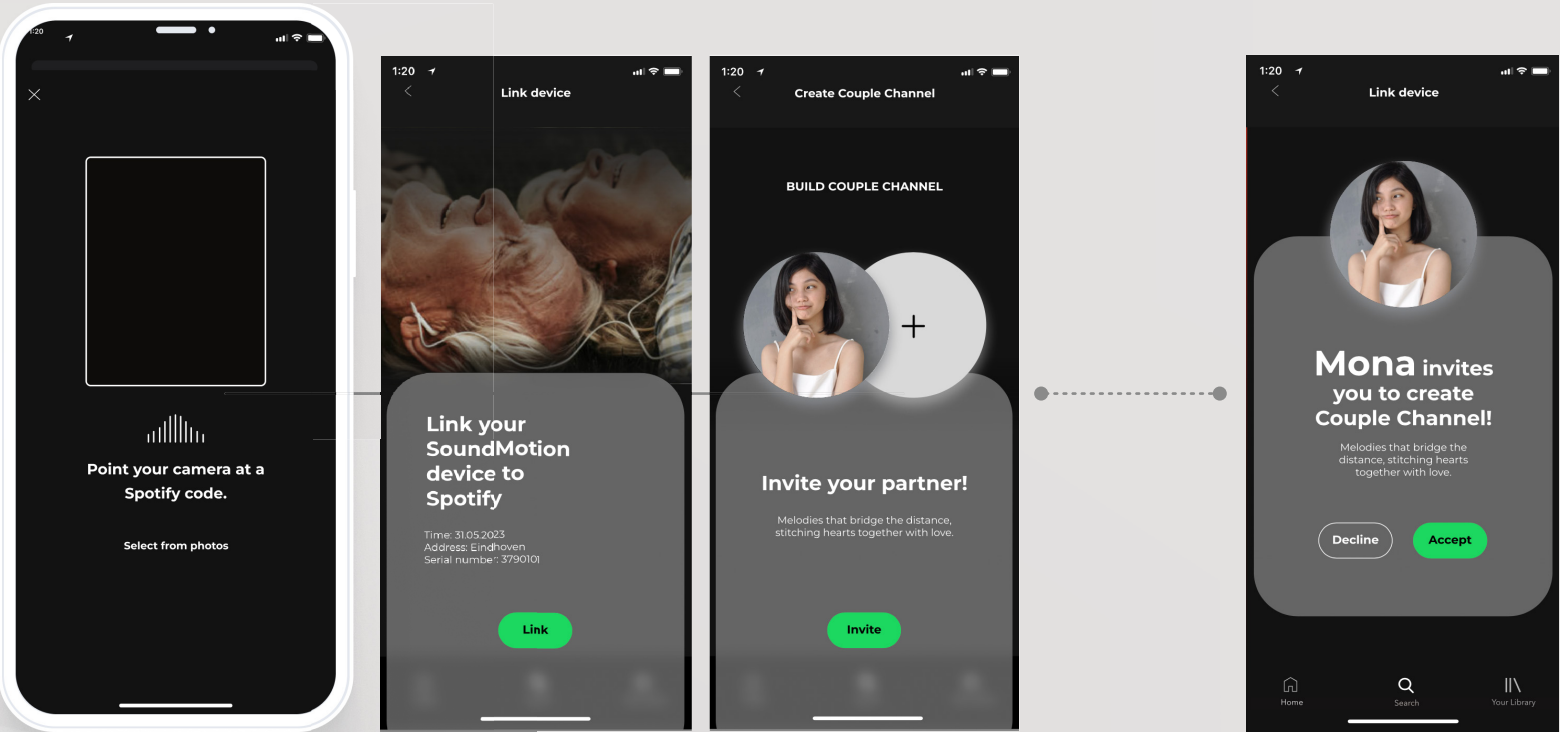
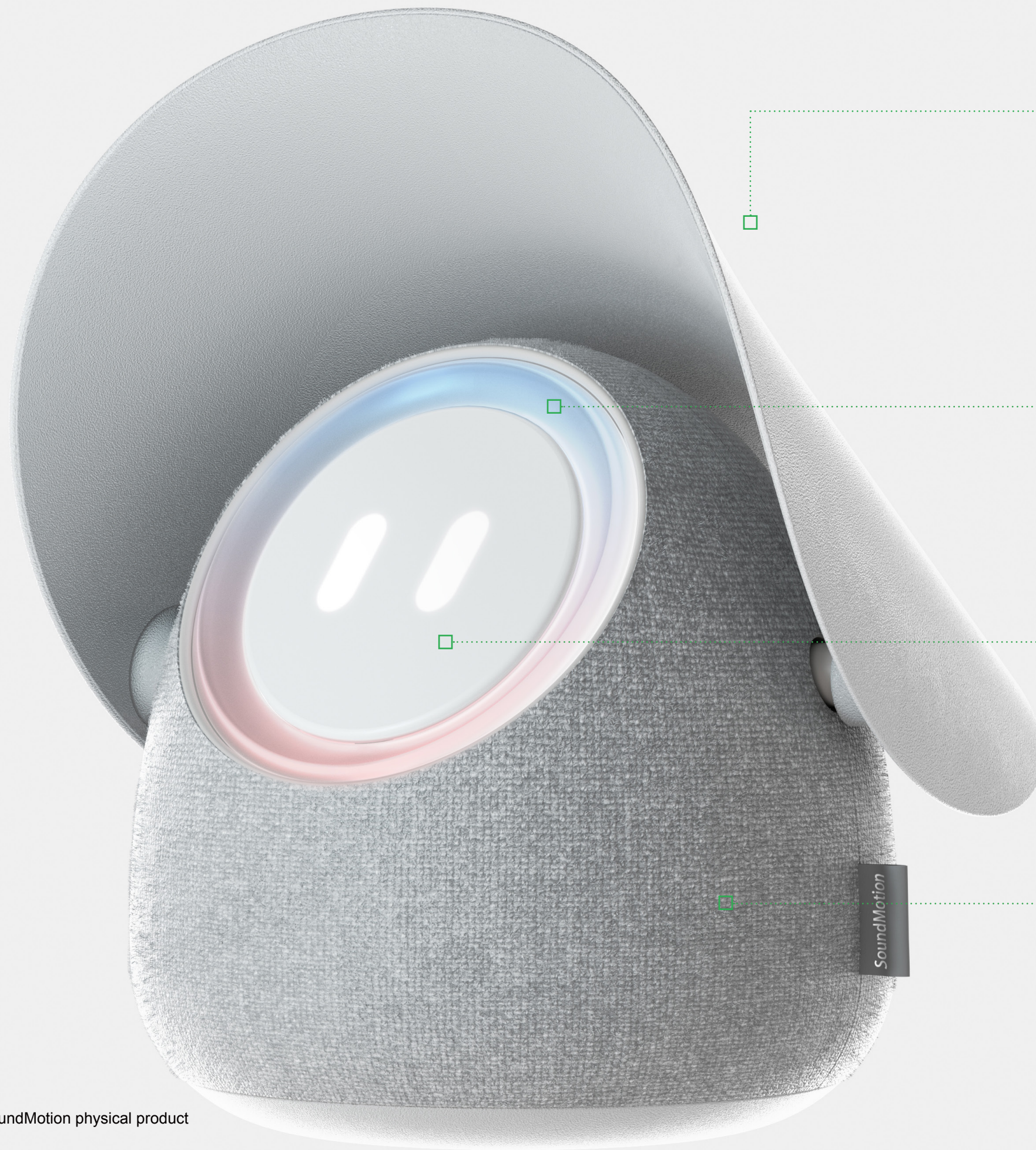


Fig.18 connect SoundMotion with Spotify

The pictures used in designing the UI are all derived from: <https://www.pexels.com>



BASIC FUNCTION

■ The Hat

The hat functions as the power switch for the entire device and also serves as the switch to toggle the Couple Channel. Additionally, its swinging motion represents the online status of the partner.

■ The halo

It incorporates a built-in haptic sensor that detects touch. When the user's finger slides along the halo, the screen displays different emojis, and the color of the halo corresponds to the emotional state

■ The screen

It is designed to display emojis.

■ The body

It incorporates built-in speakers for music playback.

Fig.19 SoundMotion physical product

STORYBOARD

Each member of the couple has a SoundMotion device for physical interaction. During regular use, the user can lift the Hat to a horizontal position, and the device functions as a regular music speaker. When the Hat is fully lifted, the device connects to the Couple Channel in the SoundMotion system and starts playing music from the playlist. If both members are in SoundMotion, both devices play the same song simultaneously, providing the couple with a synchronized long-distance listening experience.

Let's assume users A and B are using the system. When A fully lifts the Hat to enter the Couple Channel, SoundMotion starts playing music from the Couple Channel. At the same time, B's device swings to indicate A's online status. If B is not in the Couple Channel, the halo around A's screen is white. However, when B comes online, both halos around the screens turn colorful, and each other's avatars appear on the screens. By sliding along the halo, users can browse through different emoji representing their mood states. They can then send the selected emoji with a double tap. This way, the couple can interact through the screen to communicate their feelings about the music they are listening to.

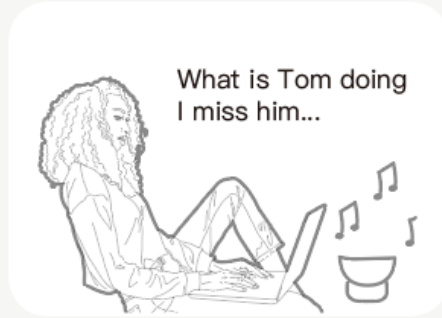


Fig.20 SoundMotion storyboard of basic function

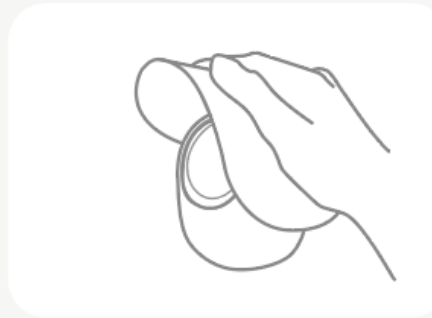
STORYBOARD

Begin with the journey

Lily's home
Beijing, China



- Lily is relaxing at home



- Open the hat to enter the Couple Channel



- Enjoying the music which mixes their music tastes



- Playing games

Tom's home
Eindhoven, the Netherlands



- Tom is working at home



- Swinging



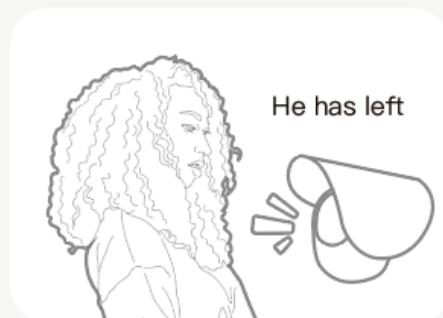
- Concentrate on his work and didn't notice the movements



- Lily is missing me!

End of the journey

Lily's home
Beijing, China



- Tom's emoji avatar disappeared



- Synchronised music listening across distance and communicate through emoji



- Slide along the colorful circle to choose emoji

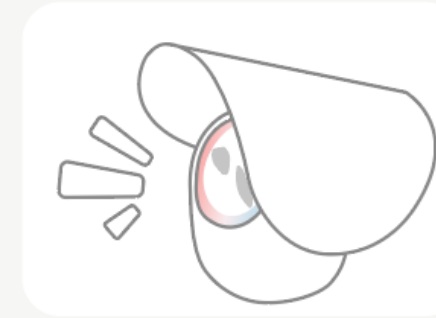


- Tom is also in the Couple Channel now!

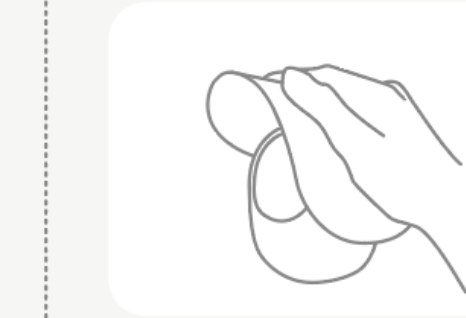
Tom's home
Eindhoven, the Netherlands



- Close the hat to turn it off



- The emoji appears on the other's screen



- Open the hat to enter the Couple Channel

Fig.21 SoundMotion storyboard with couple scenario

The two pictures of human are extracted from: <https://pimpmydrawing.com/>

SCENARIO



The Hat as a switch

Control Bluetooth speakers by toggling the Hat on and off, which acts as a switch.

Personal space: open the hat to the horizontal angle

Couple Channel: open the hat fully, the screen will appear.

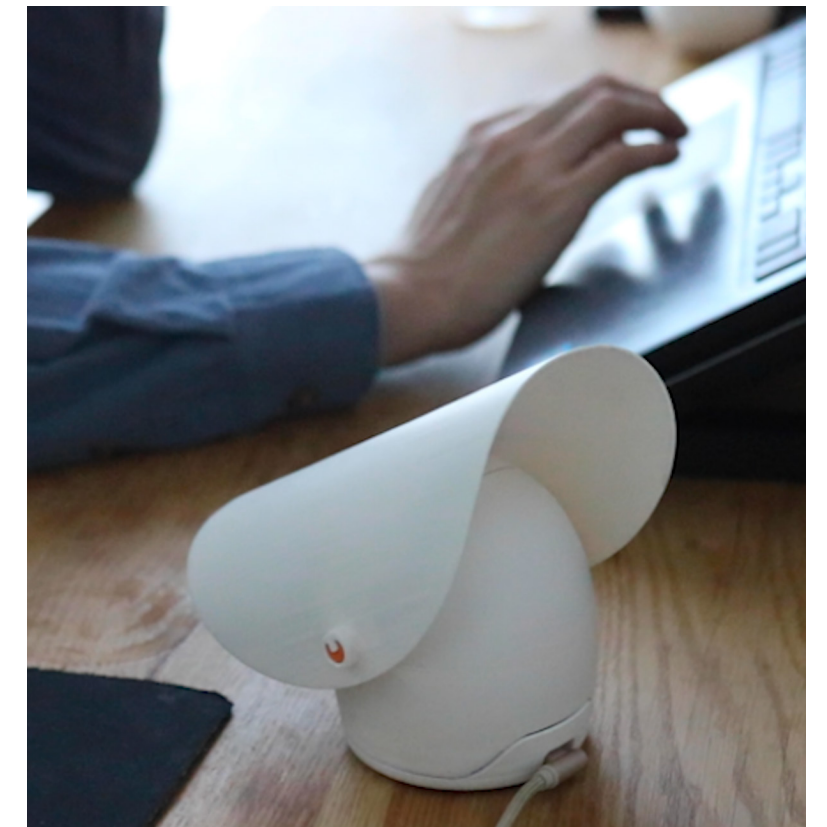
Physical interaction

When the device is turned on, if the partner is using the Couple Channel to listen to music, the Hat will continue to swing to indicate the partner's status.

Video link

This video link provides a complete scenario of SoundMotion in use, which can help readers better understand its functionality.

<https://vimeo.com/836253967?share=copy>



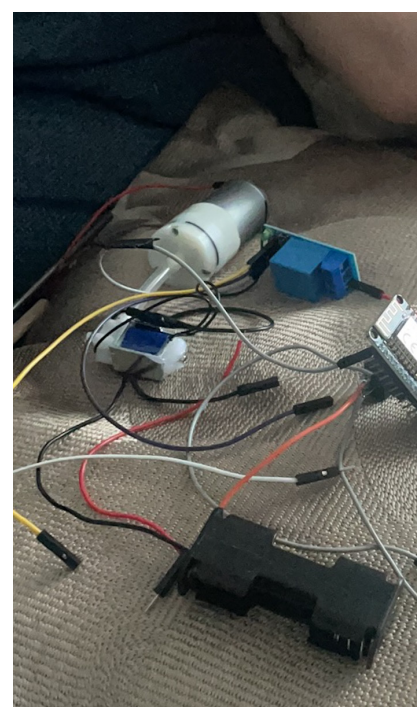
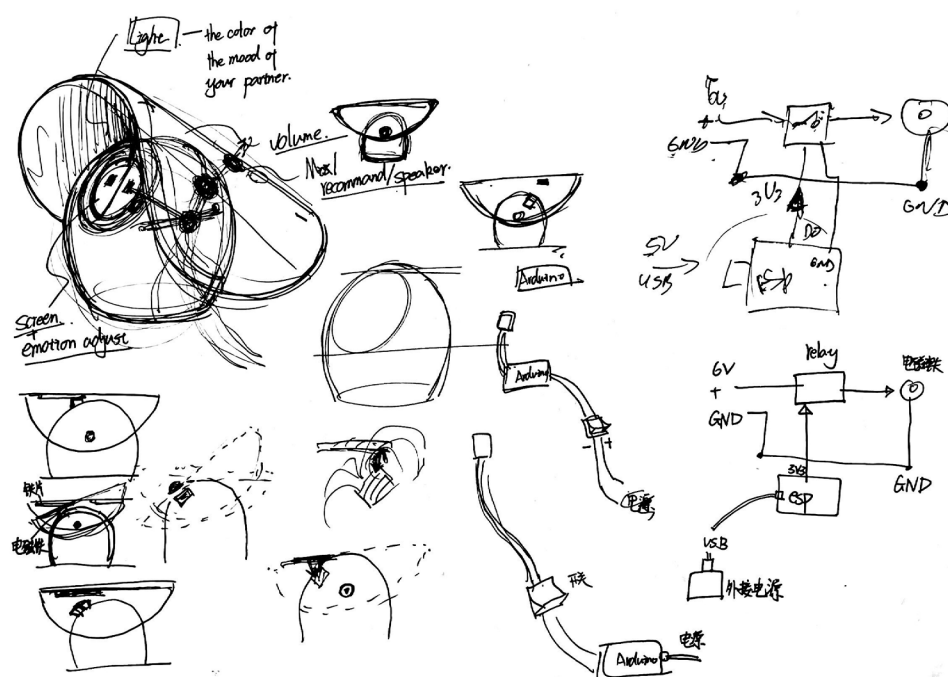
6.2 TECHNICAL REALIZATION

Based on the project timeline and technical capabilities, the focus of the model's functional implementation will be on the interaction window between the product and the user. The physical interactions to be implemented in the model primarily involve the swinging motion of the hat and the display of emoji graphics and colored halo on the screen.

For the electronic components of the screen, I opted for a 13.5-inch OLED display. Initially, I created different facial expression images using Illustrator and then converted the image information into hexadecimal C language files using a transcoding tool. Through the ESP8266, the graphic code is transmitted to the OLED screen and displayed as various facial expressions. To achieve a more adorable dynamic effect, I initially created several GIF files. However, due to the low refresh rate of the OLED display, these GIFs couldn't be effectively displayed as animations and were consequently abandoned.

Regarding the physical motion design of the hat, I went through two iterations.

Initially, I chose to use an electromagnet as the main driving component. I installed the electromagnet on the inner wall of the SoundMotion device and attached a magnet to the inner wall of the hat, as shown in the circuit diagram. When the device is powered on, the electromagnet generates a repulsive magnetic force against the magnet on the hat, causing it to pop up. With alternating current, the electromagnet produces a varying magnetic field, allowing for controlled and rhythmic popping and attracting of the hat, creating a natural swinging effect. However, during the actual experimentation process, I found that the electromagnet I purchased, which operates at 6-12V, had a limited magnetic field range and was unable to effectively attract and repel the magnet on the hat. Consequently, I opted for the second solution, which involves using a servo motor to drive the swinging motion of the hat. I connected a 5V motor to the ESP8266 and used Blinker to control the motor's amplitude range, frequency, and duration of rotation.

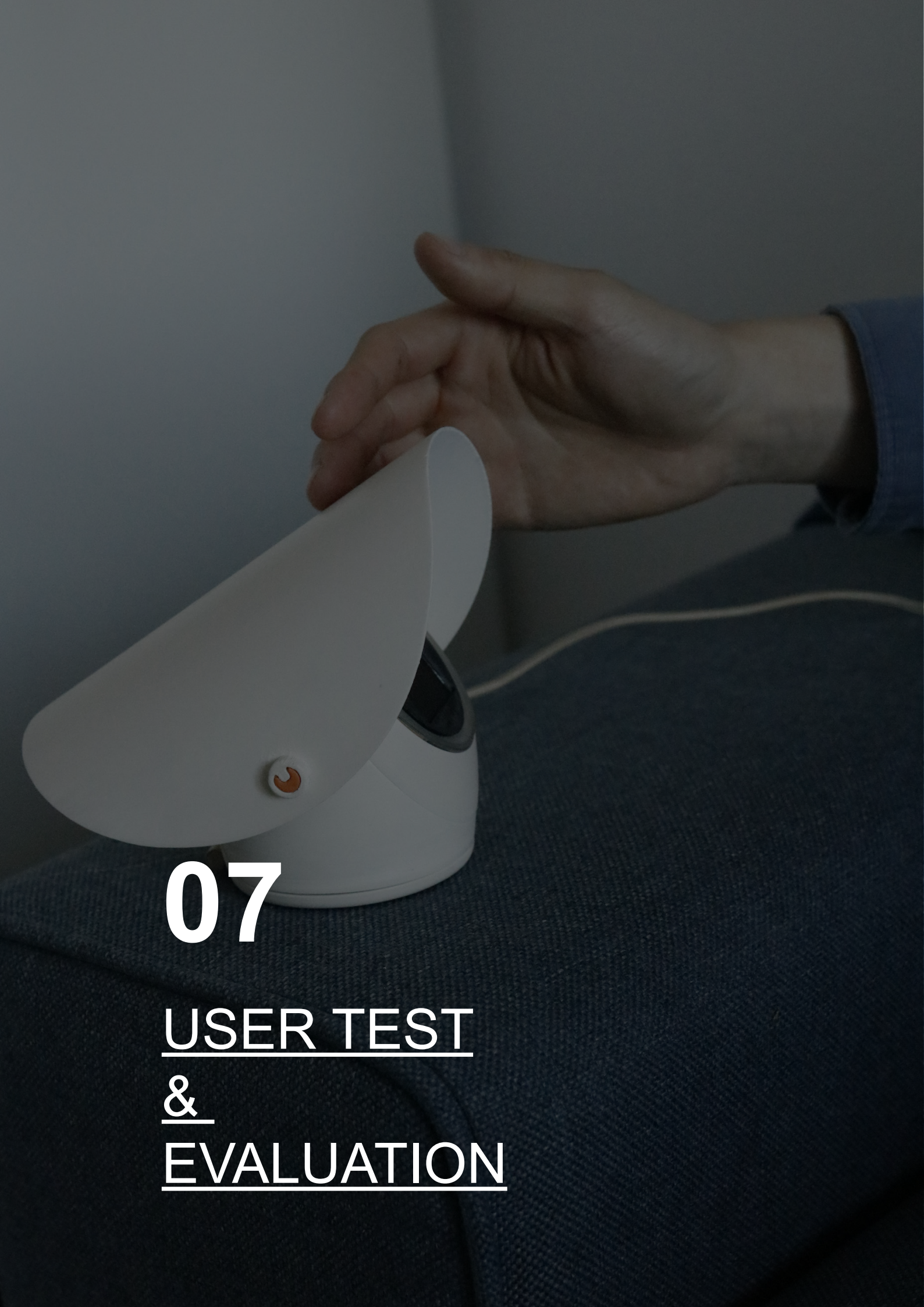


PROTOTYPE ITERATION

In the production of the physical model, I initially chose 3D printing to create the casing of the product. After further smoothing the model using filer and sandpaper, I proceeded to apply paint for coloring. Upon completing the first iteration of the model, I conducted a preliminary evaluation and decided to make adjustments to the curves of the hat to

make it more ergonomic for hand grip and aesthetically pleasing. Additionally, I made adjustments to the curves of the main body of the model to create smoother lines at the bottom. Based on these adjustments and modifications to the design, I successfully produced the second iteration of the physical model.





07

USER TEST & EVALUATION

7.1 METHODOLOGY

To test the acceptance and user experience of the new form of communication created by the SoundMotion system, I recruited six participants from social media who were experiencing or had experienced long distance relationships.

The study was conducted following the guidelines of the Ethical Review Board (ERB) within the Industrial Design department. Prior to the test, all participants were provided with a Consent Form outlining the test procedure, data collection, and privacy protection measures. Each participant read and signed this form. In the analysis phase, all collected data from the experiment underwent anonymization. Table 2 presents the anonymized participant information, including their assigned identification numbers.

Participants Table 2

ID	Age	Gender
A1	23	Female
A2	24	Female
A3	27	Male
A4	24	Female
A5	25	Female
A6	24	Male

Experiment design and procedure

The Think Aloud method was predominantly used during the testing phase to gain in-depth insights into participants' thoughts, perceptions, interactions, and feedback regarding the music sharing device prototype. Think Aloud is a user testing technique that involves participants vocalizing their thought processes while performing tasks, providing detailed understanding of their real-time reactions and experiences with the product or prototype [7].

Given that the prototype components didn't fully realize all intended functionalities and interactive actions of the SoundMotion

design, the Wizard Method was employed. Through the Blinker APP on a mobile phone connected to the ESP8266, I controlled the prototype's swinging motion and the changing expressions on the screen. This approach effectively addressed technical limitations and aided in assessing the efficacy of the responsive interaction model [8].

Supplementary to this, semi-structured interviews were conducted to delve deeper into participants' everyday communication and interaction dynamics in romantic relationships, as well as their overall user experience with SoundMotion. The user testing session lasted approximately 30-40 minutes and encompassed six sections, with each participant taking turns to engage in the testing process.

a. Pre-Test Questionnaire:

The researcher distributed the pre-test questionnaire to gather demographic information and assess participants' background in long-distance relationships.

b. Demonstration and Familiarization:

The researcher provided a brief demonstration of the music sharing device prototype, highlighting its key features and functionality. Allow participants to interact with the device and familiarize themselves with its operation.

c. Think-Aloud Session:

The researcher asked participants to perform 2 tasks using the prototype while thinking aloud. Encourage them to express their thoughts, feelings, and opinions about the device's design, interaction, and usability. The background of these tasks is the daily life of long-distance couples, and the intention is to allow participants to imagine that they are in a long-distance relationship to share music and interact intimately with their partners through this device.

d. Semi-Structured Interview:

The researcher conducted semi-structured interviews to delve deeper into participants' experiences and gather qualitative feedback. Use the interview to explore their emotional connection, sense of presence, and suggestions for improvement.

Analysis

All the data collected during the testing process was transcribed and analysed by means of Thematic Analysis. In this process, several codes were created and finally grouped into 3 broad thematic findings: Aesthetics, Interaction, Function and Expectation.

7.2 FINDINGS

Aesthetics

The evaluation and feedback provided by the participants regarding the aesthetics, form, and size of SoundMotion were utilized to analyze the product's visual design. Initially, the hat component located at the top of the device was universally perceived as an endearing feature. Participant A2 described it as "resembling a taco, both cute and easy to grip." While participants A2 and A3 expressed concerns that the hat appeared relatively thin compared to the rounded and plump body, participants A1 and A6 found the lightweight hat more fitting. Concerning size, all participants agreed that the current dimensions were well-suited for placing the device on a desk, serving as a decorative item, and facilitating hand interactions with the hat and screen.

In general, the product's design was regarded by users as simple and charming. Although individual variations in the perception of design details may be challenging to address, further attention can be directed towards refining the hat's intricacies to enhance its uniqueness while maintaining cohesion with the overall design aesthetic.

Interaction

In terms of interaction forms, the participants engaged with the SoundMotion

device through two primary processes: emoji feedback behavior on the screen and physical interactions with the hat. These two forms of interaction complemented each other, serving as a medium for remote engagement between users and their partners.

Regarding the screen-based emoji feedback, participants perceived the displayed emojis as representations of their partners' avatars. For instance, Participant A3 stated, "I might see it as representing the other person, not myself. So, it's probably the other person, and I interact with it, and then I place this thing on the other side, and it does the same action."

As for the hat, it facilitated interactions in two ways. Firstly, opening and closing the hat to power the device on/off and switch channels were perceived as intuitive and enjoyable by most participants. Participant A6 commented, "It's quite reasonable because if the hat is closed, it's like being isolated and withdrawn, and when you open it, it's like it's being opened up." Secondly, the physical interaction through swinging, indicating the partner's online status, was unanimously considered interesting and beneficial for communication. Participants A1, A2, A3, A5, and A6 believed that this interaction enhanced their partner's presence in their daily lives without disrupting their ongoing activities. A6

elaborated, "It's more like being soft, not as direct as on WeChat. Everyone has their own work. And if it's like this, it's on the edge of attention, or in the background, and you can feel it. For example, being together, having some small interactions, without taking up too much time, and not being so direct."

In summary, the combination of screen-based emoji feedback and physical interactions with the hat in SoundMotion proved significant and positively influenced user engagement, as emphasized by the participants' experiences.

Expectation

The participants expressed their expectations for the SoundMotion system primarily in two aspects. Firstly, the majority of participants expressed a desire for richer interactive experiences. Participants A2 and A3 expressed their wish for the screen to provide more interactive

content and information, such as allowing simple text messages to communicate their music experiences and share music recommendations. Additionally, A3 suggested the ability to share individual songs, as limited opportunities for synchronous music sharing with their partner due to time differences were a concern.

Secondly, the participants expressed a general desire for an expanded selection of emojis. A6 expressed the desire for a greater variety of cute emojis to choose from, which was also mentioned by A1, who stated, "I hope there can be a wider range of emotions to convey."

Notably, A1 proposed that if the system could analyze the feedback communication data from emojis to understand the preferences and emotions of the couple users, the recommended songs in the Couple Channel could become more aligned with their shared musical tastes.

7.3 LIMITATION

Although the user testing yielded valuable data on the actual user experience of SoundMotion, the experiment had certain limitations that warrant improvement. These limitations can be attributed to two main factors.

Firstly, the user testing was conducted in a controlled laboratory environment, where participants were presented with the device's usage process through storyboards and videos. This approach may have hindered participants from fully experiencing the product in their own home environments, limiting the authenticity of their feedback.

Secondly, due to budget and time constraints, it was challenging to conduct

long-term observations with the prototype placed in the homes of remote couples. Instead, the focus was on testing the usage experience with a single participant, while the researcher controlled the model for interaction. This approach falls short of capturing the full experience of couples engaging in long-distance interaction with their partners in their daily lives.

Furthermore, the lab environment constrained participants to complete tasks and engage with the product within a short timeframe, directing their attention solely towards the model. However, the primary design intent of SoundMotion was to minimize interference with the partner's activities during long-distance interaction, allowing for expressions of care and

attention while alleviating concerns about disturbing one another. Unfortunately, this aspect was difficult to observe in the experimental setup.

In the future, greater emphasis should be placed on conducting field studies, where the prototype is deployed in the homes of remote couples for an extended period.

7.4 DISCUSSION

Regarding the final design outcome, the SoundMotion system successfully adhered to the three initial design guidelines. The user testing phase demonstrated that SoundMotion effectively facilitated off-site communication and largely fulfilled the design expectations. However, it is crucial to take a broader perspective and engage in project reflection to uncover more extensive insights into music sharing and emotional experiences.

Music sharing and long-distance intimacy

Based on the exploration of music sharing behavior in the Emphasize session and the User test session, the successive rounds of user research conducted during the Emphasize stage enabled me to focus on a specific research demographic: long-distance couples. The significance of music sharing within this context can be attributed to three prominent characteristics, as illuminated by the insights gained from the user research.

Firstly, music itself serves as an ever-evolving daily topic, fostering increased communication and interaction between couples. The act of sharing music allows for ongoing conversations and a deeper understanding of each other's tastes, preferences, and emotions.

This approach would enable researchers to observe the experiences and effects of simple interactions and music sharing functions over weeks or even months, shedding light on users' perceptions and the potential for enhancing intimacy in long-distance relationships.

Secondly, sharing music provides a sense of presence and togetherness, even when physical distance separates the couple. The shared melodies create a unique bond, as if the partners are virtually connected through music. The synchronicity of listening to songs simultaneously and the subtle interactions that arise from song-switching contribute to a feeling of companionship.

Lastly, music plays a significant role in conveying and enhancing emotions, particularly in the context of long-distance relationships. On one hand, music serves as a means for couples to express their care and affection by sharing songs that reflect their current moods and feelings. On the other hand, incorporating music into conversations or using it as background ambiance can intensify the emotional experience and create a more immersive atmosphere. The influence of music in evoking specific emotions and setting the desired mood has been widely acknowledged and utilized in various domains, such as film and television productions or romantic dining settings [2].

In summary, the findings underscore the importance of music sharing among long-distance couples. It serves as a means of communication, a source of comfort and solace, and a way to enhance emotional intimacy. The insights gained from this research lay the foundation for designing a music sharing system tailored specifically

to the needs and dynamics of long-distance relationships.

The transition between implicit interaction and explicit interaction

In previous research on technologies for enhancing long-distance relationship (LDR) intimacy, explicit and implicit interactions have often been treated as distinct approaches. Many design explorations and studies aiming to establish emotional connections between users have been inclined towards employing implicit interactions as a medium. For instance, Atsuro Ueki et al. expressed a sense of togetherness by exchanging photos of the moon from their respective locations [24]. They primarily relied on metaphorical content and subtle, gradual interaction to evoke emotional engagement between the users. In the realm of explicit interactions, besides conventional means of remote communication such as text messaging or video calls, new technologies are also being applied. For example, Rui Pan experimented with virtual reality (VR) technology to establish first-person view video streaming, enabling long-distance couples to simultaneously observe each other's activities and establish a sense of virtual connection [37].

However, in practical applications, while implicit interactions are more expressive, they often have limited capacity to convey information between couples. On the other hand, explicit interactions allow for rich information exchange but can potentially increase the communication burden for users [9]. SoundMotion seeks to integrate both implicit and explicit interaction features into a single device, harnessing the strengths of both approaches and compensating for their individual limitations.

Swinging: Implicit Interaction for Conveying Partner's Status

Participant feedback indicates that SoundMotion significantly differs from commonly used communication tools for

long-distance couples. It utilizes physical interaction to convey online status and control the device. The swinging motion of the hat serves as a representation of the partner's online status, indicating their active usage of the Couple Channel and desire for interaction. Unlike intrusive message notifications on phones or other devices, SoundMotion gently prompts users through swinging motions, which do not excessively grab their attention or disrupt their ongoing activities. Users can simply glance at SoundMotion to confirm their partner's online presence, reducing the burden of communication by eliminating the need for repetitive messages to capture attention or confirm availability.

Furthermore, the physical interaction provided by SoundMotion enhances the sense of presence between partners. Even in situations where one partner is unable to actively participate in the music experience, the swinging motion of the SoundMotion device conveys a sense of care and companionship. This physical movement serves as a subtle but meaningful gesture, reminding the partner that they are still connected and that their presence is acknowledged.

Emoji: Explicit Interaction for Emotional Feedback

During synchronous music listening, SoundMotion's screen serves as a platform for explicit information exchange. The utilization of emojis enables users to effectively communicate the emotional impact of the music they are currently experiencing. In contrast to subtle light cues or other implicit interaction cues, emojis offer a distinct and intuitive visual representation, facilitating a rapid comprehension of the expressed emotions. Additionally, compared to textual or voice feedback, emojis reduce the time and cognitive effort required for message creation and interpretation. As participants were already familiar with the widespread use of emojis in communication applications and various consumer products like home robots, the incorporation of this

design feature was readily embraced. Importantly, Spotify has the potential to collect data feedback from emojis for further analysis, potentially leading to the creation of customized playlists that better align with the musical preferences of both partners. This address concerns expressed by certain users regarding significant differences in music tastes and playlist acceptance.

In the user's interaction with SoundMotion, the hat assumes the role of a switch, allowing users to alternate between implicit and explicit information. When users prefer not to engage with their partner through the

device, they can fully slide the hat forward to close the device or keep it in a horizontal position, effectively utilizing the device solely as a conventional music speaker. In these states, the hat completely obscures the screen, and the device primarily interacts with users through the swinging motion. However, when users open the hat, they can engage in explicit information exchange by employing emojis. This integration of implicit and explicit interaction forms provides users with greater autonomy and flexible communication options.

7.5 FUTURE WORK

The design and evaluation process of SoundMotion aimed to enhance intimacy in long-distance relationships by combining implicit and explicit interaction forms, with music sharing as its main functionality. The results of user testing demonstrated some success in physical interaction and emotional feedback. However, the daily lives of real long-distance couples are complex and diverse, and synchronous music listening imposes constraints on users in terms of time and context. Explorations of asynchronous or semi-synchronous communication methods, such as sharing individual songs, are still needed to address the intricate communication dynamics in real long-distance relationships. This will better integrate this lightweight emotional bonding device seamlessly into their lives and facilitate connections between partners in different living spaces.

Currently, the evaluation of SoundMotion has only been conducted through two small tasks in a laboratory setting, focusing on short-term interaction with the physical model. Such testing methods prevent users from experiencing the complete usage flow of the SoundMotion system in real-

life situations. In the future, more emphasis should be placed on conducting field studies, where the model is placed in the homes of the tested long-distance couples, allowing for experiments and observations over a month or even longer. This will provide insights into the experiential impact of such simple interactions and music sharing features on users and whether they can help improve intimacy in long-distance relationships.

Furthermore, during the model development process, I chose to use servo motors to drive the hat for swinging. While this component can achieve the desired physical interaction effect, in practical usage and testing, I found that the motor generates significant noise and maintains a somewhat rigid rotational speed, resulting in a mechanical and stiff dynamic effect. In the next iteration of the product, more attention can be given to technical research to explore ways to minimize noise and achieve a more natural and agile swinging effect.

08

CONCLUSION

This thesis explored the design and development of the SoundMotion system, aiming to facilitate music sharing and enhance intimacy in long-distance relationships. Through an iterative design process, the system was created to address the challenges faced by couples separated by distance.

The results of user research and related works indicate a lack of effective tools and technologies to support emotional connections in long-distance relationships. SoundMotion incorporates three design guidelines derived from the research findings and demonstrates a degree of success during the evaluation phase. By blending implicit and explicit forms of interaction, the system provides an engaging and gentle way for users to communicate, reducing communication burdens while offering a channel for expressing care and understanding. The cohesive design and integration of the physical components on one end of the SoundMotion system provide seamless transitions between different functionalities. Although the implementation of these features may be influenced by specific user preferences and real-life circumstances, its unique physical interaction characteristics and design semantics are expected to inspire designers and researchers in related fields.

Furthermore, while the design direction was initially refined for long-distance couples after the workshop phase, the conclusions drawn from role-playing games regarding music sharing and social intimacy are also expected to receive further attention in the future. The experimental findings clearly demonstrate a strong correlation between music sharing and social relationships, emphasizing the importance of exploring this connection.

In conclusion, future research and design endeavors should take into account the complex circumstances that may arise in long-distance relationships, including factors such as time zone differences, cultural variations, and individual preferences. By considering these aspects, designers can develop products that cater to a wider range of needs and effectively benefit more long-distance couples. Additionally, another potential direction for exploration is to focus on fostering remote intimacy in other types of relationships, such as between family members or friends. By expanding the scope of investigation, we can uncover valuable insights and create innovative solutions that enhance emotional connections across various remote relationships.

ACKNOWLEDGMENT

This project represents the culmination of my journey at the TU/e Industrial Design department, and its successful completion owes a great deal to the sincere and passionate assistance of many individuals.

First and foremost, I would like to express my heartfelt gratitude to my coach, Joep Frens. Your professional academic and design guidance throughout the project have been invaluable. Under your mentorship, I have learned numerous design methods and stepped out of my comfort zone, embracing bold experimentation. As I sought to create a perfect project, to provide a fulfilling conclusion to my graduate career, I often placed immense pressure on myself and encountered various challenges. It is during these difficult times that your support and encouragement truly made a difference. Thank you for your patient instruction and unwavering support over the past two years. I will forever hold you in high regard as an exceptional teacher.

I would also like to extend my gratitude to my friend, Jing Wu, whose assistance during the technical implementation phase of the physical model was instrumental. From conceptualizing the implementation approach to troubleshooting code, you patiently aided me in reviewing and rectifying errors. Your invaluable advice and unwavering support provided me with the much-needed encouragement during moments of intense pressure.

My appreciation extends to all the designer friends and classmates who offered their assistance. Thank you for engaging in brainstorming sessions, tirelessly evaluating design ideas, and providing invaluable recommendations.

Lastly, I wish to express my deep gratitude to the volunteers who graciously participated in the user research and model testing phases. Your feedback and suggestions have contributed significantly to the project, enriching it with valuable insights.



REFERENCE

- [1] Morgan Broacha. 2018. Long Distance Relationships as a Design Problem: Part III. Medium. Retrieved May 19, 2023 from <https://medium.com/@mbroacha/long-distance-relationships-as-a-design-problem-part-iii-7b55a8ad7198>
- [2] Groove Cartel. 2023. The Influence of Music on the Mood and Atmosphere of a Film. The Groove Cartel. Retrieved June 11, 2023 from <https://thegroovecartel.com/featured/the-influence-of-music-on-the-mood-and-atmosphere-of-a-film/>
- [3] Wei-Chi Chien and Marc Hassenzahl. 2017. Technology-Mediated Relationship Maintenance in Romantic Long-Distance Relationships: An Autoethnographical Research through Design. *Human-Computer Interaction* 35, (December 2017), 1–48. DOI:<https://doi.org/10.1080/07370024.2017.1401927>
- [4] Rikke Friis Dam. The 5 Stages in the Design Thinking Process. The Interaction Design Foundation. Retrieved January 8, 2023 from <https://www.interaction-design.org/literature/article/5-stages-in-the-design-thinking-process>
- [5] Pieter Desmet and Paul Hekkert. 2007. Framework of Product Experience. *International Journal of Design* 1, (April 2007), 57–66.
- [6] Anind Dey and Edward Guzman. 2006. From awareness to connectedness; the design and deployment of presence displays. DOI:<https://doi.org/10.1145/1124772.1124905>
- [7] World Leaders in Research-Based User Experience. Thinking Aloud: The #1 Usability Tool. Nielsen Norman Group. Retrieved June 10, 2023 from <https://www.nngroup.com/articles/thinking-aloud-the-1-usability-tool/>
- [8] World Leaders in Research-Based User Experience. The Wizard of Oz Method in UX. Nielsen Norman Group. Retrieved June 10, 2023 from <https://www.nngroup.com/articles/wizard-of-oz/>
- [9] William Gaver and Frances Gaver. 2023. Living with Light Touch: An Autoethnography of a Simple Communication Device in Long-Term Use. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems*, ACM, Hamburg Germany, 1–14. DOI:<https://doi.org/10.1145/3544548.3580807>
- [10] Shelley Gupta, Archana Singh, and Vivek Kumar. 2023. Emoji, Text, and Sentiment Polarity Detection Using Natural Language Processing. *Information* 14, 4 (April 2023), 222. DOI:<https://doi.org/10.3390/info14040222>
- [11] Celia B. Harris, Ameer Baird, Sophia A. Harris, and William Forde Thompson. 2019. “They’re playing our song”: Couple-defining songs in intimate relationships. *Journal of Social and Personal Relationships* 37, 1 (2019), 163. Retrieved May 19, 2023 from https://www.academia.edu/39233433/_Theyre_Playing_Our_Song_Couple_defining_songs_in_intimate_relationships
- [12] Marc Hassenzahl, Stephanie Heidecker, Kai Eckoldt, Sarah Diefenbach, and Uwe Hillmann. 2012. All You Need is Love: Current Strategies of Mediating Intimate Relationships through Technology. *ACM Transactions on Computer-Human Interaction (TOCHI)* 19, (December 2012), 30. DOI:<https://doi.org/10.1145/2395131.2395137>
- [13] Max Hilsdorf. 2020. How social features on music streaming services can finally succeed. Medium. Retrieved May 24, 2023 from <https://uxdesign.cc/how-community-features-on-music-streaming-services-can-finally-succeed-66a4c2fcd0c2>
- [14] Patrik Juslin, Simon Liljeström, Daniel Västfjäll, and Lars-Olov Lundqvist. 2011. Emotional Reactions to Music in a Nationally Representative Sample of Swedish Adults: Prevalence and Causal Influences. *Musicae Scientiae* 15, (July 2011), 174–207. DOI:<https://doi.org/10.1177/102986491101500204>
- [15] Alice Kiger. 2004. Teaching for Health. Churchill Livingstone. Retrieved May 27, 2023 from <https://abdn.pure.elsevier.com/en/publications/teaching-for-health>
- [16] Jina Kim, Young-Woo Park, and Tek-Jin Nam. 2015. BreathingFrame: An Inflatable Frame for Remote Breath Signal Sharing. In *Proceedings of the Ninth International Conference on Tangible, Embedded, and Embodied Interaction (TEI ’15)*, Association for Computing Machinery, New York, NY, USA, 109–112. DOI:<https://doi.org/10.1145/2677199.2680606>
- [17] Mayu Koike and Steve Loughnan. 2021. Virtual relationships: Anthropomorphism in the digital age. *Social and Personality Psychology Compass* 15, 6 (2021), e12603. DOI:<https://doi.org/10.1111/spc3.12603>
- [18] Paolo Magaudda. 2011. When Materiality ‘Bites Back’: Digital Music Consumption Practices in the Age of Dematerialization. *Journal of Consumer Culture - J CONSUM CULT* 11, (March 2011), 15–36. DOI:<https://doi.org/10.1177/1469540510390499>
- [19] Elham Saadatian, Hooman Samani, Rahul Parsani, Anshul Vikram Pandey, Jinhui Li, Lenis Tejada, Adrian David Cheok, and Ryohei Nakatsu. 2014. Mediating intimacy in long-distance relationships using kiss messaging. *International Journal of Human-Computer Studies* 72, 10 (October 2014), 736–746. DOI:<https://doi.org/10.1016/j.ijhcs.2014.05.004>
- [20] Jörgen Skågeby and Jörgen Skågeby. 1AD. Online Ethnographic Methods: Towards a Qualitative Understanding of Virtual Community Practices. <https://services.igi-global.com/resolvedoi/resolve.aspx?doi=10.4018/978-1-60960-040-2.ch025>. Retrieved December 27, 2022 from <https://www.igi-global.com/gateway/chapter/www.igi-global.com/gateway/chapter/50355>
- [21] Rongrong Wang and Francis Quek. 2010. Touch & talk: contextualizing remote touch for affective interaction. In *Proceedings of the fourth international conference on Tangible, embedded, and embodied interaction (TEI ’10)*, Association for Computing Machinery, New York, NY, USA, 13–20. DOI:<https://doi.org/10.1145/1709886.1709891>
- [22] Craig Wisneski, Hiroshi Ishii, Andrew Dahley, Matt Gorbet, Scott Brave, Brygg Ullmer, and Paul Yarin. 1998. Ambient Displays: Turning Architectural Space into an Interface between People and Digital Information. In *Cooperative Buildings: Integrating Information, Organization, and Architecture (Lecture Notes in Computer Science)*, Springer, Berlin, Heidelberg, 22–32. DOI:https://doi.org/10.1007/3-540-69706-3_4
- [23] A. Wuttke-Linnemann, U. M. Nater, U. Ehlert, and B. Ditzen. 2019. Sex-specific Effects of Music Listening on Couples’ Stress in Everyday Life. *Sci Rep* 9, (March 2019), 4880. DOI:<https://doi.org/10.1038/s41598-019-40056-0>
- [24] Xuqin Yu, Masa Inakage, and Atsuro Ueki. 2021. Aesthetic Nostalgia Mediated Design for Long Distance Relationship. In *10th International Conference on Digital and Interactive Arts, ACM, Aveiro, Portugal Portugal*, 1–5. DOI:<https://doi.org/10.1145/3483529.3483745>
- [25] Zain. 2022. Are Long Distance Relationships Worth It? Curious. Retrieved May 19, 2023 from <https://medium.com/curious/are-long-distance-relationships-worth-it-b40230b22315>
- [26] 2021. The Art of: Sharing Music as a Love Language. Tiffany’s Diary. Retrieved May 19, 2023 from <https://tiffanysdiary.com/2021/02/21/the-art-of-sharing-music-as-a-love-language/>
- [27] 2023. Thematic analysis. Wikipedia. Retrieved May 27, 2023 from https://en.wikipedia.org/w/index.php?title=Thematic_analysis&oldid=1136031803
- [28] 2023. Semi-structured interview. Wikipedia. Retrieved June 7, 2023 from https://en.wikipedia.org/w/index.php?title=Semi-structured_interview&oldid=1151750276
- [29] (PDF) Maintaining long-distance and cross-residential relationships - by Laura Stafford. Retrieved May 20, 2023 from https://www.researchgate.net/publication/249471392_Maintaining_long-distance_and_cross-residential_relationships_-_by_Laura_Stafford
- [30] Designing technologies for presence-in-absence: illustrating the Cube and the Picture Frame | SpringerLink. Retrieved June 12, 2023 from <https://link.springer.com/article/10.1007/s00779-006-0072-9>
- [31] (PDF) Beyond the Screen: Creating Unconventional Artifacts to Support Long-Distance Relationships. Retrieved May 20, 2023 from https://www.researchgate.net/publication/335868346_Beyond_the_Screen_Creating_Unconventional_Artifacts_to_Support_Long-Distance_Relationships?enrichId=rgreq-ba65d33fed199a4e1e5d8d21d9f9099f-XXX&enrichSource=Y292ZXJQYWdIOzMzNTg2ODM0NjU0NTZAMTYwNzg4MzAwMzIyNQ%3D%3D&el=1_x_2_&esc=publicationCoverPdf
- [32] ScholarWorks: MuScale: Retrieved January 5, 2023 from <https://scholarworks.unist.ac.kr/handle/201301/31790>
- [33] Miss Ü : KiKi & BoBo : a design for sharing moods in long-distance relationships | Semantic Scholar. Retrieved May 20, 2023 from <https://www.semanticscholar.org/paper/Miss-%C3%9C-%3A-KiKi-%26-BoBo-%3A-a-design-for-sharing-moods-Yi-Tung/60633984d9e62f632b6e435999265559b6011db0>
- [34] Watch, listen and play together in FaceTime calls on iPhone using Simulcast sharing. Apple Support. Retrieved May 24, 2023 from <https://support.apple.com/zh-cn/guide/iphone/iphb657eb791/ios>
- [35] Why Emojis Increase User Engagement by 15% | SignHouse. Retrieved June 6, 2023 from <https://www.usesignhouse.com/blog/emojis-engagement>
- [36] Emotion in music, giving you the chills. Your brain on music. Abbey Road Institute Amsterdam. Retrieved June 7, 2023 from <https://abbeyroadinstitute.nl/blog/emotion-in-music-giving-you-the-chills/>
- [37] “MyEyes” | Proceedings of the 2017 Conference on Designing Interactive Systems. Retrieved June 11, 2023 from <https://dl.acm.org/doi/10.1145/3064663.3064671>

APPENDIX A
-ERB and consnet form

Workshop: ERB for generative session

Ethical Review Form (Version 27.06.2019)

This Ethical Review Form should be completed for every research study that involves human participants or personally identifiable data and should be submitted before potential participants are approached to take part in the research study.

Part 1: General Study Information

1	Project title	Generative Sessions with Design Students and Staff (Note: this is an application for collective approval of a well specified set of activities- staff conducting such studies will self-check compliance using the checklist provided as an amendment)
2	Researcher	P.Markopoulos
3	Email researcher	P.Markopoulos@tue.nl
4	Supervisor(s)	N/A
5	Faculty/department	Industrial Design
6	Research location	TU/e campus or using secure remote collaboration tools supported by the TU/e (e.g. MS Teams, Canvas, Skype for Business).
7	Research period (start/end date)	April 1 2020 / December 31 2022
8	Funding agency	Variable: this application applies both to funded and non-funded research or research done for educational purposes.
9	[If Applicable] Study is part of an educational course with code:	N/A
10	[If Applicable] Proposal already approved by external Ethical Review Board: Add name, date of approval, and contact details of the ERB	N/A
11	Short description of the research question	What are suitable ideas and concepts to address a given design challenge? How do participants behave and how do they experience and reflect upon the creative session?
12	Description of the research method	A generative session where participants ideate and create representations of design ideas and situations.
13	Description of the research population, exclusion criteria	Participants are adults students and staff and non-vulnerable adults participating voluntarily in design activities.
14	Description of the measurements and/or stimuli/treatments	Representations of ideas and concepts. Artefacts participants create Observations and recordings of design rational and reflections. Quantifiable self-reports on the quality of the design process.
15	Number of participants	Between 1 and 30. Typically sessions will involve 4-7 participants, which is a suitable number for different generative techniques. Multiple sessions will be organized when large number of participants are needed.
16	Explain why the research is socially important. What benefits and harm to society may result from the study?	Generative design activities are essential in the education and the research activities of industrial design. This collective application is essential to ensure flexible design processes which are key to the way of working of industrial designers. It provides a framework within which generative activities can proceed with minimal procedure and be aligned with ethical regulation.

Ethical Review Form

3 Will you store personal information that will allow participants to be identified from their data? See VSNU draft.

4 Will you share de-identified data (e.g., upon publication in a public repository)?

Part 5: Closures and Signatures

1 Enclosures (tick if applicable):

2 Signature(s)

Signature(s) of researcher(s)

Signature research supervisor (if applicable)

Semi-structured interview

Ethical Review Form (Version 1.6)

This Ethical Review Form should be completed for every research study that involves human participants or personally identifiable personal data and should be submitted to ethics@tue.nl. For more information about how this process works please click [here](#).

Part 1: General Study Information

1	Project title	Design for music sharing experience in intimate relationship
2	Name of the researcher/student	Pang, Zhujun
3	Email of the researcher/student	z.pang@student.tue.nl
4	Supervisor(s) name(s)	Frens, Joep
5	Supervisor(s) email address(es)	j.w.frens@tue.nl
6	Department	Industrial design
7	Are you a student and is this application for educational purposes?	☐ Yes, Bachelor. Course: ☒ Yes, Master. Course: ☐ No
8	Research location	On campus
9	Start date data collection	25.04.2023
10	End date data collection	07.05.2023
11	Does your project receive external funding (e.g., NWO, relevant for special regulations from funders)?	☐ Yes. Name Funder: ☒ No
12	Which internal and external parties are involved in the study? Think about sharing data or information between TU/e and other universities, commercial companies, hospitals, etc.	Human participants (interviewees); Researchers from TU/e, industrial design department.

Participant Information Form

This document provides you with research information on "Exploring Shared Musical Experiences in 'Tangible Ways to Improve Social Intimacy'. Before starting the study, it is important that you understand the procedures followed by this study and your informed consent for voluntary participation. Please read this document carefully.

Purpose and benefits

Music is a shared experience, and with the popularity and continuous development of streaming music, this social attribute of music is also expanding. However, at present, people mainly rely on social media to share music, resulting in incoherent processes of enjoying music and sharing music, and often not receiving positive sharing feedback, which also makes people's desire to share music gradually eroded. Therefore, this design project aims to explore whether materialized forms of interaction can enrich and enhance the user experience of users in social intimacy when sharing music. The purpose of this interview is to study the current music sharing experience of groups in close relationships, such as partners, friends, and family members, and to obtain their music sharing process Pain points, needs and desired values.

Interview process

This interview is a structured interview, and the researcher will introduce the purpose of the interview before the interview.

Interview risk

The study did not involve any risks, harmful side effects, and no discomfort.

Duration

The overall experimental workflow is about 20-30 minutes.

Voluntary

Your participation is completely voluntary. You can refuse to participate without giving any reason, and you can stop participating at any time during the study. You can also withdraw your consent to the use of your data within 24 hours of it being recorded. None of this will have any negative impact on you.

Confidentiality and Use, Storage and Sharing of Data.

All research conducted at the Eindhoven University of Technology adheres to the Dutch Code of Conduct for Research Integrity and the Code of Scientific Conduct. The interview will be recorded so that it can be transcribed. After transcription, the audio file will be permanently deleted. Transcriptions will be stripped of recognition. In this study, no more personal data will be collected. Any information that can be used to personally identify you will not be shared with others.

More information

If you would like to know more about this study, its design, or the results, you can contact Pang Zhujun, z.pang@student.tue.nl.

If you have any complaints about this study, please contact the supervisor, Joep Frens, at j.w.frens@tue.nl.

Ethical Review Form

Additional explanation: Please address the following:

4 Which security measures are applied?

Part 8: Closures and Signatures

1 Enclosures (tick if applicable):

2 Signature(s)

Signature(s) of researcher(s)

Signature research supervisor (if applicable)

Informed consent

"The exploration of user-sharing musical experiences in social intimacy in tangible ways".

- I have read and understood the information in the corresponding participant information sheet.

- I had a chance to ask questions. My questions were fully answered and I had plenty of time to decide whether or not to participate.

- I know that my participation is completely voluntary. I know I can refuse to participate, and I can stop participating at any point during the study without giving any reason. I understand that I can withdraw my consent to the use of my data within 24 hours of the data being recorded.

- I agree to volunteer to participate in this study.

- I understand that any information that could be used to personally identify me or my reactions in this study will not be shared with anyone outside the research group.

Consent Form

I, (Name) _____

Hope and provide consent to participate in this study.

the participant signed _____ The _____ date

APPENDIX A

-ERB and consnet form

Final user test

Ethical Review Form

(Version 1.6)



This Ethical Review Form should be completed for every research study that involves human participants or personally identifiable personal data and should be submitted to ethics@tue.nl. For more information about how this process works please click [here](#).

Part 1: General Study Information		
1	Project title	Designing Music Sharing Experiences for Mediating Romantic Long Distance Intimacy
2	Name of the researcher/student	Pang, Zhuojun
3	Email of the researcher/student	z.pang@student.tue.nl
4	Supervisor(s) name(s)	Frens, Joep
	<i>Additional explanation: Please write down the name of your direct supervisor. You can mention several supervisors if appropriate, but at least one supervisor should be mentioned.</i>	
5	Supervisor(s) email address(es)	j.w.frens@tue.nl
	<i>Additional explanation: Please give the email address of the supervisor(s) mentioned in question 4.</i>	
6	Department	Industrial design
	Are you a student and is this application for educational purposes?	
	☐ Yes, Bachelor. Course: ☒ Yes, Master. Course: ☐ No	
8	Research location	On campus
	<i>Additional explanation: Where will the data collection take place? On campus, in a company, in public space, etc.</i>	
9	Start date data collection	24.05.2023
	<i>Additional explanation: Please state when your data collection will start. Please note that you do not have to provide information about your complete (PhD) project, but only on this particular sub-study that you are submitting for approval in this form.</i>	
10	End date data collection	01.06.2023
11	Does your project receive external funding (e.g., NWO, relevant for special regulations from funders)?	☐ Yes. Name Funder: ☒ No
12	Which internal and external parties are involved in the study? Think about sharing data or information between TU/e and other universities, commercial companies, hospitals, etc.	Human participants (interviewees); Researchers from TU/e, Industrial design department.
	<i>Additional explanation: Describe all internal and external parties that are involved in the study or project, including:</i> - human participants (e.g., people being interviewed, people participating in online surveys, patients, etc.); - researchers or research groups at the TU/e who participate in the study; (Researchers at) other universities/institutions that provide data/services, help analyzing the data, etc.); (commercial) partners, companies, government bodies, municipalities, consultancy firms, hospitals or care institutions that provide data (e.g., contact details of participants, data for further analysis). <i>Indicate which role each party plays: who defines the means and purposes in the study, who will supply the data (external parties)?</i>	



Ethical Review Form

2	Signature(s) Signature(s) of researcher(s) Date: Signature research supervisor (if applicable) Date:	  24/5/2023
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TU/e EINDHOVEN
UNIVERSITY OF
TECHNOLOGY

Information form for participants

This document gives you information about the study "Designing Music Sharing Experiences for Mediating Romantic Long Distance Intimacy". Before the study starts, it is important that you are aware of the procedure followed in this study and that you give your informed consent for voluntary participation. Please read this document carefully.

Aim and benefit of the study

Music is a shared experience, and with the popularity and continuous development of streaming music, this social attribute of music is also expanding. However, at present, people mainly rely on social media to share music, resulting in incoherent processes of enjoying music and sharing music, and often not receiving positive sharing feedback, which also makes people's desire to share music gradually erode. Therefore, this design project aims to explore whether materialized forms of interaction can enrich and enhance the user experience of users in social intimacy when sharing music. The goal of this user test is to evaluate the usability, user experience, and effectiveness of the physical music sharing device prototype designed for remote couples.

This study is performed by Zhiyun Pang of the Eindhoven University of Technology (TU/e).

Procedure

The researcher will firstly introduce the purpose of the user test, explain the confidentiality and voluntary nature of participation, and obtain informed consent from participants. The whole test will take around 30-40 minutes.

1. **Pre-Test Questionnaire:**
The researcher will distribute the pre-test questionnaire to gather demographic information and assess participants' background in long-distance relationships. It will take around 5 minutes to fill in the form.
2. **Demonstration and Familiarization:**
The researcher will provide a brief demonstration of the music sharing device prototype, highlighting its key features and functionality. Allow participants to interact with the device and familiarize themselves with its operation. This session will take around 5 minutes.
3. **Think-Aloud Session:**
The researcher will ask participants to perform 2 tasks using the prototype while thinking aloud. Encourage them to express their thoughts, feelings, and opinions about the device's design, interaction, and usability. The background of these tasks is the daily life of long-distance couples, and the intention is to allow participants to imagine that they are in a long-distance relationship to share music and interact intimately with their partners through this device. This session will take around 15 minutes.
4. **Semi-Structured Interview:**
Conduct individual interviews to delve deeper into participants' experiences and gather qualitative feedback. Use the interview to explore their emotional connection, sense of presence, and suggestions for improvement. This session will take around 10 minutes.

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Informed consent form

"An exploration of improving user's sharing music experience in a tangible way".

- I have read and understood the information of the corresponding information form for participants.
- I have been given the opportunity to ask questions. My questions are sufficiently answered, and I had sufficient time to decide whether I participate.
- I know that my participation is completely voluntary. I know that I can refuse to participate and that I can stop my participation at any time during the study, without giving any reasons. I know that I can withdraw permission to use my data up to 24 hours after the data have been recorded.
- I agree to voluntarily participate in this study.
- I know that no information that can be used to personally identify me or my responses in this study will be shared with anyone outside of the research team.

Certificate of consent

I, (NAME) want
and provide consent to participate in this study.

signature Participant's Date

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5. Post-Test Questionnaire:

Distribute the post-test questionnaire to collect quantitative data on participants' satisfaction, emotional connection, and sense of presence. Include open-ended questions for additional comments or suggestions.

Debriefing and Closing:

Thank participants for their participation, address any questions or concerns they may have, and provide contact information for follow-up if necessary. Ensure that participants understand the purpose of the study and how their feedback will contribute to improving the prototype.

Risks

The study does not involve any risks, detrimental side effects, or cause discomfort.

Duration

The interview will take approximately 30-40 minutes.

Voluntary

Your participation is completely voluntary. You can refuse to participate without giving any reasons, and you can stop your participation at any time during the study. You can also withdraw your permission to use your data up to 24 hours after they were recorded. None of this will have any negative consequences for you whatsoever.

Confidentiality and use, storage, and sharing of data.

All research conducted at the Eindhoven University of Technology adheres to The Netherlands Code of Conduct for Research Integrity and the Code of Scientific Conduct. The interviews will be audio recorded for the purpose of transcription. After transcription the audio files will be permanently deleted. The transcriptions will be de-identified. In this study no further personal data will be collected. No information that can be used to personally identify you will be shared with others.

Further information

If you want more information about this study, the study design, or the results, you can contact Pang Zhujun, z.pang@student.tue.nl.

If you have any complaints about this study, please contact the supervisor, Joep Frens (contact email: j.w.frens@tue.nl).

You can report irregularities related to scientific integrity to confidential advisors of the TU/e.

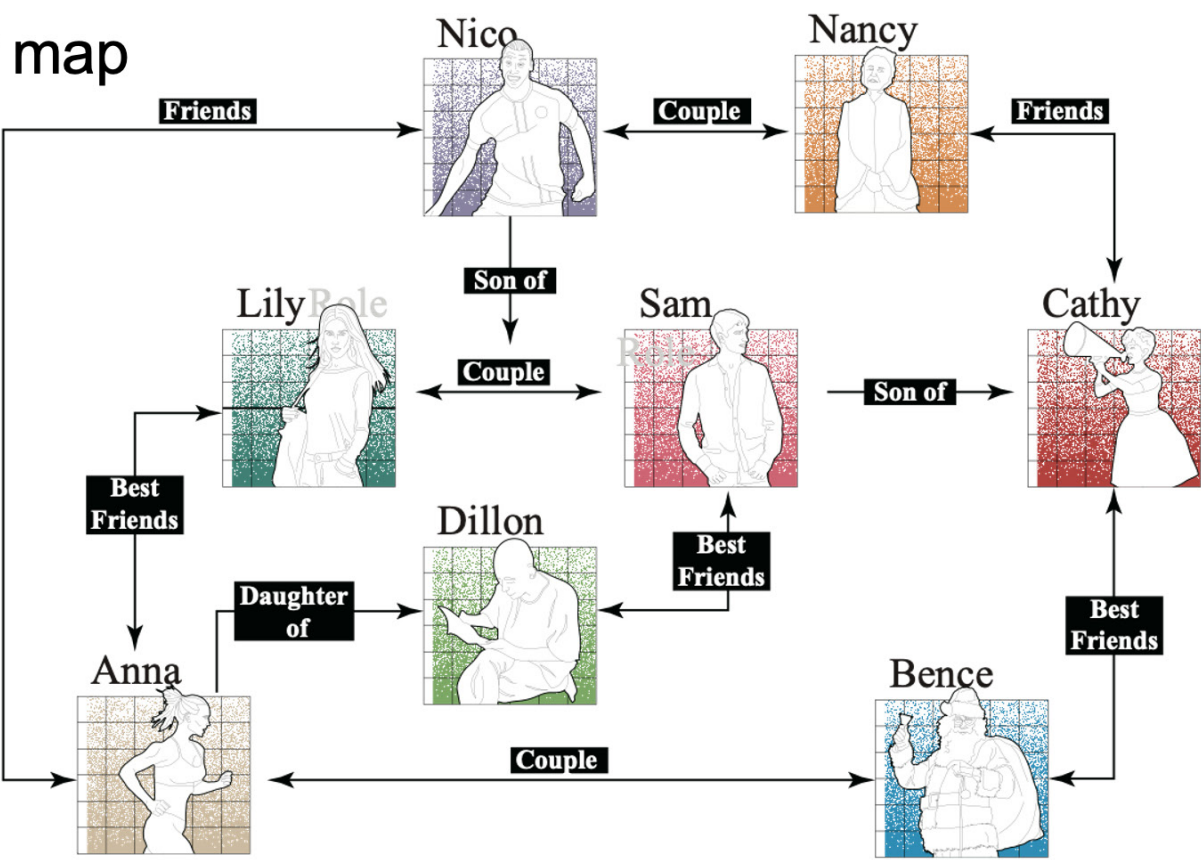
APPENDIX B

-User Test Materials

Workshop

- 1. Card game 30min
 - Each person to draw a character card, then and introduce your name (everyone to familiarize themselves with each other against the relationship chart).
 - Share your song card to the one you most want to share with in this character chat (take a turn from No.1), tell the reason to this person why you want to share this song to him/her
 - The person being shared will be given the card and insert the music card into the music box to play the song. He/she can choose whether or not to take an emoji and stick it on the song card and say how they feel about receiving it.
- 2. Brainstorm 20min
 - Conceive a creative product (as opposed to existing music playing devices such as mobile phones) to share music with the person you had just shared to.
 - Each participant has 5 minutes to brainstorm and write down his/her ideas.
 - Each participant has 1min to share their idea with the group, and the group can discuss and provide feedback.

Character map



APPENDIX B

-User Test Materials

Semi structured Interview questions

Final user test



Information form for participants

1. how old are you
2. how do you like to listen to music in general
3. do you like to share music, and if so, in what form do you like to share music?
4. why do you choose to share music in this way?
5. Who do you share your music with? What is the approximate frequency of sharing?
6. Please describe the last time you shared music
7. Why do you want to share music?
8. What factors in sharing music make you feel happy and what factors dampen your negativity?
9. What kind of feedback do you expect after sharing music? What kind of feedback do you usually get from people?
10. What are some of the existing ways of sharing music that you find troublesome?

SoundMotion Interview and Tasks

Pre-lab basic questions

1. Can you briefly describe your experience with long-distance relationships?
2. Have you used any digital tools or platforms to communicate or share experiences with your partner in a long-distance relationship?
3. What are your expectations or desires when it comes to maintaining emotional connection and intimacy in a long-distance relationship?
4. Are you familiar with music sharing activities between couples in long-distance relationships? If yes, please describe your experiences or thoughts on it.

Think-Aloud Session

Task 1: Exploring the device

Please take a few moments to familiarize yourself with the physical device. What are your initial impressions?

1. Can you describe how you would interact with the device to access the virtual music sharing space?
2. As you slide the top of the device to reveal the screen, please share your thoughts on the design and usability.
3. How intuitive or challenging is it for you to understand the emoji functionality and send them using the device?

Task 2: Music sharing and communication

Imagine you want to listen music together with your partner using this device. Please walk me through the steps you would take.

Imagine you are listening music together with your partner and interacting with him/her through this device, think aloud and share your impressions, emotions, and any interactions you would like to have with the device or your partner during this music exploration.

Semi-structured interview:

1. Aesthetic Level:
 - a) How would you describe your sensory experience while using the SoundMotion device? Did it engage any specific senses (e.g., sight, touch, sound)?
 - b) Did the design or appearance of the device contribute to your overall enjoyment or delight during the music-sharing experience? If so, in what ways?
 - c) Did the physical interaction (sliding the top) and the accompanying vibration feedback enhance or detract from the aesthetic experience? How?
2. Meaning Level:
 - a) How did you perceive the personality or expressive characteristics of the SoundMotion device? Did it evoke any specific emotions or impressions?
 - b) Did the device hold any personal or symbolic significance for you in the context of

- your long-distance relationship? If so, how did it influence your overall experience?
- c) Did the device's personalized music recommendation function based on you and your partner's music tastes contribute to a meaningful and enjoyable music-sharing experience? Why?
3. Emotional Level:
- a) Did the SoundMotion device elicit any emotional responses during the music-sharing session? If yes, which emotions did you experience and how would you describe them?
 - b) Did the physical interaction and vibration feedback enhance your sense of presence and engagement? Why or why not?
 - c) How did the synchronization of the devices and the shared listening experience contribute to your sense of connection and togetherness? How did it impact your emotional state?
 - d) Describe your interactions with the device's screen and the use of emojis during the music-sharing session. Did they effectively convey your feelings and facilitate communication with your partner?