LUNOST: Connected Tangible Messengers for Enhancing Off-Site ParentTeenager Relationships

Zhao Liu
School of Design and Arts, Beijing Institute of Technology, China.

Ernuo Cheng
School of Design and Arts, Beijing Institute of Technology, China.

Xinyuan Zhang
School of Design and Arts, Beijing Institute of Technology, China.

Xipei Ren*
School of Design and Arts, Beijing Institute of Technology, China
x.ren@bit.edu.cn

ABSTRACT

In China, off-site family relationships between college students and their parents are often problematic, which may negatively influence the personal development of teenagers. Persuading college students to build healthy and active communications with their parents can be a valuable subject. This paper presents an exploratory design study, investigating a tangible interactive product to help parents and children easily build shared communication experiences remotely. Firstly, we conducted an auto-ethnographical study to explore the design opportunities for improving off-site parent-teenager relationship. In return, we design LUNOST, a pair of metaphorical devices that enables emoji exchange, voice messaging and weather sharing between teenagers and parents over a distance through several tangible interactions, without using any digital tools. Based on the prototypes of LUNOST, we carried out a preliminary user test with 14 college students and 10 parents of them to examine the feasibility user experience of our design concept. Our quantitative findings suggested that LUNOST was experienced significantly useful, in terms of its usability (p=0.003), aesthetics (p=0.001), and perceived motivations (p=0.002). Qualitative results indicated that our design could be useful to remind youngsters to keep in touch with their parents and enable parents to subtly learn the status of their children. Based on our project, we discuss the future developments of relevant technologies for improved off-site parent-teenager relationships.

CCS CONCEPTS

• **Human-centered computing**; • **Human computer interaction (HCI)**; • **HCI design and evaluation methods**;

KEYWORDS

Parent-teenager communication, college student, tangible interaction, remote social interaction, persuasive design

ACM Reference Format:
Zhao Liu, Ernuo Cheng, Xinyuan Zhang, and Xipei Ren. 2021. LUNOST: Connected Tangible Messengers for Enhancing Off-Site ParentTeenager Relationships. In *The Ninth International Symposium of Chinese CHI (Chinese CHI 2021), October 16, 17, 2021, Online, Hong Kong*. ACM, New York, NY, USA, 6 pages. https://doi.org/10.1145/3490355.3490372

1 INTRODUCTION

The initial adult stage while studying at the university can play a crucial role in fostering many aspects of the personal traits, such as the independency, empathy, responsibility, etc. [16]. Increasingly, research evidence has suggested that good family communications can positively influence the personal development for youngers [4]. Yet it is very challenging to establish good and regular family communications.

Few college students opt to live with parents after entering their universities, which makes it impossible for in-person parent-teenager communications [19]. During the adolescence period, the risk of developing conflicts between parents and children also substantially increases, which lead family communication problems even severer [9, 14]. Therefore, to ensure healthy personal development for college students it is important to promote and sustain their good family communications.

The rapid penetration of Human-Computer Interaction (HCI) technologies presents various opportunities to enhance social interactions between college students and their parents. For instance, instant messaging apps such as WeChat and WhatsApp have facilitated convenient social interactions for teenagers and parents. Moreover, the video call functions have largely improve the experience and efficiency of remote social communications. However, given the fact that the youngsters are commonly reluctant to interact with parents [6, 15] it becomes vital important to create rituals and facilitate value exchanges for the parent-teenager communication beyond the information communication. Examples like *Cueb* by Golsteijn and van den Hoven [3] utilize tangible interactive device (photo cubes in their case) to facilitate collocated story exchange and shared experiences to help parent-child communications become healthier and more active. Similarly, our project focused on promoting the remote family communications between

*Corresponding author.

Chinese CHI 2021, October 16, 17, 2021, Online, Hong Kong

ACM ISBN 978-1-4503-8695-1/21/10…$15.00
https://doi.org/10.1145/3490355.3490372

Figure 1: process of auto-ethnography. (a) The screenshots of WeChat conversation; (b) An example of the researcher diary.

college students and their parents through embodying tangible interactions.

In this paper, we present an exploratory study of LUNOST, a pair of connected devices that enables emoji exchange, voice messaging and weather sharing between teenagers and parents remotely through tangible interactions, without using any digital tools. The design concept was developed based on a four-day auto-ethnography and preliminarily evaluated through a preliminary user study with 14 college students and 10 parents. Based on our qualitative and quantitative findings, this paper contributes insights into future development of tangible interactive systems that can potentially improve remote communications for college students and parents.

2 THE DESIGN OF LUNOST

2.1 Exploring

2.1.1 Auto-ethnography. Auto-ethnography is an ethnographic research method in which researchers themselves are deemed as the research object. Through autoethnography, the ethno-designer can formulate hypotheses about how specific design elements work 'from the inside', gaining empathy with the user's point of view [12]. As such, they can exploit the introspective access to their conscious mental and emotional states [8]. To obtain heuristic results, the subjective experience is studied along with those of other participants and reported in the ethnographic narratives [17].

The aim of this auto-ethnographical study was to gain in-depth insights into existing problems of remote social interactions between college students and their parents. The study was carried out in four days with the first four authors as the self-study subjects. We assumed that the lack of communication opportunities is one of the main possible barriers to cultivating active and healthy parent-child social interaction. Therefore, we designed and implemented a series of social tasks during the study, hoping to find out what topics and ways can make us have a good communication experience with our parents in the social process. We chose WeChat as the main research tool. As the dominant social app in China, WeChat has been widely adopted to facilitate remote communications between college students and their parents [18]. During the experiment, we were required to communicate with our parents at least three times a day, sharing our life or study using pictures and text messages (Figure 1(a)). At the end of every study day, we wrote a diary with illustrations (Figure 1(b)) to collect the overall feelings and communication experiences with our parents. Throughout the four days of the experiment, we continually tracked the changes of our social interactions with our parents, in terms of the frequency of online chatting, the content, and styles of the message, as well as the parents' feedback to our study.

Notably, during the experiment parents were unaware of our experiment. At the end of the experiment, we explained the study goal and design of our experiment to the parents and conducted a semi-structured interview to our parents with questions derived from the auto-ethnography. During the interview, we asked parents about their study experiences and whether such new experiences were more helpful to support parent-child socializing than usual. All the interviews were audio-recorded and transcribed for qualitative data analyses.

2.1.2 Design opportunities. For the scope of this paper, the research diary and interview data were all analyzed thematically and summarized into following two design opportunities.

Easing the remote interactions in busy lives. Based on our study, we found that the frequency of social interactions between college students and parents can be greatly influenced by the busy lives of both. On the one hand, helping college students socialize with their parents in a busy situation is a practical solution to enhance the parent-child bonding in a long term. On the other hand, it is also a practical opportunity to help parents better understand their children's current situation to avoid misunderstanding and facilitate the family support efficiently.

Icebreaking the communication with familiar topics. We found that, partly due to the distant space, the parents and children often lacked common topics, which made it challenging to start an online conversation. Another reason behind this phenomenon could be the generation gap related to communication styles, routines and hobbies. Rather than using text messages, additionally, we found that parent-child communications in WeChat were increasingly applying new ways of social interactions, e.g., emojis, voice messages or video calls, to support the communication and enrich their remote social experience. With the support of those new techniques, it could also be helpful to facilitate a common topic for the intergenerational communication in a casual and playful way.

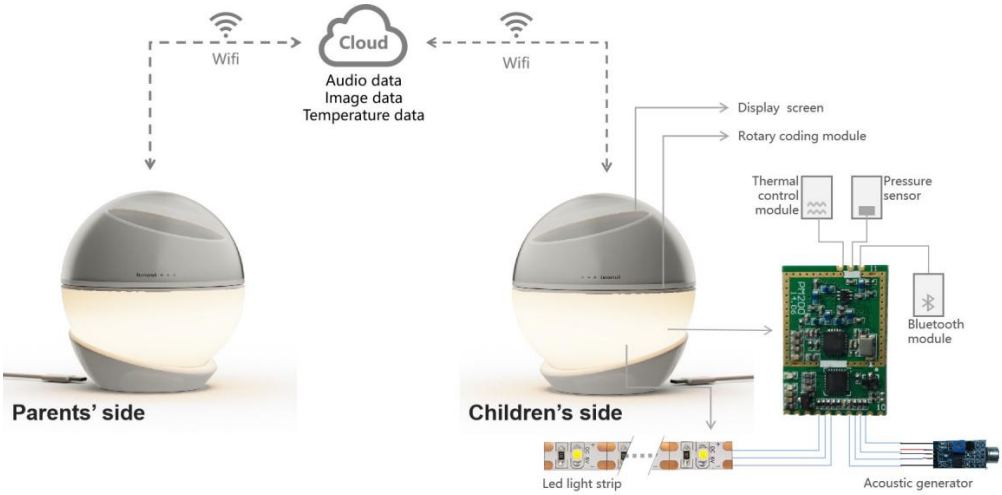

Figure 2: technical infrastructure of the LUNOST system.

Figure 3: light of LUNOST is correlated to the communication status between the college student and the parents.

2.2 LUNOST

Based on the derived design opportunities, we designed and developed LUNOST, a pair of tangible devices that provides a new form of remote intergenerational social interactions through sharing emojis and sending voice messages.

As shown in Figure 2, each LUNOST device consists of a screen with a rotatable hemisphere (the upper part) for user system interactions, and a luminating hemisphere (the lower part) that simulates the phase of the moon in the real time to implicitly express changes of the social connections over time. For instance, when the communication becomes less frequently, the light will become dimmer to remind users to interact with each other (Figure 3(a)). Based on the embedded thermistor and thermal control module, the surface temperature of the connected LUNOST devices can be kept synchronized with the weather of the other device. Therefore, users can easily feel the temperature difference between both sides by touching the device.

As shown in Figure 4, there are two types of user system interactions developed for LUNOST. First, the user can rotate the upper hemisphere to select and send a desired emoji to initiate a casual social conversation with each other (Figure 4(a)). Second, the user can simply send and receive a voice message by holding the device tightly with two hands (Figure 4(b)(c)). In addition, we envisioned that LUNOST can record the emotions and voice messages that users send to each other. These emotions form a memory map that allows users to review their interactions in the future (Figure 4(d)).

3 USER STUDY

To preliminarily evaluate the design concept of LUNOST, we conducted a user test with 14 students and their parents respectively to investigate the feasibility and user experience of LUNOST, as well as to understand whether these design properties could potentially improve remote intergenerational communications.

3.1 Participants

We recruited participants from several schools of a university in China by spreading information on the social media. We wanted to recruited students who are living far away from their parents. During recruiting, we explained the process of the study without discussing the research questions to our candidates. In the end, 14

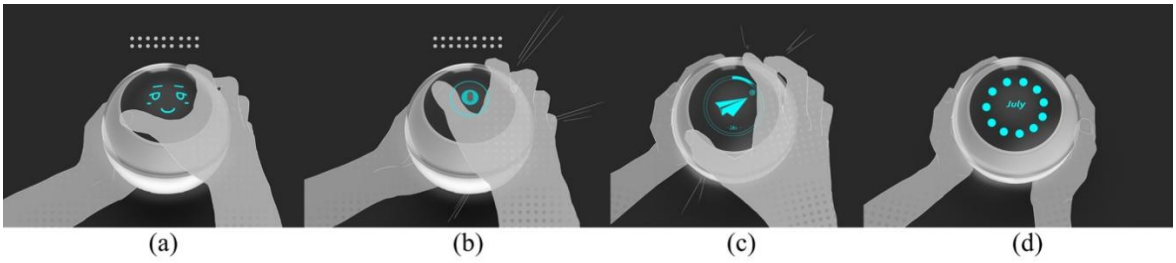

Figure 4: User system interactions of LUNOST: (a)selecting an emoji through rotating the device; (b)pressing on the device to record a voice message; (c)squeezing the device to send a message; (d) an example of the memory map of LUNOST.

Figure 5: (a) The functional prototype of LUNOST; (b) The screenshots of the video prototype.

2nd to 3rd year bachelor students (age: M=21.0, SD=1.08; gender: male: 7, female:7) volunteered to take part in our experiment and gave their consent to the study. All our participants were studying engineering disciplines, including industrial design (8), mechanical engineering (3), electrical engineering (2), and computer science (1). To acquire user feedback from the parents' perspective, we asked our participants to invite their parents to take part in the study of an online interview. Finally, ten parents accepted our invitation without allowing us to publish their personal information.

3.2 Apparatus

As shown in Figure 5(a), we developed functional prototypes to enable user experience sessions with LUNOST. Due to the technical limit at this early design stage, we mainly implemented the functions of user system interactions as demonstrated in Figure 4. The functional prototype was realized based on Arduino Uno and the Processing-based programming. We added an OLED screen to display the emoji pictures, a rotary encoder to control the selection and sending of information, and utilized the PA serial port communication to simulate the sending and receiving of information. Moreover, Figure 5(b) shows that we produced a video prototype to demonstrate all the functions of this design concept, which could compensate the limitation of the functional prototype to some extent.

3.3 Setup & Study Procedure

Before our experiment, we invited all the student participants to organize a conversation with their parents using WeChat, in order to help them gain first-hand experience with the research topic. We carried out the experiments for students and parents separately, with different setup and procedure.

As shown in Figure 6, experiments with students were conducted in a quiet classroom on the university campus, where we firstly explained the design concept of LUNOST with the physical prototype and the demo video. We then asked them to use the prototype for approximately 5 minutes to execute a few tasks, such as selecting and sending emojis and voice messages. After completing each test, we immediately asked the participant to fill in a questionnaire adapted from System Usability Scale (SUS) and User Engagement Scale (UES). Each study was concluded with a semi-structured interview with a few open-ended questions such as: *"How can Lunost remind you to communicate with your parents when you are busy?"*, *"How do you like the system interactions of LUNOST?"*, *"What do you think about the social interactions enabled by LUNOST?"*, etc.

Given the fact that all the parents participated the study remotely, they were unable to use the functional prototype. Therefore, we only presented the video-based prototype and discussed the concept with the parent participants. We also interviewed them remotely following the similar protocol as for the students.

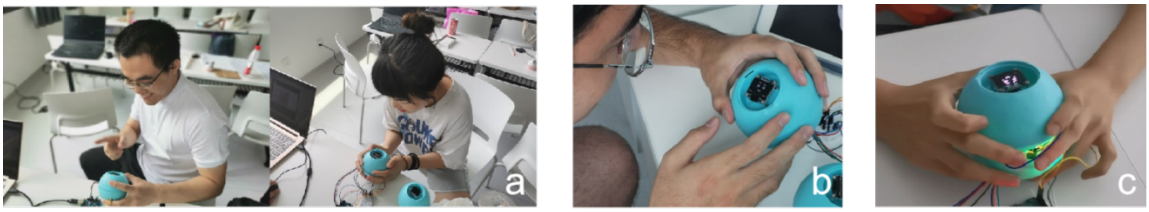

Figure 6: (a) User tests with students; (b) A participant rotating the prototype to select an emoji; (c) A participant sending the emoji and receiving feedback.

3.4 Data Collection and Analysis

In this study, we collected the questionnaire responses from the students as quantitative data and interview feedback from both students and parents as qualitative data. The questionnaire data consisted of results from SUS and UES. In the questionnaire, SUS is presented as a 12 item 5-point (from 0 to 4) Likert scale, which has been commonly applied in user research to evaluate the usability of a new product [11]. In addition, we used the short form of UES [10] to examine the user experience with LUNOST. We exclusively applied three subscales of UES, including *perceived usability* (PU) to describe the usability and acceptance, *aesthetic appeal* (AE) to describe the appearance and aesthetic of product, and reward factor (RW) to describe the rewarding item. We removed the subscale of focused attention as we envisioned LUNOST as an ambient device for social interactions. Each subscale of UES contains three items measured with 5 points (from 1 to 5).

All the questionnaires were presented in English. The received SUS data were processed and calculated into a SUS score, according to [1]. The UES responses were analyzed using SPSS software to conduct non-parametric comparisons. We applied the one-sample Wilcoxon signed rank test to compare the questionnaire results of each subscale against the median value (3). The interviews were conducted in Chinese, audio-recorded, transcribed and translated for thematic data analysis.

4 RESULTS

4.1 Quantitative Findings

In general, we received relatively positive feedback on the usability and user experience of LUNOST from our student participants. Explicitly, The SUS score reached 69.6 (SD=9.49), which is higher than the benchmark score of 68, indicating that LUNOST was perceived as a good product. In terms of UES results, the mean values of all the three subscales were similar, with 4.10 (SD=0.92) for PU, 4.07 (SD=0.63) for AE, and 3.93 for RW, respectively. One-sample Wilcoxon signed rank test indicated that the questionnaire results of this study were significantly higher than the median score when it came to the perceived usability (p=0.003), aesthetic appeal (p=0.001), and reward factor (p=0.002).

4.2 Qualitative Findings

From the qualitative analysis of students' feedback, we learned that most participants considered the novel and playful interactions offered by LUNOST as an appropriate reminder for increasing the frequency of communications with parents. For instance, one participant described that our design was more effective in reminding him to communicate with parents than the existing manner: *"Even if I put my parents on the top of the WeChat contacts list. I would also be overwhelmed by the huge information flow of WeChat, resulting in me not wanting to talk to my parents, and LUNOST pulled my parents from my WeChat to the desktop, which is so necessary."*

As for the parents, they felt that LUNOST helps them build connections with children without too much life disturbance. As one of the participants said, *"I am usually embarrassed to bother my child. He is always busy and asking about his situation will disturb him. By feeling the temperature, I can care about my child without disturbing him."* When discussing the reminder effects of LUNOST, most of the parent participants expressed negative attitudes towards initiating the conversation using LUNOST. They tended to expect the children to contact them, in order to not influencing children's study. This suggests that some of the reminder persuasion for young people may not work for parents.

5 DISCUSSION, CONCLUSIONS, LIMITATIONS

In this paper, we have presented the design process and preliminary user study of LUNOST, which focus on investigating tangible social interactions to improve long-distance relationship between parents and children. Through our auto-ethnography and design practice, we developed LUNOST as a possible solution for improving long-distance parent-teenager social interaction in Chinese families and provides quantitative and qualitative findings for future research and development of this type of interactive system. We hoped that our project can contribute to enhancing family communication by designing a tangible interactive product as persuasive technology.

In our design practice, we have verified the important role of embodied tangible product in seducing college students and parents to develop a good relationship with enhanced remote social interactions. Our are consistent with the previous research [2, 7], advocating new technologies for the need of healthy and appropriate parent-teenager communications. Too little parent-child communication leads to alienation and too strong parent-child tie leads to dependence or psychological inversion [5]. HCI technologies for improving remote intergenerational communication should be helpful and persuasive in maintaining such balances.

In terms of interaction designs, we learned that novel communication approach, intimate communication experience and empathic reminders can effectively improve users' willingness to use this type of social system. For example, LUNOST enables parents to experience the local temperature of their children's living environment,

which has been proven as fit-to-need function to most parents. Future designs may explore further on combining the state-of-the-art interaction techniques, such as augmented reality or virtual reality, for improved user experiences as persuasive design [13].

Our study also has some limitations. First, due to the low technical fidelity, we could not provide participants with full user experiences of LUNOST, which may limit our findings. Second, our sample size is relatively small. We might need more participants with different study backgrounds and culture norms to draw more solid conclusions. In the future, we will firstly modify the design concept based on lessons learned from this project and implement hi-fi prototypes. Finally, we will conduct longitudinal field studies with a diversity of participants.

ACKNOWLEDGMENTS

We thank all participants who volunteered to take part in this study. In addition, we would like to express our gratitude to Yuzhong Zhuang, who have made great contributions to our research. His contributions include but are not limited to providing materials of auto-ethnography study, model rendering and video-prototype production. This work was supported by Beijing Institute of Technology Research Fund Program for Young Scholars.

REFERENCES

[1] Brooke, J. 1996. SUS-A quick and dirty usability scale. Usability evaluation in industry. 189, 194 (1996), 4–7.
[2] Gammon, D., Årsand, E., Walseth, O.A., Andersson, N., Jenssen, M. and Taylor, T. 2005. Parent-child interaction using a mobile and wireless system for blood glucose monitoring. Journal of medical Internet research. 7, 5 (2005), e57.
[3] Golsteijn, C. and van den Hoven, E. 2013. Facilitating parent-teenager communication through interactive photo cubes. Personal and Ubiquitous Computing. 17, 2 (2013), 273–286.
[4] Henry, C.S. 1994. Family system characteristics, parental behaviors, and adolescent family life satisfaction. Family relations. (1994), 447–455.
[5] Hoffman, M.L. 1975. Moral internalization, parental power, and the nature of parent-child interaction. Developmental psychology. 11, 2 (1975), 228.
[6] Jaccard, J., Dittus, P.J. and Gordon, V. V 2000. Parent-teen communication about premarital sex: Factors associated with the extent of communication. Journal of adolescent research. 15, 2 (2000), 187–208.
[7] Kildare, C.A. and Middlemiss, W. 2017. Impact of parents mobile device use on parent-child interaction: A literature review. Computers in Human Behavior. 75, (2017), 579–593.
[8] Newell, B.R. and Shanks, D.R. 2014. Unconscious influences on decision making: A critical review. Behavioral and brain sciences. 37, 1 (2014), 1–19.
[9] Noller, P. and Callan, V.J. 1990. Adolescents' perceptions of the nature of their communication with parents. Journal of Youth and Adolescence. 19, 4 (1990), 349–362.
[10] O'Brien, H.L., Cairns, P. and Hall, M. 2018. A practical approach to measuring user engagement with the refined user engagement scale (UES) and new UES short form. International Journal of Human-Computer Studies. 112, (2018), 28–39.
[11] Ohgi, J. and Sauro, J. 2011. ISO standards and enterprise software: A case study using SUMI and SUS in an International Sale. International Conference of Design, User Experience, and Usability (2011), 178–184.
[12] Rapp, A. 2021. In Search for Design Elements: A New Perspective for Employing Ethnography in Human-Computer Interaction Design Research. International Journal of Human–Computer Interaction. 37, 8 (2021), 783–802.
[13] Ren, X., Lu, Y., Brombacher, A. and Bekker, T. 2016. Shuttlekickers: exploring social persuasions to encourage physical activities. Proceedings of the 30th International BCS Human Computer Interaction Conference 30 (2016), 1–11.
[14] Richardson, R.A. 2004. Early adolescence talking points: Questions that middle school students want to ask their parents. Family Relations. 53, 1 (2004), 87–94.
[15] Rosenthal, D.A. and Feldman, S.S. 1999. The importance of importance: adolescents' perceptions of parental communication about sexuality. Journal of adolescence. 22, 6 (1999), 835–851.
[16] Schurer, S., de New née Kassenboehmer, S.C. and Leung, F. 2015. Do universities shape their students' personality? (2015).
[17] Tedlock, B. 1991. From participant observation to the observation of participation: The emergence of narrative ethnography. Journal of anthropological research. 47, 1 (1991), 69–94.
[18] Verlinden, J., Wiegers, T., Vogelaar, H., Horváth, I. and Vergeest, J. 2001. Exploring conceptual design using a clay-based wizard of Oz technique. IFAC Proceedings Volumes. 34, 16 (2001), 177–182.
[19] Zhou, R., Wen, Z., Tang, M. and DiSalvo, B. 2017. Navigating media use: Chinese parents and their overseas adolescent children on WeChat. Proceedings of the 2017 conference on designing interactive systems (2017), 1025–1037.