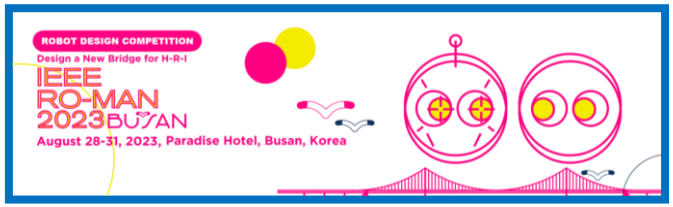
Can a Robject Express Moods in Long-Distance Relationships?



Hisham Khalil[1], Pablo Osorio[2], Daisuke Takamatsu[1], Akiyoshi Hayashi[2], Gentiane Venture[1]

[1] The University of Tokyo, hishamkhalil@g.ecc.u-tokyo.ac.jp, d-takamatsu@g.ecc.u-tokyo.ac.jp, venture@g.ecc.u-tokyo.ac.jp
[2] Tokyo University of Agriculture and Technology, s202108v@st.go.tuat.ac.jp, s217711r@st.go.tuat.ac.jp

In today's information-intensive world, a considerable number of people find themselves in long-distance relationships. Despite the prevalent use of video chat and other digital communication tools, the craving for personal, face-to-face interaction remains unmet. Telepresence technology steps in to bridge this gap, providing a more intimate communication experience. Yōkobo, a telepresence robject, offers a warm welcome to users and bridges the physical distance between couples by learning and mimicking their individual moods. This proposal introduces an upgraded Yōkobo model with enhanced functionalities, including mood exchange and touch responsiveness. Designed for couples residing far apart, these Yōkobo devices, armed with their user's learned mannerisms, facilitate a sense of direct communication. Regardless of the physical distance, interacting with Yōkobo would emulate the feeling of being in the immediate presence of one's partner.

INTRODUCTION

In today's information-dense society, many individuals find themselves in long-distance relationships due to different educational paths or job relocations. These geographical separations often cross national borders, making in-person meetings a rare occasion, sometimes limited to an annual basis. In these circumstances, couples frequently resort to computer-mediated communication (CMC) tools to maintain their connection. Video chat tools, in particular, are prevalent as they enable visual contact and verbal communication. However, in societies that have adopted a more isolated lifestyle due to the global pandemic, it has become apparent that virtual interactions via computers or smartphones are not adequate substitutes for face-to-face encounters. While video chats are beneficial, they cannot replace the need for in-person communication. In instances where physical meetings are challenging, telepresence and social robots play a crucial role in bridging the gap, offering interactions that mimic the essence of in-person communication [5].

Robots, designed to recognize, respond to, and engage with human activities in social contexts, have gained popularity as desirable household companions. They can serve as emotional companions or intelligent assistants, leveraging vision and auditory cues to interact and respond [7]. Their functionalities encompass recognizing human movements and sounds, followed by corresponding reactions that engage human auditory and visual senses.

Yōkobo

Yōkobo (see Figure 1) is a robject, that serves as both a conventional key bowl, storing everyday items like keys or coins, and as an interactive conduit facilitating communication among household members. Employing movement and light as its primary modes of communication, Yōkobo is envisioned as a component of a smart home system, designed with the core objective of fostering interpersonal connections [2, 3].
Essentially, Yōkobo's mission is to offer a warm welcome to family members or guests upon their entry into the home, while also conveying certain actions of a user to another via its motor-driven movements, or 'motion messages'. Additionally, Yōkobo leverages the data from

Figure 1. Yōkobo

environmental sensors, such as those for temperature or humidity, integrating this information into its behaviors.

Expanding Interactions

Yōkobo, holds the potential for addressing broader issues such as social isolation, long-distance relationships, and companionship. Its unique design, which interprets human movements, allows it to act as a messenger and bridge between individuals. While its current iteration proves effective within household settings, the interactive capabilities of Yōkobo can be enriched, diversified, and repurposed for a range of scenarios.

Existing telepresence robots primarily focus on visual and auditory interactions, often neglecting two crucial components of human communication - haptics and adaptability. Tactile communication is instrumental in human-to-human and human-to-animal interactions. Past research indicates that humans tend to instinctively express their emotions through touch gestures when interacting with robots [4]. Meanwhile, promoting adaptability leads to more personalized experiences. By integrating these two elements, we aim to evolve a robject - an everyday object imbued with robotic functionalities [6] - that communicates through movement. Our goal is a robject that facilitates deeper connections between partners, extends the sense of presence, and paves the way for more fluid and expressive interactions.

DESIGN PROCESS

Following the Double-Diamond design process [1], we decided to delve into potential developments for the robject. The aim is to discover and define possible use cases and extensions of the current version of Yōkobo, extending its interactions and enhancing its current capabilities.

Discovery Phase

The epicenter of our discovery stage was a user study performed in a laboratory by laboratory members working in different shifts. This study revealed that participants were capable of discerning and experiencing the mannerisms of their colleagues via the robot, which spurred an intriguing hypothesis for Yōkobo's extended use. Notably, in these interactions, there was no direct communication or physical contact between the users. Moreover, their interactions were entirely asynchronous, owing to their differing schedules.

Define Phase

This discovery phase sparked a novel prospective application for Yōkobo: supporting long-distance relationships. Insights gleaned from the exploratory phase reveal that participants are keen to engage with the robot continually. However, they found its current functionalities somewhat restrictive. Moreover, they expressed a desire for Yōkobo to manifest a more nuanced and dynamic representation of their partner's emotional landscape.

Develop Phase

To address these challenges, Yōkobo's interaction capabilities can be enhanced. Instead of just conveying motion messages, Yōkobo could learn from human interactions, creating a mood map based on user emotions and data collections from smart sensors.

To cater to individuals in long-distance relationships as represented in Figure 2, Yōkobo can add a 'mood exchange' feature to its motion message capabilities. This feature uses users' mood data to exchange mood profiles between different Yōkobo units, fostering communication and connection.

Figure 2. Interacting couples in a long-distance relationship via Yōkobo

Equipped with a learned mood map from one partner, each Yōkobo interacts with its primary user in a personalized way, thereby improving the user's connection and communication with their distant partner. There is no necessity for both partners to engage with Yōkobo simultaneously. Even during periods devoid of user interaction, Yōkobo continually communicates with the corresponding unit, ensuring that it presents the most recent mood map when the user resumes interaction. This constant updating process enables Yōkobo to reflect the most updated representation of the absent partner. This asynchronous behavior performs differently than with a voice or video call. The mood maps are a cumulative result of each interaction the robot shares with individual members of the couple.

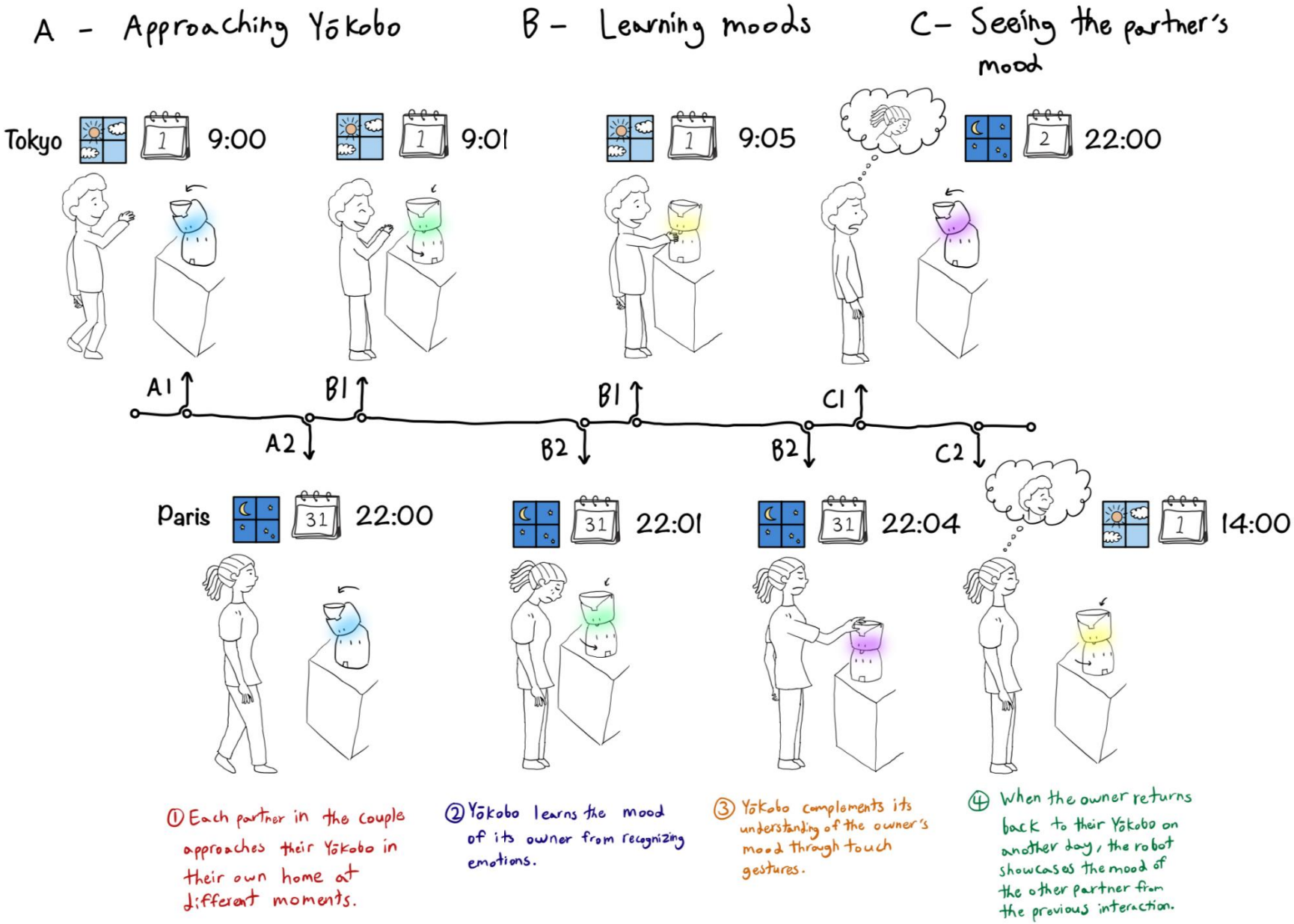


Figure 3. Example of the interaction scenario between the couple. Here, the couple showcases opposing moods of excitement and heartbrokenness, and Yōkobo reflects those states with movements and yellow- and purple-colored lights, respectively. This causes mood flips of anxiousness and relief from the partners.

To intensify the sense of their partner's presence the interaction can be enriched by adding touch recognition, enabling Yōkobo to interpret various touches, gestures, and related intentions using touch sensors.

Yōkobo will then leverage this new data to augment its existing repertoire of body movements and light cues. The generation is derived from a set of basis functions.

Yōkobo's behaviors are crafted based on a proxemics study, wherein the level of interaction corresponds to distinct proximity circles, each symbolizing the depth of the bond between the user and the robot. The closer the user is to Yōkobo, the more profound the interaction becomes. The most intimate state, occurring within the innermost proximity circle, is when Yōkobo initiates the creation of motion messages. Consequently, any touch gesture or personality response from the user is expected to occur within this state, thereby making the interactions more personable and engaging.

Deliver Phase

This stage is still ongoing, and we are preparing to test our new interactions and hardware improvement in small use cases scenarios with couples and lab members.

INTERACTION SCENARIO

Let's imagine a couple in a long-distance relationship between Tokyo and Paris, each having their own Yōkobo unit placed at the reception of their respective houses. Whenever they think about each other, they approach their Yōkobo to interact with it.

In Figure 3, we can see Yōkobo initiating the interaction by bowing in greeting. The first partner appears to be in a positive mood, showing enthusiasm by waving at Yōkobo while approaching it. Meanwhile, the second partner seems to have a neutral facial expression, potentially indicating a negative mood. Yōkobo begins to learn the current mood of its owner by first recognizing their emotional state through facial expressions. During this learning process, Yōkobo performs random movements and emits different light colors, trying to optimize the matching of its mood expression with the partner's mood.

The first partner clearly displays a mood of excitement, evident not only from their facial expressions but also through energetic hand gestures. On the other hand, the second partner starts crying in front of Yōkobo, clearly indicating a mood of heartbreak.

However, Yōkobo understands that it needs to complement its understanding of the user's mood from another dimension. Therefore, the first partner gently pats the body of Yōkobo, expressing care and positive vibes to the other partner. Meanwhile, the second partner grabs the bowl of Yōkobo and shakes it slightly aggressively, reflecting their negative mood through this touch gesture. Yōkobo then learns the correct moods of the partners and adjusts its movements and light colors, accordingly, using yellow to represent excitement and purple to signify heartbreak.

After both partners interact with their respective Yōkobo units, the two Yōkobo units exchange the learned mood models of the couple. This exchange occurs during their rest state. The next time the partners approach their Yōkobo units, the first partner appears shocked, reflecting a mood of anxiousness about the second partner's negative mood. In contrast, the second partner grins in relief, knowing that the first partner was in a positive mood during their earlier interaction.

CONCLUSION

Couples living far apart often struggle with finding quality time to interact due to busy schedules and time difference. Therefore, we introduce an interaction framework between couples involving an adaptive and expressive robject, Yōkobo.

Yōkobo uses learning techniques to emulate the mood of a user's partner, thereby enhancing a sense of connection, especially for long-distance couples. It simulates nonverbal, emotional, and tactile interactions, offering a more encompassing communication experience compared to conventional phone calls or text messages. Yōkobo provides a more intuitive understanding of emotional states by replicating the partner's mood. This is a significant advancement over previous communication methods, which were limited to visual and auditory data relayed via smartphones.

Our proposed interaction framework showcases how Yōkobo enables the exchange of mood profiles between the robjects, allowing the partners to experience a more dynamic and connected relationship despite the physical distance between them.

REFERENCES

1. Patrícia Alves-Oliveira, Patrícia Arriaga, Ana Paiva, and Guy Hoffman. 2021. Children as robot designers. In Proceedings of the 2021 ACM/IEEE International Conference on Human-Robot Interaction. Association for Computing Machinery, New York, NY, USA. 399-408. https://doi.org/10.1145/3434073.3444650
2. Siméon Capy, Pablo Osorio, Shohei Hagane, Corentin Aznar, Dora Garcin, Enrique Coronado, Dominique Deuff, Ioana Ocnarescu, Isabelle Milleville, and Gentiane Venture. 2022. Yōkobo: A Robot to Strengthen Links Amongst Users with Non-Verbal Behaviours. Machines, 10(8), 708. https://doi.org/10.3390/machines10080708
3. Dominique Deuff, Isabelle Milleville-Pennel, Ioana Ocnarescu, Dora Garcin, Corentin Aznar, Siméon Capy, Shohei Hagane, Pablo Felipe Osorio Marin, Enrique Coronado Zuniga, Liz Rincon Ardila, Gentiane Venture. 2022. Together alone, Yōkobo, a sensible presence robject for the home of newly retired couples. In Proceedings of the 2022 ACM Designing Interactive Systems Conference (DIS '22). Association for Computing Machinery, New York, NY, USA, 1773–1787. https://doi.org/10.1145/3532106.3533485
4. Yun-Kai Li, Qing-Hao Meng, Tian-Hao Yang, Ya-Xin Wang, and Hui-Rang Hou. 2022. Touch Gesture and Emotion Recognition using Decomposed Spatiotemporal Convolutions. IEEE Transactions on Instrumentation and Measurement, 71, 1–9. https://doi.org/10.1109/TIM.2022.3147338
5. Valentina Ramírez, Dominique Deuff, Xela Indurkhya, and Gentiane Venture. 2022. Design Space Survey on Social Robotics in the Market. Journal of Intelligent & Robotic Systems, 105(2), 25. https://doi.org/10.1007/s10846-022-01624-1
6. Florian Vaussard, Michael Bonani, Philippe Rétornaz, Alcherio Martinoli, and Francesco Mondada. 2011. Towards Autonomous Energy-Wise RObjects. In Towards Autonomous Robotic Systems: 12th Annual Conference, TAROS 2011, Proceedings 12. Springer Berlin Heidelberg, 311–322. https://doi.org/10.1007/978-3-642-23232-9_28
7. Lillian Yang, Carman Neustaedter, and Thecla Schiphorst. 2017. Communicating Through A Telepresence Robot: A Study of Long Distance Relationships. In Proceedings of the 2017 CHI Conference Extended Abstracts on Human Factors in Computing Systems. Association for Computing Machinery, New York, NY, USA, 3027–3033. https://doi.org/10.1145/3027063.3053240