Implementing mind monitoring service for elderly people at home using LINE Chatbot
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Purpose Self-care and independent living are not so easy for most elderly people, since their physical abilities and cognitive functions are being declined. Moreover, elderly people have a higher risk of mental depression compared to those of younger ages, due to their lost experiences. Taking these facts into consideration, it is essential to monitor mental states of elderly people at home, as well as to encourage their ability of self-care. To support in-home long-term care, the research and development of elderly monitoring system with IoT and smart homes are attracting great attention. However, the conventional systems monitor externally observable events only, and do not cover internal states of elderly people. To overcome this challenge, we propose the Mind Monitoring Service, which aims to monitor mental states of elderly people at home. **Method** Figure 1 shows the system architecture of the Mind Monitoring Service. The proposed service consists of two essential parts. The first part is to establish a communication between a target elderly person and a chatbot using the Mind Sensing technique (Nakamura et al., 2019). It aims to record the internal mind of a target person that cannot be observed externally by general sensors or IoT. In the Mind Sensing, a virtual agent (VA) or chatbot asks the person various questions to externalize his/her mind as words. In the proposed service, a chatbot sends questions to a target person over a mobile phone at a fixed time every day. As the target person answers the question, then the service records the answer as the current mental states. The second part is the context-aware inquiry method. We develop a set of inquiries specific for acquiring mental states of elderly people. We also introduce a state transition model, where the state is changed based on the user's answer. Depending on the current state, the chatbot asks different questions, which implements a context-aware inquiry method. More specifically, the proposed service first sends a question to ask the state of a target elderly person, and collects the answer. If the answer is problematic, the service moves to the "observation" state, in which the chatbot repeatedly asks the detailed circumstances for the follow-up observation. If the service stays at the "observation" state for a long time, it then moves to "alert" state, where the service alerts the situation to external supporters for asking appropriate instructions. Thus, the proposed service monitors the mind of elderly person. **Results and Discussion** We have prototyped the proposed service with LINE chatbot (LINE, 2019) (Figure 2). Using the prototype, we have conducted a preliminary experiment. The experiment was conducted for seven days with six subjects who were two men in the 70's, a man in the 40's, and three men in 20's. The preliminary results show that data characterizing mental states of individual subjects was obtained successfully. Currently, we have been conducting the additional experiment to verify the inquiry methods. In our future work, we investigate more effective and efficient inquiry methods for mind monitoring.

References
Nakamura, M., Hatano, K., Miyazaki, J., Yasuda, K., Kuwahara, N., Kazui, H., & Kosugi, N. (2019). Developing a system for self-care and mutual-aids of elderly people at home based on externalization of internal states. JSPS KAKENHI, Grant-in-Aid for Scientific Research (A), (19H01138), 2019-2023.
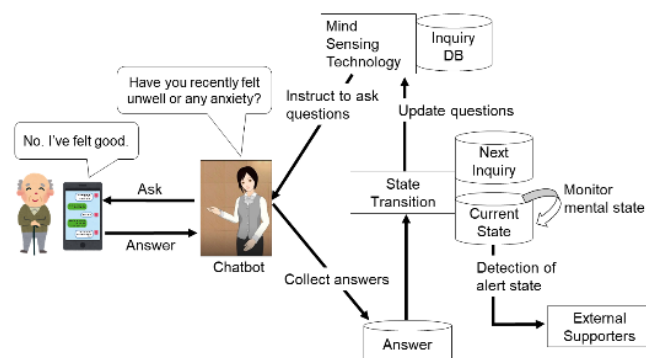LINE. (n.d.). LINE. Retrieved [Oct, 2019] from https://line.me/en/

Figure 1. System architecture of the mind monitoring service

Figure 2. LINE screen