A Teachable Agent to Enhance Elderly's Ikigai

Extended Abstract

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ABSTRACT

Ikigai is a Japanese term that is argued to be the most used index of well-being in Japanese studies about the elderly. It is often referred to as 'purpose in life' and 'the sense that life is worth living'. Family, work, and friends are common sources of *ikigai*. However, as people age, they will likely experience a loss of *ikigai*. Teachable agents (TAs) have long been used in the education field to help students with 'learning by teaching the agent'. It has been demonstrated that they may instill a sense of purpose, leading to growth in students' self-esteem. These benefits of teaching a TA may be experienced by the elderly, thereby improving their *ikigai*. We present a TA which is designed based on the concept of *ikigai* with the aim of enhancing the *ikigai* level of the elderly to help them age more healthily. A user study following the phenomenological approach was conducted, and the results demonstrated the attractiveness and effectiveness of our proposed TA design.

KEYWORDS

Ikigai; Teachable agents; Human-agent interaction; Geriatric care

1 INTRODUCTION

Ikigai is a Japanese term that is often referred to as 'purpose in life', 'the sense that life is worth living', or 'a reason for living' [8, 12, 14, 15, 18]. Motivation, meaning, joy, pleasure, social values, and societal roles are just some of the aspects of the term. [9, 26, 28, 29]. It provides a uniquely comprehensive way of looking at one's psychological state and is argued to be the most used index of well-being in Japanese studies of the elderly [15, 16, 23, 30]. Research also shows that *ikigai* may be applicable to non-Japanese cultures [13]. It is associated with longevity [1, 4, 19], and a high level of *ikigai* promotes well-being and overall quality of life [6]. However, the elderly tend to lose feelings of *ikigai* as they age due to reasons

such as retirement, and the loss of loved ones. These changes may lead to a decrease in some aspects of *ikigai* like self-esteem [25], and self-efficacy [22].

Besides declining *ikigai*, many seniors wish to pursue a healthy lifestyle, but face the obstacle of limited health literacy [2, 11]. The combination of problems inspired us to recruit a teachable agent (TA). TAs have been proven to enhance self-efficacy [17, 27] and self-esteem [3] during 'learning by teaching'. Can they also have the same effect on the elderly? A TA can assist the elderly in learning health-related topics, not only motivating them to learn, but also protecting their self-esteem and self-efficacy, and increasing their *ikigai*. Our inspiration motivated us to develop a teachable agent that improves the well-being of seniors by providing both psychological and knowledge support.

Here we present a TA which is designed based on the concept of *ikigai* with the aim to enhance the elderly's *ikigai* level to help them age healthily. A user study following the phenomenological approach was conducted, and the results demonstrated the attractiveness and effectiveness of our proposed TA design.

2 PROPOSED TEACHABLE AGENT ARCHITECTURE

To define the proposed TA, we begin with the basic definition of a generic agent system. An agent, according to Franklin and Graesser [7], is a system that is placed within an environment. It perceives that environment, and then acts on it over time to achieve its own goals and modify what it perceives in the future.

Based on this definition, and inspired by Lim *et al.* [10], we define:

Definition 2.1 (Teachable Agent for Improving Ikigai). A teachable agent for improving *ikigai*, $TAII$, is a tuple $TAII = (E, Et, K, R, A)$, where

- E is the set of environments that an agent interacts with;
- Et is the set of perception states or events that the agent perceives from the environment;
- K is the set of pre-stored knowledge and the knowledge that the agent learned;
- R is the set of reasoning mechanisms, including *Ikigai* Assessment Reasoning (As), Teachability Reasoning (Tr), and Practicability Reasoning (Pr), employed by the teachable agent;
- A is the set of actions that the agent takes.

The architecture for the proposed TA for improving *ikigai* is as shown in Figure 1.
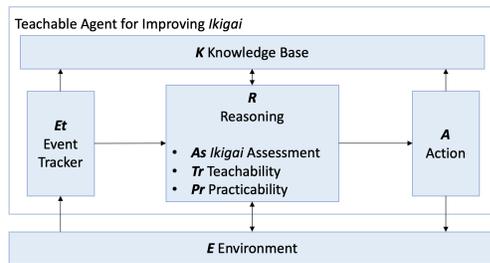

Figure 1: Teachable agent for *ikigai* architecture

As, *Tr*, and *Pr* enable the agent to evaluate the level of *ikigai*, learn new knowledge, and practice the knowledge it has learned. The proposed model enables the agent via three primary types of tasks. These are repeated and form three running cycles, namely the assessment cycle ($EtAs(KA)$), the teaching cycle ($EtTrK$), and the practicing cycle ($EtPr(KA)$).

2.1 *Ikigai* Assessment

To assess the user's *ikigai* level, the four-factor scale [25] is used. It measures one's *ikigai* based on self-esteem, purpose in life, personal energy, and life satisfaction, which are considered the most appropriate factors to explain the concept. One needs to rate whether he/she agrees with each of the twenty-eight items on a five-point rating scale.

2.2 Knowledge Teaching and Practicing

A knowledge graph describing the concept to be taught is created and stored in the Knowledge Base to help agents identify possible misunderstandings. TAs learn from users and check what they have learned against the 'correct answers' stored in the knowledge graph. The entity and relation are extracted from the user input text and compared with the knowledge graph. When the agent suspects a misunderstanding about a concept, for example, different triplets for input and knowledge graph, it generates questions about it to see whether the user comprehends it. A tailored message will be sent if the user does not understand the content. It is to guide him and prompt him to examine the concept more closely.

2.3 Modelling with Goal Net

Throughout its lifetime, a TA senses, reasons, and acts in its environment. The agent's main routine is the repeated cycle, which may be modeled using goal-oriented agent modeling, known as Goal Net [20, 21]. With this, the TA can be more proactive in assessing the elderly's *ikigai* level, incorporating the knowledge learned from the elderly user, and practicing the knowledge learned from the elderly. Goals may be decomposed into sub-goals and the agent must complete a sequence of sub-goals in order to reach their goal.

3 USER STUDY

For an assessment of the effectiveness of the proposed philosophy and design of TA, we recruited 10 seniors between the ages of 55

and 68 (n=10, mean=61.75, SD=3.52) and conducted a 1-month user study using the phenomenological approach. By observing people's experiences in various ways, phenomenology is a qualitative research method widely used in describing and analyzing lived experiences [5], and a typical phenomenological study involves one to ten participants [24]. During the study, our teachable agent Akeso, installed on each participant's smartphone, communicated with the participants every day. This study was approved by the Nanyang Technological University Institutional Review Board with reference number IRB-2022-032.

The post-study questionnaire results showed a high acceptance of Akeso with a score of 4.57 out of 5. Participants enjoyed communicating with Akeso and had a good time. Eight out of ten of our participants would like to use Akeso in their daily life.

Following the phenomenological approach, we categorized the participants into 2 groups based on the different changes in their *ikigai*. Participants' *ikigai* improved in Group 1 (n=5), while participants' *ikigai* did not increase significantly in Group 2 (n=5).

We did not find significant differences in learning effectiveness and interactional engagement between the two groups. By coding the experiences of the participants, we found the following commonalities among those who showed an improvement in their *ikigai* level:

- **Asking questions to the agent**. While the major communication pattern of our agent system is questioning by the agent and answering by the users, all the participants in Group 1 asked questions to the agent actively.
- **Searching for further knowledge**. When Akeso asked questions that were slightly beyond the given learning material, participants in Group 1 replied with active knowledge-digging behaviors like *'I searched via Google...'*.
- **Rectifying the behaviors of the agent**. Group 1 showed a specific tendency to correct the agent and the corrections were not related to the key knowledge GI.
- **Treating Akeso as a human being**. Participants from Group 2 considered Akeso as a human being while the majority of participants in the other group believed it was a robot.
- **Expressing feelings during the interview**. The participants in Group 1 expressed more emotional feelings associated with interacting with Akeso, for example, *'I feel strong and powerful when Akeso admits her fault and commits to changing her behaviors'*.

We further summarized the first 3 points as proactive behaviors during the interaction and the last two as humanized cognition of the agent.

4 DISCUSSION AND CONCLUSION

Based on the analysis results, we reveal aspects of the lived experiences of senior users when using our proposed TA, Akeso, and demonstrate its effectiveness in enhancing the *ikigai* level, especially in terms of self-esteem, of the elderly users. Based on this finding, we will study how to improve the humanized cognitive features of the agents in conversation functions, and how to encourage active behaviors of participants.

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