

A Method for Reducing Loneliness in Older Adults Through Empathetic Responses Based on Conversational History

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Abstract—Japan currently has the highest proportion of older adults in the world, and this percentage is expected to continue increasing. Alongside this demographic shift, the number of older adults living alone is also on the rise, contributing to concerns about social isolation and loneliness. To address this issue, we are developing a virtual agent (VA) listening service that engages in daily conversations with home-dwelling older individuals. However, prior VA listening service have struggled to generate personalized responses tailored to each user’s background and needs. In this study, we propose and implement a method for automatically constructing user profiles based on dialogue history between the VA and the user. By leveraging Facebook AI Similarity Search (FAISS) and large language models, the system enables natural and empathetic dialogue tailored to the user’s personality, hobbies, interests, concerns, lifestyle, and recent experiences. This approach improves the individualization of interactions, contributing to more engaging and supportive communication for older individuals. An exploratory evaluation was conducted using real dialogue histories from two older adults. Through qualitative review of generated prompts, the method demonstrated its potential to produce context-aware and empathetic utterances.

Index Terms—Virtual Agent Listening Service, ChatGPT, FAISS, Older Adults, Loneliness

I. INTRODUCTION

Currently, Japan has the highest proportion of older adults in its total population worldwide, and this proportion is expected to continue rising in the future [1] [2]. The proportion of older adults living alone is also increasing, leading to a rise in the

number of older adults experiencing loneliness and isolation. Against this backdrop, our research group has developed a Virtual Agent (VA) listening service that provides emotional support to home-dwelling older individuals by allowing them to share their daily anxieties and concerns with a virtual agent [3] [4] [5]. However, this service has two main issues.

P1: Uniform and formulaic prompts

P2: Responses limited to the immediate context

The objective of this study is to address the issues in the VA listening service and create a service that provides emotional support and a sense of security to older users. To achieve this goal, we propose five approaches in our method.

A1: Vectorization and accumulation of dialogue history

Dialogue history is vectorized and stored in a FAISS index for each user.

A2: Construction of user profiles

Extract information from dialogue history using semantic search to construct structured user profiles.

A3: Automatic updating of user profiles

Automate the process from acquiring dialogue history to updating profiles using a workflow orchestration tool, ensuring that the latest user status is always reflected.

A4: Personalized response generation

Generate natural responses that consider the user’s personality and situation by including user profiles in the prompts, thereby enhancing the quality of the dialogue.

A5: Generation of empathetic prompts based on user

emotions and interests

Generate psychologically empathetic questions based on the profile to foster a sense of security and trust, enabling continuous dialogue.

By employing approaches A1 through A5, this study realizes a method that enables the generation of personalized prompts and responses. A future challenge is to verify the effectiveness of the improved VA listening service by having it used by actual older adults.

The structure of this paper is as follows. Section 2 provides background information on the current state of an aging society. Section 3 describes the architecture and functions of the proposed method. Section 4 discusses the preliminary evaluation experiment of the service. Section 5 presents a discussion. Finally, Section 6 concludes the paper.

II. BACKGROUND

A. VA Listening Service

Our research group has developed a VA listening service that uses virtual agents to provide emotional support to home-dwelling older adults in their daily lives [3] [4] [5]. The service allows older adults to share their daily anxieties and concerns with a virtual agent, providing emotional support.

Results from demonstration experiments using the VA listening service have shown that it functions as a platform for emotional expression and is effective in addressing loneliness and emotional changes [6]. The service is equipped with a human detection sensor, allowing it to automatically initiate conversations when the user approaches the computer.

B. Issues in Prior Research

In prior research on VA listening services, two main issues can be identified.

P1: Uniform and formulaic prompts

In the current VA listening service, questions about "breakfast," "lunch," "dinner," and "hydration" are asked mechanically according to the time of day. For example, around 8 a.m. every morning, a standard prompt such as "Could you tell me what you plan to eat?" is used. Such uniform and formulaic prompts do not take into account the user's personality or lifestyle, they may feel boring and mechanical, making it difficult to establish an emotional connection between the VA and the user.

P2: Responses limited to the immediate context

In the current VA listening service, responses are generated without considering the user's past statements or behavioral history. Therefore, it is believed that the service cannot provide responses that take into account what the user has previously said or done, limiting its effectiveness in providing emotional support. When users feel that their previous statements are not remembered, their trust in the VA may decrease, potentially leading to reduced communication with the VA. Such interactions risk giving users the impression that their words are not genuinely acknowledged, which may lead to a decline in their amount of speech and make it difficult to foster a trusting, long-term relationship with the VA.

For older individuals to feel psychological comfort and a sense of connection in their interactions with the VA, it is essential that the dialogue moves beyond simple exchange of information and reflects an effort to understand the individual's experiences and emotions. If the VA can understand the user's thoughts and past experiences, and engage in dialogue based on that understanding, users may begin to perceive the VA as an entity that genuinely cares for them and understands their individuality. As a result, psychological benefits may emerge, such as reduced loneliness and a greater willingness to continue engaging in conversation. Therefore, addressing P1 and P2 requires a two-pronged approach: (1) building a foundation for understanding users and (2) generating dialogue based on that foundation.

C. Related Work

We introduce a paper by Choi and Lee [7]. This paper summarizes the development trends of ICT interventions designed to reduce loneliness in the older adults, and shows the effectiveness of ICT interventions designed for the older adults in reducing loneliness and social isolation, and for social networks. It has been shown that interacting with software humanoid animation agents that assess the emotional state of the older individuals and their daily step count alleviates social isolation. Furthermore, it has been shown that receiving appropriate and healthy feedback from these agents motivates the older individuals to engage in physical activity. In addition, Kryazhych et al. proposed a personalization approach based on users' cognitive and query behaviors within the GOMS framework, aiming to optimize chatbot interaction without explicit user registration [8]. While their work focuses on interaction-level personalization, our study advances long-term understanding by leveraging dialogue history to construct user profiles for empathetic response generation.

These studies do not delve into continuous individual understanding based on the speech history of each older adult. In this study, we focus on automatically constructing user profiles from dialogue history to enable empathetic response generation that reflects the user's personality and context.

D. FAISS

FAISS (Facebook AI Similarity Search) [9] is a large-scale vector search library developed by Facebook that provides the capability to perform fast and efficient similarity searches between vectors in high-dimensional spaces. Representative index structures include IndexFlatL2, which performs exact searches by sequentially comparing all vectors, and IndexIVFFlat, which enables approximate nearest neighbor searches using clustering. In particular, IndexFlatL2 is a method that performs a complete exhaustive search based on Euclidean distance (L2 distance), making it suitable for scenarios where search accuracy is prioritized. In this study, we leverage FAISS, a high-dimensional vector search tool, to quickly extract semantically related utterances from vast dialogue histories, using it as a foundation for constructing user profiles.

E. Apache Airflow

Apache Airflow [10] is a workflow orchestration tool that allows for the explicit definition and control of task dependencies. Workflows written in Python are structured as Directed Acyclic Graphs (DAGs), where each node represents an individual task, and edges indicate the execution order and dependencies. By using Airflow, periodic task scheduling and execution can be automated. In this study, we adopt Airflow for workflow automation, enabling the periodic reconstruction of profiles in response to updates in dialogue history, thereby allowing for response generation that always reflects the latest user status.

III. PROPOSED METHOD

A. Objectives and Approaches

The objective of this study is to address the issues outlined in Section II-B and create a VA listening service that provides emotional support and a sense of security to older users. To solve this problem, it is necessary to meet the following two requirements.

R1: Extraction and construction of user profiles based on dialogue history

To enable empathetic prompts and responses, it is essential to accurately understand the user’s characteristics, such as personality, interests, and lifestyle. Therefore, a mechanism is needed to extract and summarize semantically related utterances from accumulated dialogue history and organize and construct them structurally as user profiles.

R2: Generation of empathetic prompts and responses based on user emotions

To function as a trusted conversational partner, the VA must provide responses that consider the user’s situation and emotional state. Therefore, it is necessary to utilize the constructed user profiles to generate prompts and responses tailored to individual emotions and interests.

In this study, we propose five approaches to meet these requirements. Each approach implements functions that satisfy the requirements.

- A1: Vectorization and accumulation of dialogue history
- A2: Extraction of user profiles
- A3: Automatic updating of user profiles
- A4: Personalized response generation
- A5: Generation of empathetic prompts based on user emotions and interests

B. Overall Architecture

The overall architecture of the system is shown in Figure 1. The system consists of a VA listening service, a database, a vector index, an orchestrator, and user profiles. The orchestrator periodically vectorizes the dialogue history accumulated in the database and stores it in the vector index. Furthermore, the orchestrator updates user profiles based on the vector index, and the VA listening service generates empathetic prompts and responses based on these profiles. The dialogue log stored in MongoDB is vectorized via embedding model and indexed

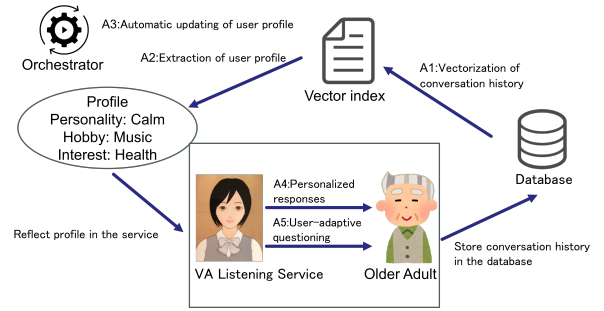


Fig. 1: Overall architecture of the system

in FAISS, which is then accessed by the VA module for personalized response generation.

C. A1: Vectorization and Accumulation of Dialogue History

The dialogue history between the user and the VA in the VA listening service is stored in a database (MongoDB [11]). However, incorporating this history directly into prompts can result in an excessively high token count, making practical processing difficult. To address this issue, the dialogue history is vectorized and stored in a FAISS index (IndexFlatL2) [9] for each user. Specifically, the dialogue history is extracted from the database and saved in CSV format. Subsequently, the dialogue history is vectorized using an embedding model (text-embedding-3-large [12]) and stored in a FAISS index for each user.

D. A2: Construction of User Profiles

In this system, a FAISS index is maintained for each user to enable semantic retrieval over their dialogue history and to construct a corresponding user profile. To systematically capture multifaceted user information—encompassing personality traits, persistent interests, recent activities, and exceptional events beyond routine behavior—query representations are formulated and vectorized to retrieve semantically aligned past utterances. The FAISS index embeds metadata such as utterance content and timestamps for each vector, thereby allowing the retrieved instances to be contextualized in terms of when and under what circumstances they were produced.

In this system, FAISS, as described in Section II-D, is first used to quickly extract semantically related utterances, obtaining the top 100 candidates. Then, a temporal weighting method is applied based on the timestamps, giving higher weights to more recent data, followed by another extraction process of 50 items. Furthermore, by inputting the utterances selected by each query vector into ChatGPT, a structured user profile is generated by summarizing the user’s personality, hobbies, interests, lifestyle, and events over the past 30 days.

E. A3: Automatic Updating of User Profiles

The user’s state, interests, and events occurring around them change daily. In particular, events happening around the user are highly time-dependent, and outdated information may not accurately reflect the user’s current situation. Therefore,

user profiles need to be updated regularly and maintained based on the latest dialogue history. In this system, Apache Airflow [10], as described in Section II-E, is used to automate the construction and updating of user profiles. Specifically, the entire profiling pipeline is scheduled to run once every 24 hours, and the dependencies of the processing steps are explicitly defined in an Airflow DAG, and by sending HTTP requests sequentially to APIs corresponding to each processing step once a day, a series of processes are executed automatically. Through scheduling with Airflow, consistent updates of user profiles are achieved while keeping up with the user’s changing state. This enables the VA listening service to generate personalized responses based on the most current information.

F. A4: Personalized Response Generation

In conventional response generation in VA listening services, individual information such as the user’s personality and lifestyle was not reflected in the prompts, making it difficult to provide flexible responses that fully consider the user’s background and situation. As a result, the generated responses could not be said to adequately consider the user’s individuality, leading to dialogues that tended to be somewhat formal and general. Additionally, the insufficient utilization of past dialogue history and context resulted in a lack of continuity in conversations, making it difficult to deepen the relationship with the user.

To address these issues, this study incorporates user profiles explicitly into the prompts to enable response generation that aligns with the user’s characteristics and state. The constructed profiles include multifaceted information about the user, such as personality, hobbies, interests, anxieties, lifestyle, recent events, and special events.

Specifically, the user profile is described at the beginning of the prompt to ChatGPT, instructing it to generate responses that consider this content. This allows the LLM to generate contextually appropriate responses while understanding the user’s background information. For example, responses that reference hobbies or recent events, or prompts that consider individual lifestyle rhythms can be realized, enabling dialogues that give users the impression of being “understood.” This approach allows for the provision of personalized dialogue experiences tailored to each user’s individuality and situation, moving away from conventional formal responses.

G. A5: Generation of Empathetic Prompts Based on User Emotions and Interests

In VA listening services, the focus has been on predetermined, standardized prompts, such as asking about meals and hydration during morning, noon, and evening time slots based on sensor responses. While this allows for the collection of basic lifestyle information, it does not adequately address the user’s psychological state or emotional changes, leading to interactions that tend to be mechanical. To move away from such mechanical dialogues and build more human-like and continuous relationships, this study proposes a method

for automatically generating prompts that empathize with the user’s emotions and interests.

This method generates individual questions that reflect the user’s personality, lifestyle, recent events, and other aspects based on the constructed user profile. Additionally, seasonal and date-related elements are incorporated to aim for more natural and warm expressions. The generated prompts can be broadly classified into the following two types:

Empathetic Questions: These prompts focus on the user’s health, emotional state, and connections with others, using soft and indirect expressions. For example, questions like “How have you been feeling lately?” or “If there are any memorable summer traditions or social events, I would love to hear about them.” provide a sense of security to the user and encourage natural self-disclosure.

Questions Reacting to Daily Events: These prompts utilize information about “recent events” and “special events” included in the dialogue history to elicit specific impressions, feelings at the time, and underlying stories. For example, questions like “How was your walk you mentioned the other day? Did you enjoy it?” or “What happened after your conversation with your friend last week?” enable responses that consider past dialogue content.

The former focuses on empathy towards internal elements such as emotions and health, while the latter responds to specific past events. Such prompts are not merely intended for information retrieval but are designed to gently empathize with the user’s emotions, playing a crucial role in building trust. Psychological empathy leads to experiences where users feel “remembered” and “understood,” resulting in the realization of continuous dialogues and the deepening of monitoring support. This method enables VA listening services to provide dialogues that are not limited to formal prompts but are characterized by individuality and warmth.

IV. EVALUATION EXPERIMENT

A. Overview of the Experiment

This chapter describes the evaluation experiment of the proposed method. The purpose of this evaluation experiment is to qualitatively assess how well the prompts and responses generated using profiles constructed based on actual older users’ dialogue history reflect the users’ characteristics and life context, and how empathetic they are. The subjects of the evaluation are two older men living alone (User A: in his 90s, User B: in his 80s). User A has been continuously using the VA listening service since March 2024, and User B since January 2024. The evaluation is conducted based on the dialogue history accumulated during that period. This experiment targets dialogue data collected up to July 17, 2025, and with the clear consent of the users, the content of their utterances is used for profile construction and system development and evaluation.

Across this period, a total of 9,457 utterances were recorded for User A and 6,809 for User B. Each dialogue instance in this study is treated not as a single sentence, but as a

conversational exchange comprising multiple back-and-forth utterances between the user and the VA. These dialogue exchanges, each associated with timestamped interaction data, were vectorized and processed using FAISS (IndexFlatL2) to enable semantic retrieval during profile construction.

Based on the collected dialogue history, profiles are constructed for each user. These profiles include multifaceted elements such as personality, hobbies, interests, anxieties, lifestyle, recent events, and special events. Using the constructed profiles, individualized prompts are generated for each user based on the method described in Section III-G. Additionally, following the method outlined in Section III-F, the dialogue responses in the VA listening service are personalized for User A using User A's profile. Subsequently, a qualitative evaluation is conducted to assess how well the generated prompts and responses reflect the users' characteristics and life context. Through these processes, the aim is to clarify how the proposed method enhances understanding and empathy towards users and enables more natural and reliable dialogues.

B. Experimental Results

In this experiment, using the profiles of User A and User B constructed from the dialogue history accumulated in the VA listening service, prompts were automatically generated using LLM. Below are the respective profiles and the generated questions.

Profile of User A:

Personality / Lifestyle: Sociable, values interactions with local people, participates in local gatherings, and regularly obtains information through TV and newspapers

Hobbies / Interests: Watching baseball, watching TV, politics, world events, and local activities

Frequently Discussed Topics: Waiwai Cafe (Local Community), baseball, local gatherings

Concerns: health condition, local events

Recent Events / Special Events:

- July 17, 2025 (Thursday) 15:10: Went to Waiwai Cafe and had a great time
- July 18, 2025 (Friday) 20:10: Ate sukiyaki and had an important conversation after returning home

Empathetic Questions (User A):

How have you been feeling lately regarding your health condition? The summer heat can affect health, so I hope you're staying as well as possible.

During your enjoyable time at Waiwai Cafe, were there any memorable stories or encounters?

How was your walk you mentioned the other day? Did you enjoy it?

Questions Reacting to Daily Events (User A):

I heard that you visited Waiwai Cafe on July 17. How was that day? What moments stood out to you the most?

How was your special day on sukiyaki day (July 18)? Did you have any new discoveries or joyful events?

How was your walk you mentioned the other day? Did you enjoy it?

Profile of User B:

Personality / Lifestyle: Optimistic and sociable, enjoys daily life and lives as if every day is a holiday, spending time on hobbies

Hobbies / Interests: folk songs, shakuhachi(Japanese musical instrument), paper cutting, darts, Japanese drums, and interest in traditional music and culture and healthy living

Frequently Discussed Topics: Hydration, hobbies, daily activities, meals

Concerns: Nothing in particular

Recent / Special Events:

- July 5, 2025 (Saturday) 07:41: Started attending a Japanese drum class
- July 5, 2025 (Saturday) 07:41: Enjoying the darts club

Empathetic Questions (User B):

What fun conversations have you had recently with your traditional music friends or darts club members?

Have you tried any new foods recently, or found something particularly delicious?

How was your walk you mentioned the other day? Did you enjoy it?

Questions Reacting to Daily Events (User B):

Since you started attending the Japanese drum class, what changes have you noticed? How did you feel on your first day (July 5)?

Through your activities in the darts club, if you've acquired any new skills or have interesting episodes, please share them.

How was your walk you mentioned the other day? Did you enjoy it?

As a preliminary evaluation of the responses generated using User A's profile, the actual dialogue content is shown below.

VA: Please feel free to talk to me about anything.

User: Hello.

VA: Hello, Taro! I'm glad to see you looking well today.

VA: Have you had any fun experiences at local events recently? I'd love to hear about your time at Waiwai Cafe.

User: I went to Waiwai Cafe yesterday.

VA: Hello,Taro! You went to Waiwai Cafe yesterday.

VA: What fun experiences did you have? Please share your experience, Taro.

V. DISCUSSION

A. Discussion of Experimental Results

This study verified whether prompts adapted to the life context of each older adult can be automatically generated by integrating personal profiles constructed from dialogue history into LLM using Retrieval-Augmented Generation (RAG). As a result, it was confirmed that the generated prompts were not limited to general and standardized expressions but exhibited

diverse formats based on individual interests and experiences, indicating the possibility of establishing individualized dialogues.

From the combined perspectives of accuracy and empathy, the generated prompts demonstrated that the LLM did more than simply retrieve profile information. They accurately reflected factual details—such as referencing User A’s visit to Waiwai Cafe on July 17—while transforming those facts into personalized and considerate inquiries that resonate with the user’s life context. Rather than repeating events verbatim, the prompts encouraged storytelling and emotional engagement, as seen in questions addressing health concerns or personal hobbies. This integration of factual grounding with empathetic framing suggests that LLMs can facilitate dialogues that acknowledge not only what users have experienced, but also how they may feel about those experiences.

Next, in terms of memory recall, prompts based on specific dates and experiences served as triggers for recalling past experiences, going beyond mere response elicitation. For older adults, the act of narrating their own events may be linked to psychological processes involving self-confirmation and re-evaluation of life, and this method provided linguistic stimuli that could serve as triggers for such processes. This suggests the potential for dialogue systems to play a welfare function.

Furthermore, phenomena related to conversation facilitation and perceived understanding were also observed in this study. In the case of User A, when the user mentioned Waiwai Cafe, a place for community interaction, the VA maintained the specific context while re-asking about the details of the event, demonstrating a format that continued the dialogue. Such context-following does not introduce new topics but provides a foundation that makes it easier for users to narrate their experiences, contributing to the avoidance of silence and the natural development of dialogue. Moreover, by issuing prompts based on specific life backgrounds, it creates an effect that makes users feel “remembered,” potentially leading to psychological trust that cannot be obtained through standardized dialogues.

B. Future Challenges

The results of the evaluation experiment confirmed that the generated prompts and responses were empathetic to the users’ characteristics and life context. In the future, it is necessary to have multiple older users utilize the improved VA listening service, which applies the proposed method, over an extended period to verify its usefulness in continuous dialogues. Specifically, it is essential to clarify the extent to which the proposed method contributes to reducing users’ feelings of loneliness and isolation through comparisons with the conventional VA listening service. Additionally, future challenges include conducting quantitative analyses on how prompts based on profiles elicit reactions in actual dialogues and their impact on users’ speech volume and emotional expressions. In the future, we plan to compare the number of utterances, average utterance length, and subjective satisfaction (on a 5-point scale) with more than 10 older users as subjects.

VI. CONCLUSION

In this study, we proposed and implemented a method to extend the existing “VA Listening Service” by constructing user profiles based on dialogue history, enabling the generation of individualized prompts and responses. The background for proposing and implementing this service is the increasing proportion of older adults living alone, leading to a rise in the number of older individuals experiencing loneliness and isolation. The aim of this research is to realize a VA listening service that empathizes with the hearts of older users and creates a sense of security. The proposed method demonstrated the feasibility of individualized dialogues based on a series of approaches, including accumulation of dialogue history, profile extraction, automatic updating, personalized responses, and empathetic prompts. Future challenges include having older users utilize the improved VA listening service and quantitatively evaluating its usefulness.

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