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Towards a Humorous and Empathetic Companion Dialogue System with a Cultural Persona for Older Adults

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Abstract: Artificial Intelligent (AI) dialogue systems have been used as companions to provide daily social support and promote healthy lifestyles for older adults. Existing studies on empathetic companionship of AI dialogue systems found that these dialogue systems have primarily focused on passive observation of scenarios and computational simulation of companionship. In addition, these dialogue systems are unable to provide tangible empathetic and humorous companionship through meaningful and purposeful involvement to alleviate loneliness of older adults while considering their cultural backgrounds. In this research-in progress paper, we propose a companion dialogue system with an empathetic and humorous persona to actively collaborate with older adults to help curtail loneliness by resolving a task together while considering the user's cultural backgrounds. The companion dialogue system will be capable of offering personalized therapeutic intervention based on behavior modification models, fostering emotional empathy and intermediate humor via culturally rich conversational exchanges, and reducing loneliness and depression through activities that involve team cooperation.

Keywords: Artificial Intelligent, older adults, humor, empathy, culture, persona

1 Introduction

The percentage of the population that is aged 65 and older is expected to skyrocket over the next decades, rising from 17.4% in 2014 to 25.6% in 2030 (Kamali et al., 2018). Numerous elderly individuals live alone, and the experience of isolation might aggravate some of the medical ailments they already have. Despite the fact that nurses and other caregivers often fill in for absent family members, these alternatives are becoming more restricted as demand exceeds the supply. As a result of advancements in artificial intelligence (AI), it is now possible to build therapeutic interactions not just with humans but also with artificial entities, which are often referred to as social dialogue systems or dialogue systems. AI dialogue systems are software agents that allow users to access services and information via interaction in the users' everyday language, whether that engagement takes place through text or speech. These dialogue systems are able to speak with older adults in an empathic and humorous manner and often have become companions (Shum et al., 2018; Takahashi, 2019).

These existing companion dialogue systems for older adults, however, are only capable of addressing a provocation of empathy from passive observation instead of active involvement to better mental health, to cognitive function, and most importantly to avoid social isolation. Due to the unfamiliarity with the complicated technology, the interaction between companion dialogue systems and older adults seems rather mechanical, patronizing, and lacks humor (Takahashi, 2019). In addition, none of the existing studies have focused on older adults' cultural heritage when designing a companion dialogue system, and cultural heritage can improve older adults' health and well-being by igniting their memories and imaginations.

Therefore, this paper proposes a companion dialogue system with an empathetic and humorous persona to actively engage with older adults to resolve a task, such as Trivia Quizzes, Puzzles or Sudoku, by deciding together while considering their cultural backgrounds. By doing so, the dialogue system

attempts to curtail loneliness by offering personalized therapeutic intervention based on behavior modification models and fostering empathy and humor via emotionally and culturally rich conversational exchanges.

2 Related Work

Many studies have been conducted in finding ways to mitigate older adults' loneliness and social anxiety (Razavi et al., 2019; Shum et al., 2018; Takahashi, 2019). These studies can be generally classified into four types of AI dialogue systems embedded with humor, empathy, culture, and persona. The AI humor system is primarily employed to imitate the style of human interaction to mitigate frustration when engaging in a conversation with a computer (Shum et al., 2018). The AI empathetic system has been used for analyzing older adults' emotions and generating responses (Li et al., 2022). The AI Culture system has been embedded in the systems to indicate society's shared ideas and make contributions to society (Takahashi, 2019). A persona-based dialogue system is a character that aims to mitigate seniors' loneliness, social anxiety, or social isolation (Razavi et al., 2019).

2.1 AI Humor

Humor is an indispensable and pervasive aspect of daily life associated with various positive consequences. It is believed that humor and positive expression of emotion reduce users' anxiety, including seniors, and act as a buffer against stress. Thus, various humorous companion dialogue systems have been introduced to curtail the issues of anxiety and loneliness (Mundhra et al., 2021). In 2014, China launched XiaoIce (literally Little Ice in Chinese), a social companion dialogue system (Shum et al., 2018). The system architecture and main components are highlighted by the core chat computing module. Core Chat is an advanced technology that engages users to participate in extensive and open-domain discussions with other users. Similarly, Replika is a chitchat companion system whose architecture resembles that of Core Chat in XiaoIce. Replika combines neural generation and retrievalbased techniques to condition responses. Replika's neural generating component is persona-based, similar to XiaoIce's neural response generator. Replika is believed to contribute to higher self-esteem by reducing loneliness and introducing optimism and humor if it is used to motivate individuals to reach out to others with more confidence and vigor (Takahashi, 2019).

2.2 AI Empathy

Empathy is the capacity to place oneself in another's position and make an informed judgment. As individuals age, they become more fragile, and their demands increase. Companion dialogue systems have been proven efficient in addressing social isolation and loneliness in older adults by offering empathetic responses. Zorrilla et al. (2018) proposed an empathetic virtual coach for older adults at home, and the authors believed that the virtual coach was able to develop causal models of coach-user interaction to help older adults curtail loneliness, maintain their health status, and enhance their quality of life. Ring et al. (2015) introduced a multimodal conversational agent-based system intended to offer longitudinal social assistance to solitary older adults. Based on the exploratory pilot study, the system has a high degree of acceptability and customer satisfaction. Results showed that it effectively mitigated loneliness when the system actively invited older adults into interactions triggered by a motion sensor. The design of active involvement of the system is in contrast to the existing studies, which often involve companion systems' passive participation depending upon elders to initiate interactions.

2.3 AI Culture

Through the lens of their respective cultures, people identify themselves, conform to society's shared ideals, and make contributions to society (Takahashi, 2019). Cross-cultural studies of companion dialogue systems for older adults are scarce, and only a few studies include cultural elements in the design of dialogue systems, such as Xiaoice and CARESSESS. XiaoIce allows users to build long-term, emotional bonds with one another, and it also takes into account cultural variations and a large number of sensitive ethical concerns (Shum et al., 2018). The author believed that when XiaoIce is embedded onto an open social chatbot platform for third parties, its persona is able to be customized according to the particular user scenarios and cultural norms of the users. Riva and Riva (2019) proposed a

companion dialogue system, CARESSES, embedded with culturally competent artificial intelligence. CARESSES was made aware of the particular older adults' cultural backgrounds, and the system employs the appropriate Cultural Knowledge Base (CKB), which is able to predict participants' values and preferences. The results showed that using the CARESSES system is likely to enhance the psychological well-being of older adults.

2.4 AI Persona

A persona dialogue system is a character the system presents to its users. It endows the dialogue system with a personality that distinguishes it from a monotonous conversation (Li et al., 2016). Razavi et al. (2019) proposed an automatically spoken dialogue manager for LISSA, an on-screen virtual agent that can engage in a series of casual discussions with older adults to mitigate seniors' loneliness, social anxiety, or social isolation. LISSA is capable of adapting its behavior to the unique requirements and preferences of individual users. The results showed that older adults found LISSA easy to use and user friendly. Dratsiou et al. (2022) introduced a dialogue system embedded with persona, SHAPES, integrating a wide variety of digital technologies into a healthcare-related technological ecosystem. This system supports the healthy, active, and independent living of older adults. The authors believe that SHAPES has the potential to engage senior citizens in an all-encompassing technological environment and make it easier to preserve a good quality of life.

The existing studies, however, have segregated the important components, such as humor, empathy, culture, and persona, to mitigate the loneliness and social anxiety of older adults. Therefore, this paper proposes a companion dialogue system with an empathetic and humorous persona to actively engage with older adults to resolve a task, such as Trivia Quizzes, Puzzles or Sudoku, by deciding together while considering their cultural heritage. By doing so, the dialogue system attempts to curtail loneliness by offering personalized therapeutic intervention based on behavior modification models and fostering empathy and humor via emotionally and culturally rich conversational exchanges.

3 Discussion

Existing companion systems overlooked the difficulties of humor as older adults find the intermediate level humor the funniest, whereby humor that is either too simple or too complex to grasp is likely to be ignored (Shum et al., 2018). Studies found that older adults scored lower on affiliative humor, which is used to strengthen social relationships and put people at ease by cracking jokes. In addition, existing studies seemed to overlook older adults' cultural backgrounds when designing a companion dialogue system, as these types of cross-sectional research on companion dialogue systems are subject to cohort effects, in which individuals from various generations are impacted by distinctive life experiences, demographic tendencies, and societal conventions (Shum et al., 2018).

Existing companion systems did not specify which types of empathy affect the quality of older adults' life and social integration as most dialogue systems have primarily been used for analyzing older adults' emotions and producing generic responses (Li et al., 2022) rather than actively collaborate with older adults to help mitigate social isolation by participating in meaningful and purposeful activities to increase seniors' positive and uplifting feelings. Older adults might have weaker cognitive empathy (i.e., the ability to comprehend others' ideas and feelings) than younger people but have higher levels of emotional empathy (i.e., the ability to feel emotions that are similar to others) (Li et al., 2022).

These studies have not specified the particular layer of the culture embedded in the companion dialogue systems as people identify themselves, conform to society's shared ideas, and make contributions to society (Takahashi, 2019). According to Haarmann (2007), there are generally five layers of cultural aspects, which embrace (1) signs & symbols, (2) behaviors & institutions, (3) cultural values, (4) belief systems, and (5) worldview. First of all, signs & symbols are referred to as material culture. This includes materials that may be easily observed, such as symbols, tools, architecture, art, and spoken language. Secondly, observable behaviors and the 'institutions', which are subsets of a society's members who share a common goal, such as schools (for education) and hospitals (for health care), as well as shared activities, such as gestures. Thirdly, cultural values (e.g., collectivistic cultural value and individualistic cultural values) drive decision-making and interpersonal behavior. Cultural values give significance to signs and symbols and influence behavior and Institutions. Fourthly, belief systems are convictions that people live by and have a set of core ideas that leads them through life. Lastly, a worldview is a collection of preconceived notions and underlying assumptions that explain the reality of the universe and our existence.

A persona-based dialogue system is a character that engages in a series of casual discussions with older adults to mitigate seniors' loneliness, social anxiety, or social isolation (Razavi et al., 2019). However, existing studies did not delineate what type of persona has been employed in the design of the companion dialogue systems. According to Alduaifi et al. (2020), there are four types of personas, including (1) goal-directed personas, (2) role-based personas, (3) engaging personas, and (4) fictional Personas. The purpose of a goal-directed persona is to investigate the method and workflow that the user would prefer in order to achieve their goals. The role-based views' personas are mainly data-driven and combine both qualitative and quantitative data sources. Engaging personas that are designed to increase user engagement with the system. Fictional personas assess elements such as users' emotions, psychological status, and their backgrounds and make these elements relevant to the task.

4 Research Contribution

The proposed companion dialogue system entails two parts including (1) a knowledge base and (2) a corpus. The knowledge base retains a conversational history as well as a few lines that describe who it is (its persona). The corpus contains three components, such as a cultural model, an emotional empathy model and an intermediate level humor model. When the dialogue system receives a new utterance from a user, it initially will mix the information from this knowledge base with the newly obtained utterance in order to provide a general reply. As the conversation proceeds further, and a game such as Trivia Quizzes, Puzzles or Sudoku will be introduced. During the conversation of the game participation, GPT dialogue system is able to identify the user's social background whether it is collectivistic or individualistic cultural value from user utterance. The dialogue system will concatenate the contextual segments (either with intermediate humor or emotional empathy) into a single sequence. The single sequence then combines the dialogue history to generate a response to mitigate older adults' loneliness and social anxiety by actively involving a collective game session (See Figure 1).

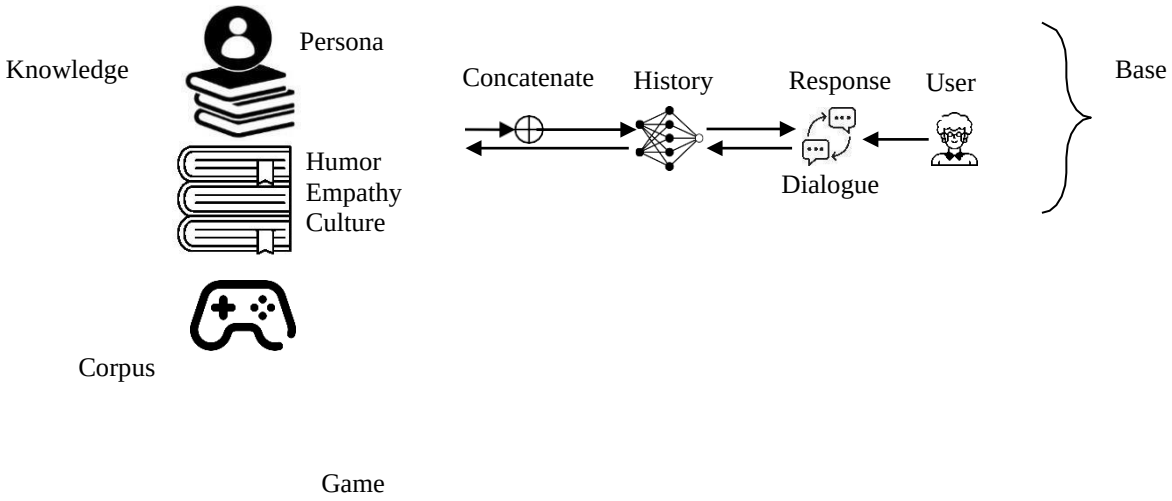

Figure 1. A summary of the GPT companion dialogue system

4.1 Humor Model

This study adopted the humor generator proposed by Akbar et al. (2021), and the generator utilized a comprehensive pre-trained language model generative pre-trained transformer (GPT2). In addition, a humor classifier employs the fine-tuning bidirectional pre-trained encoder (BERT) in order to categorize easy humor, intermediate humor, and complex humor. The humor dataset includes 200,853 news headlines, links, categories, and individual articles (Akbar et al., 2021). The number of characters used in humor ranges from 10 to 200. Each line in the file is associated with a unique ID and humor. The dataset has been compiled into a single.csv file and is downloadable from Kaggle. It is vital to embed Akbar et al.'s (2021) intermediate-level humor generator, which aims to curtail anxiety and loneliness along with empathy and cultural models.

4.2 Empathy Model

This study adopts Muthukumar et al.'s (2021) fine-tuning of the GPT-2 model in order to provide a brief, user-specific empathetic emotional responses. The model employs a sentiment analysis history-based reinforcement learning strategy to respond empathically and individually to users. For the datasets, this study utilized the EmpDG model introduced by Li et al. (2022), which consists of two types of information sources: ConceptNet and the NRC VAD emotional lexicon. ConceptNet is a knowledge graph that employs natural language to represent extensive human knowledge, and it plays a crucial role in sentiment-related activities. It is important to embed Muthukumar et al.'s (2021) fine-tune the GPT-2 model in a companion dialogue system for older adults, as the model focuses explicitly on emotional empathy to mitigate the emotional impact of being socially isolated and speed up emotional recovery from loneliness and social anxiety.

4.3 Culture Model

Drawing inspiration from Liang et al. (2019), this study employed a culture classifier to forecast the culture likelihood. Each dimension was normalized by using a culture-specific z-score to reduce the influence of cultural differences on the pre-processing of the data. This approach is essential because it mitigates the negative effects of culture on multimodal emotion detection. The Wikipedia Cultural Diversity Datasets, which cover more than 300 language versions across 90 territories, were used for the cultural elements (Miquel-Ribé & Laniado, 2019). The data files were compressed into bzip2 and stored in the comma-separated values file (CSV) format to facilitate processing. The English Wikipedia occupies 265 MB of the dataset's 1.67 GB overall size. The importance of Liang et al.'s (2019) model is that it can distinguish senior users' cultural backgrounds, whether they are from collectivistic societies (e.g., tend to experience a high level of loneliness) or individualistic societies (e.g., tend to experience a low level of loneliness). The uniqueness of Liang et al.'s (2019) model is it can decrease the probability of seniors being physically isolated, lack of social engagement by considering various cultural backgrounds.

4.4 Persona Model

This study adopts Nißen et al.'s (2022) MANOVA model, which is specialized in dialogue system persona, and it takes into consideration participant gender and age. There is a statistically significant interplay between persona and age. Older participants reported higher levels of outcomes with the closer peer and dialogue systems. This study uses the PERSONA-CHAT dataset extracted from Amazon Mechanical Turk, in which each pair of speakers conditions their interaction on a predefined profile (Nißen et al., 2022). The importance of Nißen et al.'s (2022) MANOVA model is that it focuses on users' gender and age and is designed to increase user engagement with the system to mitigate seniors' loneliness, social anxiety, or social isolation. These personas assess elements such as users' emotions, psychological status, and backgrounds and make these elements relevant to the task.

5 Proposed System Design and the Pilot Study

The design of the study will be divided into two stages. In this initial step, a prototype for the companion dialogue system will be designed. The second step is the pilot study, which consists of participant recruiting and an interview lasting 30 minutes to assess the viability of the chatbot. A companion dialogue system's initial step of development involves the incorporation of four additional features: intermediate humor and emotional empathy, cultural values, and persona. Older adult participants for the pilot study will be recruited from a local city council in Brisbane, Australia. It is anticipated that a total of twelve participants will be chosen, and the arguments for this sample size are based on logic about the practicability of the endeavor (Julious, 2005). The participants will be provided access to a chatbot for a 14-day intervention as soon as they have agreed to participate in the study and have returned the completed interview permission form and information sheet.

6 Conclusion and Future Work

This research in progress paper proposes a companion dialogue system with an empathetic and humorous persona to actively collaborate with older adults to help curtail loneliness by resolving a task together while considering the user's cultural values. The significance of the companion dialogue system is believed to offer personalized therapeutic intervention based on behavior modification models, foster empathy and humor via emotionally and culturally rich conversational exchanges, and fight loneliness or depression through activities that involve team cooperation.

For future studies, we recommend that research can be done on BERT to improve the detection of emotional empathy, sense of intermediate humor, cultural values, and engaging persona for older adults to mitigate their loneliness and social isolation.

This research has several contributions including (a) an expansion of the existing body of work on a companion dialogue system for older adults with a particular emphasis on culturally relevant humor and empathy algorithms, (b) the identification of the gaps and limitations of companion dialogue system implementation and application; and (c) a recommendation for more research on companion dialogue system that takes into consideration a user's cultural background.

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