Designing a Disembodied Conversational Agent as a Digital Companion for Older Adults

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Abstract
Social isolation and depression have been a constant issue for older adults living alone in multiple countries. [1, 2]. Singapore has been seeing a rise of older adults living alone hence the risk of social isolation and depression is expected to increase as well [3]. As more of these users have access to smartphones, we designed a proactive chatbot that can provide social support for older adults living alone. We conducted an experiment with 12 participants to see if a proactive chatbot could improve their loneliness and feel socially connected. Our qualitative analysis showed that a proactive chatbot made users feel contented knowing that there is someone out there that is constantly checking in on them via their smartphone.

Author Keywords
Older adults; Seniors; Chatbots; Proactive; Mental health; Digital health; Digital companion; Smartphones

CSS Concepts
• **Human-centered computing~Human computer interaction (HCI)**; *Social support agents; Disembodied conversation agents;* Conversational user interface

Introduction

Older adults are slowly adopting smartphones throughout the years in the United States, with an increase of 18% in 2013 to 42% in 2017 [4]. The Singapore Infocomm Media Development Authority (IMDA) reported a similar increase as well. There are at least 76% of older adults aged 60 and above that used an internet-enabled feature phone or a smartphone in 2019 [5] as compared to 2013 where only 18% of older adults used these devices [5]. This number is expected to rise even further with the introduction of the Seniors Go Digital programme by IMDA. With the increasing usage of smartphones among older adults, we saw an opportunity to explore the use of a digital companion in smartphones for older adults using a chatbot. Chatbots have been mainly used to set up appointments or to automate first-level queries for self-diagnose health checks [6, 7]. In these cases, the chatbot is used punctually and reactively, with the user starting the interaction with a clear goal in mind. These chatbots are not designed to be empathetic and maintain a conversation with an older adult. Our study explores the range of empathetic interactions between a proactive chatbot and older adults in a text messaging on smartphones. There are social chatbots developed on smartphones for the younger crowd as a digital companion [8]. However, we did not find any development of such a chatbot for older adults. We see the possible value of having an easily accessible chatbot as a companion for them to contact anytime through their smartphone if they ever feel lonely.

We hypothesize that older adults living alone will have a decreased level of loneliness after interacting with a chatbot on their smartphones. An experiment was conducted over 2 weeks in which 12 participants were tasked to interact daily with a proactive chatbot. The key findings were as follows:

- 7 out of 12 participants regards the chatbot as human and assume human-like characteristics.
- 3 out of 12 participants felt good to have someone messaging them as it shows there is someone out there who cares about them
- 2 out of 12 participants were comfortable enough to share their concerns with the chatbot

Related works

Embodied conversational agents

There have been various research works done to use technologies as a form of social support agent for older adults. This varies from wearables and devices that encourage multimedia sharing to connect with the community [9] to embodied social agents such as an in-home robotic companion [10, 11], or digital pet [12]. Embodied conversational agents are convenient as users can see them, but these solutions tend to require a complicated setup at home and the need for maintenance. As such it may be impractical for isolated elderly users. Instead, we decided to leverage smartphones to create a social support agent in the form of a chatbot. The easily accessible option of messaging "someone" straight from your smartphone provides a natural alternative for older adults that are seeking a companion or a form of social support.

Disembodied conversational agents

Microsoft has developed a chatbot, XiaoIce, which is able to understand users' emotional needs and engages

the user in a conversation similar to a friend [8]. It is developed for the regular adults in China and they have since developed similar chatbots for Japan, India and the United States. However, there are currently no such chatbots developed catering for older adults. We see the potential use of a similar chatbot for older adults to engage them and reduce their loneliness living alone.

Chatbot Prototype

Homebound older adults staying alone value independence more than daily company and assistance. They do not like to trouble others even though some of them still have children that offer to take care of them [13]. Regardless, one of the main interactions they get is through home visits by social organizations that are concerned with their welfare [14]. To understand the interaction during home visits, we conducted unstructured interviews with a community nurse and a social case worker that conducts home visits for older adults living alone. From the interviews, the typical conversations revolve around how they are getting by, their well-being, their breakfast or lunch for the day, their medicine consumption, or physical ailments.

We used these insights to develop phrases and intents that will cover these conversations and trained our chatbot on Google Dialogflow platform. We created a Progressive Web App (PWA) as the main platform for them to access the chatbot as it is the easiest platform to install for older adults and it can be accessed via an url link too. The chatbot is designed to prompt the user 3 times a day. Randomly once between 9-10 am, once between 1-3 pm, and once at 9.30 pm. These three timings are chosen as they are timings that are either after breakfast, after lunch, or before sleep. English language was chosen as the main medium of communication because it is widely used among all Singaporeans and the pilot test is done for all races.

Each prompt will ask questions related to their well-being according to the specific timing. For example, in the morning, the chatbot will prompt "How was your sleep yesterday? Did you have a good rest?" The check-in question is reflective of the timing that it was sent. Users will have a continued exchange of conversations until they feel there is nothing to talk about. In a case where the chatbot do not understand what the user is trying to convey, the default fallback reply will be "Ok." Commercial chatbots will usually express uncertainty and suggest likely alternatives to the questions asked [15]. However, for our chatbot, we wanted to try show agreeableness to the user in times of uncertainty. Agreeableness has been used as one of the strategies to maintain positive relationships with others thus we would like to try to maintain the same positive relationship with the user [16].

Experiment

The study was initially designed for older adults living alone in Singapore. However, due to government restrictions stemming from Covid-19, and the vulnerability of older adults, we adapted our criteria to target older adults that are considered lonely based on the three-item loneliness scale [17]. We managed to obtain only 4 participants that hit the three-item loneliness scale of 5 and above. Thus, for the remaining 8 participants, we had to take the next best option which are those who are single or retired. Even though this category of older adults may live with their spouse or family members and are not lonely, we chose them as the next best option as they would have plenty of time on their hands and may feel lonely not knowing what to spend their time on.

Study Method

We conducted a two weeks long experiment with 12 participants (5 Male, 7 Females) aged 55-75 years old. Each participant was asked to do a short survey based on the three-item loneliness before and after the experiment. This was to gauge if there is an improvement in the level of loneliness after introducing the digital companion to them. The participants were then briefed on the study and how to go about using the app to communicate with the chatbot. They were asked to communicate with the chatbot every day for 2 weeks. The timing of the messages, as well as the type of messages sent, were randomized every day to replicate real-life messaging conversations between humans. They were sent randomly within the range of time given to each of the three selected periods. We also delayed the reply of the chatbot and randomized the delay to show a more human-like style of replying. The delay given ranged from 1-20 secs. As chatbots reply instantly when asked a question, we did not want the user to feel like they are talking to a chatbot but to a human that usually needs some time to reply. At the end of the experiment, we conducted a semi-structured interview on their experience communicating with the chatbot. These interviews were audio recorded and were later transcribed for qualitative analysis.

Results and Discussion

We conducted inductive and deductive coding on their conversation with the chatbot as well as their feedback in the post-experiment interviews. We discovered that there are 3 key recurring themes in their conversations. Firstly, most participants (7, 58%) regarded the chatbot as human. Secondly, some participants (3, 25%) felt thankful for the concern shown by the chatbot. Lastly, some participants (2, 17%) were comfortable enough to share their concerns with the chatbot. The majority of the participants asked questions to the chatbot as if it was a human. For example, P1 messaged the chatbot *"How about you..Did you take your breakfast already?"* and P6 & P9 similarly asked the chatbot what plans it had for the day. This shows that despite being briefed that it was an automated chatbot, they still regarded the chatbot as a human and showed affection and concern typically reserved for people.

Two participants were comfortable enough to share their problems with the chatbot. P8 confided in the chatbot saying *"No n feel stress because my girlfriend is 42 years and both of us is still looking for job. Any better idea for us? girlfriend invited me to her house for reunion dinner meet family members and I feel shameful because I am a 58 year old man and poor"* after the chatbot asked him if he slept well last night. This shows a possibility that the chatbot may be an avenue for the older adult to share their concerns and confide in as it is not someone they know hence it is safe for them to share all their worries and not feel shy about it.

They were also thankful for the concern shown by the chatbot which increased their propensity to share more about themselves. This was demonstrated by P12 when she replied *"Thanks for your concern Sofia! I'm fine. Today is CNY eve. I was busy with festive preparation, therefore I didn't sleep well."* The participant felt cared for and was thankful for the concern shown by the chatbot even though it is coming from a robot with no emotions. Phrases that indicate care and concern such as "I am here for you. You can tell me anything" or "I hope you will feel fine later" were of comfort to the

user. P3 remarked when asked about how he felt when he received a message from the chatbot, saying *"Happy la. You know like got someone to ask about you. Like we humans also hardly got people asking about you right. So this is at least something la, like got a friend."* They felt that it was nice having someone to check in on them because friends do not message these types of messages to check in on you. It feels good having someone messaging you as it shows that there is someone out there that cares about you. This shows that despite having access to direct communication with friends or families via mobile phone, they still lack interaction or companionship. They feel like nobody really cares about them or cares enough to check in on them as others are busy with their own lives and activities. They also feel hesitant to communicate with others about their life and problems as they do not want to worry others much. Hence having "someone" or a chatbot to initiate a talk with them and checking up on them breaks this barrier. It shows that the chatbot will always be there to talk and hear their worries.

We compared both scores of the loneliness scale survey done before and after the experiment and did not find any significant improvement. We were hypothesizing that the participants will feel less lonely and have a lower score after communicating with the chatbot. All participants did not see a decrease in scores. The scores did not have much significant improvement due to the profile of participants that we managed to get. As mentioned in the study design, we were limited to getting the participants that were not staying alone and expected to have a connection with other people in their household hence the level of loneliness was low in the beginning. Future experiments that have access to isolated older adults may show improvements in the loneliness level.

Conclusion

The nature of older adults is that they tend not to want to trouble their family members or friends, and therefore hardly make the first move of initiating a conversation if they want someone to talk to [13]. To make matters worse, older adults living alone or single and living with children will not have much contact to initiate this conversation or their family members are busy with life and they do not want to trouble them. Therefore, we see the functionality of a proactive chatbot in personal smartphones as an important direction towards showing that there is someone out there who cares about the person. Even though that "someone" out there is a chatbot and not a human, most of them regard the chatbot as human and do not feel any difference. To them, seeing a message or words coming from someone is enough to make them feel taken note of, especially when they hardly get any personal message from family and friends. This chatbot may also provide them an avenue to talk to someone that is readily accessible via their smartphone at any time.

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