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A Robotic or Virtual Companion for Isolated Older Adults

Candace Sidner, Charles Rich, Mohammad Shayganfar and Morteza Behrooz
Worcester Polytechnic Institute
Worcester, MA, USA
sidner@wpi.edu

Tim Bickmore, Lazlo Ring and Zessie Zhang
Northeastern University
Boston, MA, USA
bickmore@wpi.edu

ABSTRACT

We summarize the status of an ongoing project to develop and evaluate a companion, embodied as a robot or virtual agent, for isolated older adults. Three key issues in the project are: the embodiment of the agent, methods to reduce social isolation, and the nature of the social relationship between the user and the agent. Our agent/robot supports multiple activities, including discussing the weather, playing card socially, telling life stories, exercise coaching and video conferencing.

1. INTRODUCTION

The Always-On project[1] is a four-year effort, currently in its fourth year, supported by the U.S. National Science Foundation at Worcester Polytechnic Institute and Northeastern University. The goal of the project is to create a relational agent that will provide social support to reduce the isolation of healthy, but isolated older adults. The agent is "always on," which is to say that it is continuously available and aware (using a camera and infrared motion sensor) when the user is in its presence and can initiate interaction with the user, rather than, for example requiring the user login to begin interaction.

The agent will help reduce the user's isolation not just by always being around but also by specific activities that connect the user with friends, family and the local community. Our goal is for the agent to be a natural, human-like presence that "resides" in the user's apartment for an extended period of time. Beginning in the late spring of 2014, we will be placing our agents with users for a month-long evaluation study.

Three issues of our project directly concern the topics of the HRI workshop "Socially assistive robots for the aging population: Are we trapped in stereotypes?" namely,

- the embodiment of the agent,
- methods to reduce social isolation, and
- the nature of the social relationship between the user and the agent.

1.1 Embodiment

We are experimenting with two forms of agent embodiment. Our main study (with 24 users) will employ the virtual agent Karen, shown in Figure 1, that comes from the work of Bickmore et al. [1]. Karen is a human-like agent animated from a cartoon-shaded 3D model. She is shown in Figure 1 playing a social game of cards with user. Notice that user input is via a touch-screen menu. Also, the speech bubble does not appear in the actual interface, which uses text-to-speech generation.

Figure 1: Virtual agent interface — "Karen"

We are also planning an exploratory study (with 8 users) substituting the Reeti[2] robot, shown in Figure 2, for Karen, but otherwise keeping the rest of the system (i.e., the menus, text-to-speech and other screen graphics) the same. Both our agents, virtual and robotic, will be "living" in the homes of single older adults for a minimum of a month's time. While the difference in these two agents may seem of less interest to the robotics community, many researchers see the likelihood of having a robot in the home and its virtual agent counterpart on a portable device that travels with the users. Hence understanding how these two agents affect users sheds light on this eventuality.

Figure 2: Robotic interface — "Reeti"

One small difference between these two agents is that the virtual agent moves its head much more quickly than our robot can, so we have slowed down all the interactions a bit to accommodate this difference. A potentially greater difference is the reliability of the agents. Virtual agents, once a system is debugged, do not have body failures. They can work indefinitely. Robots on the other hand are prone

[1] http://www.cs.wpi.edu/~rich/always

[2] http://www.reeti.fri

to failures. While we expect our agents will not be used by adults in more than 3-4 sessions of 20 minutes a day (though the adults can use them as much as they wish), even 1.5 hours a day of use for a month can be a lot for a robot. We are preparing for dealing with replacing robots when they fail in our users' homes.

One big difference we expect to occur in users' behavior results from the use of face tracking with our two agents. Our previous experience with robots indicates that face tracking is a very noticeable effect with people. While we do not have any experience yet with users interacting with virtual agents that track the user's face, our own personal experience indicates that this is not a particularly strong effect. Thus it may be the case that users who "live" with our robot Reeti will be much more aware of its presence, which may generate additional effects in terms of desiring interaction, paying attention to Reeti or being afraid of it. On the other hand, because Reeti is not as human-like as Karen, it is possible that it will not be as well accepted overall as Karen.

By comparing people's responses to these two embodiments in situ, we hope to learn more about the nature of people's behavior with virtual versus robotic agents when they interact for an extended period of time. Due to the longevity of the interaction as well as the richness of activities (some purely conversational and some task-based), we hope that that users in both conditions will have extensive interactions, find those interactions satisfying, and develop a strong working relationship with their companion, in whichever embodiment. Part of our month long study will be to assess these experiences and determine if differences do occur.

1.2 Reducing Social Isolation

One of the principal goals of this project is to see if users will report a reduction in isolation after a month of an agent companion in their home. We will be measuring this via a set of standard psychological measures.

Several activities directly address the project goal of connecting the user to other people. The Northeastern team has implemented an activity called "Skype™ buddy," an activity in which the agent arranges video calls for the user with family and friends. A second activity that coaches outdoor walking, an area well explored by Bickmore in earlier work [1], can result in more social connection by getting the user out of his/her apartment and into the community.

A third activity, life story acquisition, addresses both a project goal and a user desire. Seniors tell stories about their lives in part to make sense of their life experience [3]. Our system supports sharing these stories with family and friends over the internet, thereby also mitigating social isolation.

These activities are often not possible for elders because many elders cannot keep track of the complexity of programs and system calls needed to operate most computers. By having an agent and its behind-the-scenes programs do all the legwork, these activities will be very easy for elders to do. The agent, who will communicate solely by dialog, will ask the elder if he or she would like to undertake one of these and then arrange all the details. There are no WIMP issues, no remembering where things are in files or how one manipulates the complex interfaces of programs are needed.

While these three activities appear to be good choices for reducing isolation, only our month long study will provide a clear indication of whether that is true.

1.3 Relationship

Since the user and agent have conversations over an extended period of time, it is natural to consider that they have some kind of social relationship [2, 5]. To reason about this relationship, we have implemented a planning system [4] that decides which activities are appropriate to suggest to the user each time they interact (in what we call a *session*). This planning system uses a relationship model based on the *closeness* between the agent and user. Their closeness increases as they do activities together. Some activities such as calling friends on SKYPE or relating life stories to tell friends and family make sense to pursue once the elder and agent have interacted together for a period of time so that the elder feels comfortable telling the robot about friends and family. Because doing exercise is not something the many people welcome, it also makes sense to delay discussion about this until the elder has some interaction wiht the user.

Relationship is clearly a cultural matter, and our studies are based on our own American cultural biases and assume that the participating elders are Americans. We have tried to choose activities overall that reflect typical human-to-human social interactions that were also feasible to do with a robot or virtual agent without several years of programming to create the activities. Our studies will also indicate what activities elders did regularly and their perpeptions of these.

2. PRELIMINARY STUDIES

To better understand what users want to do with the robot, the effect of being always on, and to evaluate some candidate activities, the Northeastern University team has conducted a series of preliminary studies. These studies include a Wizard of Oz (WOZ) study in which several users interacted with a virtual agent controlled remotely by an experimenter, and an early prototype of a fully autonomous virtual agent. Both studies involved having the agent in the homes of older adults for a week. In the WOZ study [11] we discovered that more than half of the participants wanted to talk about the weather, family and personal stories (telling stories to the agent). Additionally, half of all the conversations involved discussing the participant's future plans and activities.

The preliminary study with a fully autonomous virtual agent [9] used a motion sensor, but no camera, to detect the user's presence. The agent could thus initiate interactions. Users could converse about the weather and exercise, and could hear humorous anecdotes told by the agent. In these studies, users indicated high levels of acceptance of the agent. Participants did not find the agent intrusive, and almost all participants had short conversations with the agent every day.

3. ACTIVITIES FOR USER AND AGENT

One take-away of our preliminary studies is that users would like to have more activities to do with the agent. For example, they wanted to be able to tell the agent about their friends and family.

Different activities can serve different goals, either improving the user's well-being by reducing social isolation (which is the project's main goal), or just doing something the user wants to do. Activities such as talking about the weather or playing a social game of cards or checkers are meant as ice breakers, to give the user and agent a way to develop

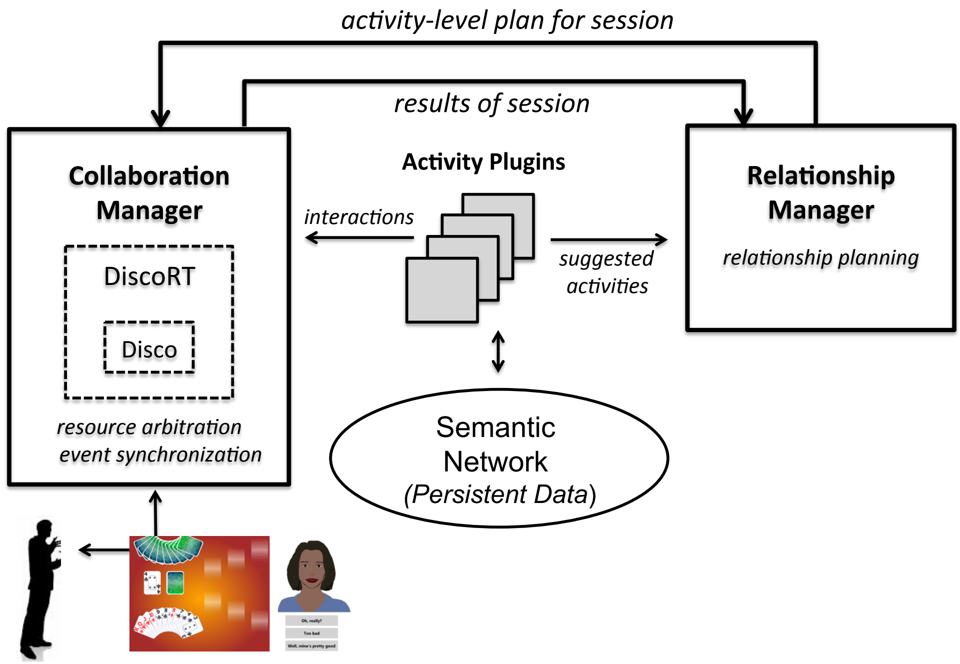

Figure 3: Always-On system architecture

relational closeness. Other activities are more instrumental, such as the agent's self-introduction dialogs, in which it interactively explains its capabilities to the user, or the user's enrollment dialogs, in which he/she provides information about family members, such as their relationship, geographic location, birthday, etc.

Once the agent knows about the user's family and friends, it can support the user's desire to talk about them, albeit in a very limited fashion and offer to make SKYPE calls to them. To provide some light-hearted enjoyment, the agent can tell short humorous anecdotes to the user, an activity that users reported liking in preliminary studies. The agent can also offer nuitrition and health tips. All of these activities serve to allow the elder to become comfortable with the robot or virtual agent before pursuing activities such as SKYPE buddy, telling life stories or being encouraged to exercise.

Developing an adequate set of activities has been our biggest challenge in the Always-On project, because of the extensive programming needed and complexity of the heterogenous real-time operating environment. We expect that not all users will use every activity. After our main study, we will understand better when and how often each activity is used, and the effects of their their use on the participants' sense of isolation and their development of a working alliance with the agent.

4. SYSTEM ARCHITECTURE

Figure 3 shows the high-level architecture of our system, which addresses two main challenges. The first challenge is modularity and extensibility with respect to activities. To address this challenge, we developed a plugin approach, which has allowed different members of the research team to separately develop new activities for the agent.

The second main challenge is the need to operate at multiple time scales [7] from hard real-time (milliseconds) to long-term (days and weeks). At the real-time end of this spectrum, our solution is an extension, called DiscoRT (Disco for Real-Time) [6], to the collaborative dialogue system Disco [8]. DiscoRT implements an arbitration-based parallel schema architecture that handles such phenomena as barge-in (the agent immediately stops speaking in the middle of an utterance when the user touches a menu item on the screen) and time-outs (the agent repeats an utterance when the user doesn't respond after some time). DiscoRT also coordinates the inputs from the agent's sensors and helps manage Disco's dialog focus. At the other end of the spectrum, the relationship manager handles the per-sesson planning, as discussed above.

The system is implemented in a combination of Java and .NET on Windows™.

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