Toward an Always-On Relational Agent for Social Support of Isolated Older Adults

Bahador Nooraei[1], Zhaochen Liu[1], Christopher Conley[1], Candace L. Sidner[1], Charles Rich[1], and Timothy Bickmore[2]*

[1] Worcester Polytechnic Institute, Worcester MA 01609, USA
[2] Northeastern University, Boston MA 02115, USA

One of the long-held dreams of artificial intelligence is to create an agent (whether robotic, animated or only a disembodied voice) that functions as a permanent member of a human household. Because humans are deeply and fundamentally *social* beings, they cannot help but expect such a continuously present artificial agent, especially if humanoid, to become part of their network of *relationships*.

Previous work [1] has placed intelligent virtual agents in people's homes for months at a time, but these agents were not "always on," i.e., it was up to the person to log in once a day to interact with the agent. There have also been long-term always-on agents in public settings, such as Roboceptionist [2], that did not, however, build a continuing relationship with any single person.

The goal of this research is to develop and implement a computational model for building long-term relationships between humans and virtual agents, along with the interaction affordances to support this process. As theoretical starting points, we look to Grosz and Sidner's [3] collaborative discourse model and Bickmore's [4] relationship model. Our initial application focus is to provide companionship and social support and to promote wellness for older adults who are living alone. This paper reports on one of the first products of our research, which is a demonstration system that illustrates our vision.

The accompanying video[3] shows a typical interaction between an always-on relational agent and an isolated older adult at a point in their relationship where they know each other pretty well:

– The interaction begins when the agent sees the person walking by and initiates interaction with a greeting (see line drawing above).

---

[3] Video can be found on YouTube by searching for the paper title.

- Chit-chat about the local weather and unusual weather in the son's city segues into the agent showing the person recent photos from the son's Facebook page.
- Friendly social comments ("Good hand!") about a shared game of Rummy (card game) are interspersed with the agent's attempt to broach the topic of getting more exercise.
- The agent notices that is time for the person to meet with a friend (as previously arranged with the help of the agent) and ends the interaction by reminding the person of where and when the meeting is to take place.

The technology underlying this demonstration is a mixture of prototype and mock-up. Motion detection and human face tracking were implemented using our own OpenCV vision algorithms. The toon-rendered agent face (see above) is taken from Bickmore [1]. This animation style avoids the "uncanny valley," obviates the need for high-end graphics cards, and aligns well with the current state of the art in dynamically computed expressions.

Conversational interaction uses text-to-speech (AT&T Natural Voices) for agent output paired with touch-screen text menus for human input. We do not rely on speech recognition or natural language understanding, although we do plan to model dialogue structure. We also use sound detection for simple situational awareness by the agent and will support menu selection by voice as a supplement to the touch screen.

Going more deeply, the interactions based on weather and Facebook information are currently scripted. However, techniques for retrieving such information automatically are well-known and straightforward to implement. The Rummy game is an implemented prototype. All the other dialogue is scripted.

Finally, we have begun a series of empirical studies to reach a better understanding of the needs of isolated elders, including the kinds of things they would like to talk about with a virtual agent. We accompanied and audiotaped volunteers on home visits with isolated elders. We are also about to conduct a Wizard of Oz study in which a remote-controlled version of our virtual agent is placed in elders' homes to gather similar information.

References

1. Bickmore, T., Schulman, D., Yin, L. (2010) "Maintaining Engagement in Long-term Interventions with Relational Agents", *International Journal of Applied Artificial Intelligence*, 24(6): 648-666.
2. Gockley, R., Bruce, A., Forlizzi, J., Michalowski, M., Mundell, A., Rosenthal, S., Sellner, B., Simmons, R., Snipes, K., Schultz, A.C., Wang, J.: Designing Robots for Long-Term Social Interaction. In: *IEEE/RSJ International Conference on Intelligent Robots and Systems* (2005).
3. Grosz, B., Sidner, C. (1986). "Attention, Intentions, and the Structure of Discourse." *Computational Linguistics* 12(3): 175-204.
4. Bickmore, T., Picard, R. (2005). "Establishing and Maintaining Long-Term Human-Computer Relationships." *ACM Transactions on Computer Human Interaction* 12(2): 293-327.