Collaborative modeling for robot design

Selma Sabanovic
School of Informatics and Computing
Indiana University
selmas@indiana.edu

Matthew Francisco
Department of Science and Technology Studies
Rensselaer Polytechnic Institute
francm@rpi.edu

In this poster, we describe a method for using grounded theory and modeling to support collaborative design of social robots for the elderly. Robotic technologies are being designed to assist people in their everyday lives in various ways: as companions [9], domestic helpers [4], receptionists [1], and educational aids [8]. In response to the steadily rising average age of the population in the US, Europe, and Japan, the elderly are often designated as an appropriate audience for assistive robotic technologies. Designing robots for the elderly poses a variety of social challenges—understanding the specific needs and desires of the elderly, supporting independence and human dignity, and making sure that technologies can be successfully incorporated into existing social and physical environments, or "elder ecologies" [3]. These challenges suggest that designing robots for the elderly calls for attention to individual attitudes towards technologies as well as community norms and practices of social interaction and technology use.

1. DESIGNING WITH THE ELDERLY

In designing robots that can participate in the daily lives of the elderly, we propose working *with* rather than just *for* the elderly. The elderly are a vulnerable population whose worldviews and expectations can be very different from those of robot designers. Furthermore, technology designs assuming the elderly need to be assisted by machines, rather than use machines to help themselves, reproduce a situation in which the elders' agency is diminished. We suggest a grounded approach to research that would support technology design, accompanied by an iterative practice of collaborative modeling that will include the presentation of research results in the form of ethnographic findings and computational models to elders for reflection and critique.

We would like to increase participation of elderly in design for two reasons:

1. To improve the designs of technology
2. To give elderly more agency in constructing their interactions and environments.

The resulting technology designs would include the viewpoints, needs, and desires of the end users; they would be built according to their understandings of space, interaction, needed and appropriate assistance. Furthermore, we want to build a system that will enable and encourage discussions among the elderly about issues of design, how technologies fit into their communities and everyday lives, as well as about the values and practices that they want to develop in their communities. Finally, we hope that the resulting models and robotic technologies will contribute to the community's ability to self-organize and be reflexive about its change and development.

2. MODELING A COMMUNITY

We imagine the community as an "information ecology" [7]—a social space in which the technology's functions and people's actions and sense-making about robots is mutually constructed. The metaphor of the ecology encourages a focus on the diversity of contexts of use, relevant actors and their roles, and the dynamic changes that a habitat and its denizens go through. Designing for an information ecology also calls for the incorporation of the values and perceptions of community members, as well as the potential differential impacts that the technology may have on various groups. In the case of assistive robots the context of design (i.e. the laboratory) is often different from the context of use in an ecology of care. For example, the design of the assistive robot Paro involves people, spaces, and activities (see Figure 1) that are distinct from those present involved in its use (see Figure 2).

We propose building computational models to observe and think about change in the community. We use agent-based modeling because it allows for us to model interactions and local processes of the community [5]. ABMs such as these can be used not just for design of policies and technologies but also to have a framework for evaluating how the introduction of technologies affects the ecology. Another benefit is that agent-based models produce generative data that gives the ability to not only match real data for validation [6], but also provides easier to understand explanations for why particular patterns emerge across populations [2].

In our models we consider interactions between community members, staff, spaces, and technologies. Interactions can

Figure 1: An office at AIST in Tsukuba, Japan, where Paro, a seal robot for the elderly, is designed.

Figure 2: A nursing home in Japan, the information ecology in which Paro is put to use.

range from conversations to uses of particular technologies. It is possible to generate many kinds of interactions with agent-based modeling software, which is formalized as a type of edge, or link, in a network of interactions. The majority of our selections of technologies, actors, and processes to model will come from interviews and activities with the community. However, we will have to formalize some spaces from top down. In order to do this we consider what objects are most important in supporting community self-organization and self-evaluation. A house, a space that one occupies for much of their time, could be one such object. Common spaces, where members of the community gather and interact, are another relevant space.

The model will be itself designed using grounded methods. We follow carefully what aspects of the ecology are significant to the various actors in it and use those in the model building process. If organizing social events and who participates in events is one of the most important concerns we will focus our model on that. We also document the model building process through field notes to trace the development of design themes and problems throughout the project.

For this poster we will display some prototype models of the retirement home and its community areas and describe the different technical choices we made to code and define each space. We also describe a card game that we are introducing to the members of the community that we will use to gather data. The game is an activity that focuses broadly on the values members ascribe to technology and how these values are negotiated within the group. The games will evolve as the models evolve and, hopefully, help us understand how people makes sense of objects found to be relevant in the models.

3. REFERENCES

[1] R. Birby, F. Broz, J. Forlizzi, M. Michalowski, A. Mundell, S. Rosenthal, B. Sellner, R. simmons, K. snipes, A. Schultz, and J. Wang. Designing robots for long-term interaction. In *Proceeding of IEEE International conference on intelligent robots and systems*, pages 2199–2204, 2005.

[2] J. M. Epstein. *Generative social science: Studies in agent-based computational modeling*. Princeton UP, Princeton and Oxford, 2006.

[3] J. Forlizzi, C. DiSalvo, and F. Gemperle. Assistive robotics and an ecology of elders living independently in their homes. *Journal of human computer interaction*, 19:25–59, 2004.

[4] B. Gates. A robot in every home. *Scientific American*, 296(1):58–65, 2007.

[5] N. Gilbert. *Agent-based models*. Sage Publications, Los Angeles, 2008.

[6] V. Grimm and S. F. Railsback. *Individual-based modeling and ecology*. Princeton series in theoretical and computational biology. Princeton University Press, Princeton, 2005.

[7] B. Nardi and V. O'Day. *Information ecologies: Using technology with heart*. M.I.T. Press, 2000.

[8] P. Ruvolo, I. Fasel, and J. Movellan. Auditory mood detection for social and educational robots. In *Proceeding of IEEE International conference on robots and automation*, 2008.

[9] K. Wada and T. Shibata. Social effects of robot therapy in a care house—change of social network of the residents for one year. *Journal of advanced computational intelligence and intelligent informatics*, 13(4):386–392, 2009.