

# Subtly Stimulating Elderly Life with Ambient Technology

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## ABSTRACTION

This study explores the everyday lives of senior citizens to investigate how ambient technology can build on already familiar domestic practices, stimulating social connectivity among separated friends and family members. We build on previous research in HCI, and findings from our initial study, to present a set of implications to guide future research relating to ambient technology in the domestic domain.

## Author Keywords

ambient displays, ubiquitous computing, domestic object.

## ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

## INTRODUCTION

As seniors age, their social network typically begins to decrease and they face a risk of social isolation, which has been shown to result in an increased risk of depression as well as physical and mental deterioration [2, 9]. In this study we examine the everyday lives of senior citizens to explore how ambient technology can be used to stimulate social connectivity among separated friends and family members. We conducted a series of preliminary studies that relied on a variety of approaches, such as *contextual interviews*, *participatory sketching exercises* [6], *cultural probes* [3], and *technology probes* [4, 7]. These initial studies aimed to obtain deeply textured accounts of senior citizens' everyday domestic lives and explore the role that ubiquitous technology could potentially play in this domain.

Based on the results of these initial studies, we focused on exploring the deeper social and emotional side of domestic life. After generating a number of design ideas based on this direction, we implemented a prototype of ambient plant pot and conducted a technology probe study by deploying a pair of prototypes in two households. We conclude with a set of implications for designing ambient ubiquitous technology, particularly in relation to augmenting already familiar objects within the domestic domain. Brief summaries of the results of these studies are presented here.

## STUDY1: CONTEXTUAL INTERVIEW

To develop a deeper understanding of everyday elderly life, we conducted contextual interviews with two couples (P1,

P2). We focused on the meaningful relationships that participants formed with objects and environments in and around their homes. Our interview process involved: (i) asking participants about their activities and relationships, (ii) touring participants' homes and documenting personal objects that they held deeply meaningful, (iii) observing participants sketching relationships among common domestic activities and objects, and (iv) posing general questions about habits of interactive technology use.

Sketching exercises (Fig 1) were helpful for engaging participants in reflection on their everyday activities and emotional attachments to objects and spaces. Also, stories about favorite objects often provoked their life memories and relations with others (e.g., souvenir, sentimental heirlooms, family pictures, etc.). These exercises resulted in the creation of physical maps visualizing an ecology of social and material relationships which characterize the participants' daily domestic interactions.



**Fig 1. Maps of domestic activities and objects**

## Findings

From these initial user studies, we focused the following findings as the core impetus for our design objective to support and stimulate social connectivity among senior citizens and their separated loved ones.

- As expected, participants strongly valued their social relationships with family members. Similarly, the objects that participants felt to be most meaningful often had direct ties to the memories associated with these familial relationships. These findings are linked to their desires to find meaning of life by reminding of their memories with family members and their contributions to their children.
- Participants had largely and seamlessly integrated technologies, such as the cell phones, computers, and emails, into their everyday domestic lives. This contradicts our original perception that elderly citizens within our target group would be somewhat resistant to

using new technology. However, they still feel annoyed by intrusive or complicated technologies- particularly cell phones and remote controllers, although not frustrated.

- Participants exhibited highly active lifestyles in, around, and outside of their homes, for example taking sports classes, going to movies, organizing regular social gatherings, and family events, etc. This is also very different from the initial perception that they would have a lack of activities and that new incentives to promote activities could be beneficial. In fact, it was apparent that our participants unequivocally did not need a new device prompting them to engage in more activities.

These findings likely do not represent the typical case for most of elderly people. However, we considered this target group provides potential design opportunities for positive experience of elderly people beyond assisting health care.

### STUDY2: CULTURAL PROBE

While our contextual interviews provided a foundation for our design objective, we still required additional information to understand how relationships and interactions among participants and their domestic environment connect to separated family members. This requirement motivated us to conduct a series of cultural probe studies that allowed participants to unobtrusively reveal their personal and emotional relationships with objects, places, and people [3]. Specifically, we provided two elderly households (P3, P4) with diaries, disposable cameras, and an instruction sheet, to provoke participants to reflect on these relationships. After two weeks, the probe packages were returned and the information was analyzed.

#### Findings

While both participants had a similar set of tasks to complete for the probes, their responses provided a variety of different outcomes. Pictures and responses from P3 tended to be more nostalgic and describe the histories of objects common to his everyday life, whereas P4 was focused more on practical aspects of daily activities.

The pictures taken by P3 illustrated their interests in sharing the memories related to awards received during diplomatic service, care for the nature and the environment, family activities, and common hobbies and activities within the house. The pictures taken by P4 highlighted interests in collective family interactions and activities, wonders of natural and animal life in and around their home, heirlooms and antiques, and activities for self-betterment (e.g. yoga).

We discussed in detail about all the probe data in detail to identify common patterns among the participants. Both participants took a variety of pictures of their family and noted that they prefer to spend considerable amounts of time with their children and grandchildren whenever possible. For instance, P3 meets his grandchildren every week for lunch and P4's grandchildren often visit for extended stays. Apart from family relationships, P3 grows a variety of vegetables and fruits in his house. P4 maintains

multiple bird feeders in her backyard that are visible from her breakfast table. These examples characterize the two main themes that emerged from our cultural probe data: *caring* (taking care of various projects and family relationships) and *sharing* (relating memories, personal activities, and family information to others).

### CONCEPT DEVELOPMENT

Based on the findings and insights from our user research, we continued to explore the design space by generating specific design concepts through two brainstorming sessions. Themes emerged from the cultural probe study - *caring* and *sharing*, guided a direction of concept generation. Additionally, all concepts were categorized according to whether they would be embedded in an existing familiar object or created as a new device. We mapped each concept on the two dimensional axes of themes and interface, which allowed us to critique the potential benefits and drawbacks offered by each (Fig 2).

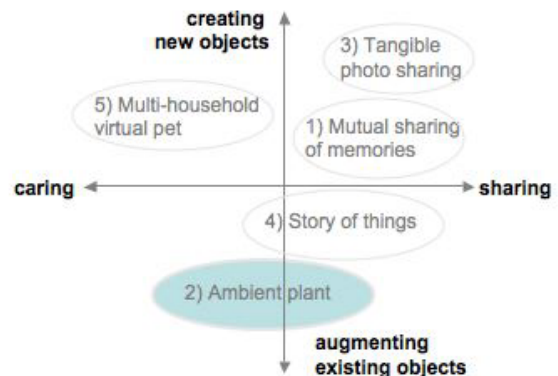


Fig 2. Conceptual dimensions

Our ultimate objective was not specifically to produce a concept capable of advancing both sharing and caring, but rather one that would most strongly stimulate the emotional and social aspects of daily life and unobtrusively fit within the domestic ecology. While each of these conceptual ideas touch upon our criteria, the ambient plant presented the most compelling case, offering strong potential to easily integrate into the daily lives of our target population, and build on a common, already existing domestic practice.

### STUDY3: TECHNOLOGY PROBE

As a next step, we conducted a technology probe by deploying an interactive prototype in two households. The ambient plant pot was selected as a catalyst to provoke richer user responses, but not necessarily as the final design concept of this study [4, 7, 10].

#### Ambient Plant Pot

The ambient plant pot aims to provide separated family members with a sense of social connection by presenting ambient information related to the moisture levels of multiple plants, in addition to providing members with a subtle sense of each other's bodily presence.

The ambient plant senses local plant moisture levels and conveys this information as a color produced by LEDs on a plant pot-based display (i.e. from red when a plant is dry to green when it is wet). A second display conveys the condition of the remote household plant, allowing members to visualize the state of their family member's plant. In this context, the everyday practice of nurturing houseplants becomes a symbolic act to reflect on the emotional climate of a separated loved one's household. Additionally, when a family member is in close proximity to their plant, the distant household's pot will begin to glow brightly to convey a loved one's temporary presence. These surprising moments may result in a stimulating period of time characterized by a participant's interpretation of and reflection on what family members may be doing [10]. The ultimate desired outcome of the ambient plant is not to replace direct forms of communication (i.e. telephone and face-to-face interactions), but rather support social connection among separated family members through subtle enrichment of a familiar domestic object and practice.

### Procedure

Each prototype was deployed to two separate households—an elderly couple's (P5) and their daughter's (P6). We visited both of their houses, conducted a brief interview, and installed the prototype. In the first visit, we asked them about how they typically communicate with each other and where they would prefer to place the plant pot and why. Then we instructed them to use provided self-diary sheets to note their feelings whenever they see pot display changes and to write down any actions they do to the pot along with any responses from the pot according to their manipulation. We also instructed them to provide date and times of all diary entries so that responses to the same event can be compared across participants. After two weeks, we visited our participants again to remove the prototypes, collect diary sheets, and ask participants about their overall experiences.

### Findings

Responses from both households are compared in terms of locations of the pots, interactions, and comments.

#### *Locations of the pots*

P5 initially placed the pot in the kitchen but then relocated it next to TV. They explained that the kitchen was not preferred because it is usually busy with many activities. Rather, they liked that they could see the plant pot while watching TV in the living room in the evening but noted that the light was quite distracting. P6 placed the pot on her work desk because the room is quiet and she spends much of her evening time there (Fig 3).



**Fig 3. Ambient plant pots in participants' households**

#### *Interactions*

Both P5 and P6 reported that it was interesting to guess what was happening in the other house whenever the display changed. (P5: "I was almost sure my daughter is shaking hands to the plant pot." P6: "I can picture that my father was doing something around the kitchen.") P6 mentioned that it was good to feel connected just through sharing some atmospheres of their parents' place without doing anything special. This is very different from actively engaging with interactive communications such as by looking at photos, touching a device, or sending messages that demands attention of others apart to some extent. Sometimes they remotely played with each other by waving their hands in front of the plant pot to change the display color as the distant sensor detected each of their movements.

The passive aspects of interaction seemed like more sincere interaction in a sense of respecting the others' situation. Specifically, as P5 really worries about intruding on the busy schedule of their children ("they are busy with their work. Their time is more important than ours"), and P6 also cares about their parents ("I cannot really visit them as much as I want."), this indirect communication might make both of them feel more comfortable. Additionally, P6 compared the plant pot to other devices that she had tried: "I had presented my parents digital photo-frames before, but they do not use them at all. This pot feels like more absorbed in home because it does not have a screen. It can be refined not to look cheap by reducing the display size."

#### *Complaints and comments*

P5 was concerned about the aesthetics of the plant pot. Though all the sensors and cables were hidden in the pot, she complained of its big size and material quality in their domestic context. Both participants often mentioned distraction from the continuous LED lights as problematic.

P5 mentioned that it would be better if the sensors were attached to the place where more actions are made (e.g. bathroom), and similarly P6 mentioned that sometimes she wanted wider and deeper range of sensors to deliver subtle changes of climates regardless of detecting more actions and status information. Interestingly, P5 considered it as kind of monitoring system that shows all the activities recorded when they are not at home [5]. Additionally they mentioned that the interaction would be more valuable if they lived alone or very far away from their children.

## DISCUSSION

In this section, we discuss our multi-dimensional study approach and design implications for using ambient technologies for elderly citizen's domestic lives from the study results.

### Multi-dimensional user studies

We conducted different methods of user study- contextual interviews, cultural probes, and technology probes with different participants for each study session. By recruiting two households for each step of studies (total 6 households, 5 elderly couples and 1 daughter), we tried to get a broad range of feedback with a limited number of participants. Also, as an exploratory study to find new design opportunities, we looked for interesting insights from findings in different situations, rather than on discovering problems or design requirements for general target groups.

Results from each session are not linearly linked to specify the final concept decision, but complemented each other to provoke various design implications centering on our design direction- using ambient technologies for the positive domestic experience of elderly people. The contextual interview was found to be an appropriate method to get initial insights about daily routines and domestic environments through engaging elderly people in a comfortable way of story telling. The cultural probe study was conducted to prove and specify some insights from the contextual interview results but produced no new findings. With the ambient plant pot prototype as a catalyst to provoke user responses, the technology probe study produced more concrete insights on using ambient technology in domestic environments than the previous studies.

### Design implications

Mostly based on our technology probe studies, we suggest following issues for designing ambient ubiquitous technology for the domestic domain.

- *Augmenting symbolic meanings of familiar objects and activities with ambient technology*: Considering elderly participants' dense domestic ecology and cognitive or physical requirements, we augmented one of their most familiar objects (plant pot) and practices (caring for plant pot) with ambient communication information. With this as an example, more design space for subtle interaction can be explored. Aesthetics and unobtrusiveness of ambient technology was found to be a critical issue considering its subtleness as a continuous background and elderly people's preference of authentic and artistic objects.
- *Passive and ambiguous interaction for comfortable and sincere connection*: Passive aspects of interaction with the plant pot was one of the most significant differences compared to other ambient devices such as photo-frames or screen based and communication-focused interfaces [1, 8]. By sharing contexts through usual activities (water

the plant pot) and displaying users status in ambiguous status, the interaction gave more space for users either to decide either to more engage in the interaction or to just ignore that [10].

## CONCLUSION

In this study we explored the households of senior citizens to investigate how ubiquitous technology might build on already familiar domestic objects and practices to enrich everyday life. We have described the process through which we developed an interactive prototype to subtly stimulate social connectivity. Then we suggest broader implications of the study in this domain for future design. While these implications provide insight into conceptualizing and embedding ambient information within common household objects, they simultaneously raise several questions of how to evaluate subtle user experience with ambient technologies. Following questions will be further investigated in our future studies both for determining a suitable final concept and evaluating it:

- How should researchers determine appropriate objects and practices to augment with new interactions or streams of ambient information?
- What core qualities and methodologies ought to guide the evaluation of these new designs in terms of seamless integration into the domestic ecology and enrichment of daily life?

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