Close To You: Unobtrusive Awareness Communication to Bring Family Living Far Apart Closer

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***Abstract*—The purpose of this research was to propose an unobtrusive system to communicate awareness; thereby maintaining connectedness of family members who are living separately. A prototype system was implemented and evaluated by participant including older adults. The subjective evaluation by the participants as well as quantitative data of their usage suggested that the proposed system was successful in giving the participants sense of awareness of their counterparts.**

I. Introduction

Recently a number of older people are living independently from their families and children. While respecting their independence, on the other hand, connectedness with other family members is a major factor to maintain their quality of life (QOL). Being aware of how their counterparts are and what they are doing significantly helps to maintain their connectedness. This sense is called *awareness*, and the systems to support communicating the sense of awareness are called *awareness systems* [1].

There have been a number of such systems proposed to support awareness of families living far apart from one another [2]-[7]. Most of these systems, however, require intentional operations, often with arbitrary coding scheme for communication, requiring certain demands especially for older users. Other systems are more security-oriented; whose major purpose is monitoring the security of family members (often older ones) in distant locations [8]. The sense of being monitored may give negative psychological effect on older users.

When designing awareness systems connecting family members or people in close relationships living far apart, one of the most important issues is privacy. Some of the existing awareness systems were designed to address this privacy issue by blurring information of the users, although they were not so successful [9]. Others conveyed indirect information of users' behavior instead of users themselves [2], [10]. In these cases, schemes of coding information are often arbitrary, which may result in cognitive demands to users. Awareness systems in those settings should convey indirect information that can be naturally mapped with user's presence and behavior.

Another issue for awareness system in home settings might be intentional communication induced by the system. Even when one wants to know what remote family members are doing, she may be reluctant to make a phone call because it may interrupt what her remote member is doing, which might be obtrusive. It is often the case when two households are located in different time zones. *Moderate* awareness systems that do not force users to respond to and join immediate communications, whereas they can still convey the feeling of the remote users' presence and behavior might be appropriate in such situations.

The purpose of this research was to propose an unobtrusive system to communicate awareness; thereby maintaining connectedness of family members who are living separately. A prototype system was implemented and evaluated by participant including older adults.

II. System Design

The goals of the proposed system were to sense what a family member is doing in one site, and to display information suggesting that action at the other site (Fig. 1). When people are living with others, they are often aware of others by the results of their actions, such as smell or noise of cooking. The proposed system does not transfer direct information of a person (e.g. video or voice recording) to protect privacy. Instead, prepared sounds or smells that suggest the actions of the remote users are displayed.

The system does not require user any conscious operations. Users do not have to learn any operations, or coding rules to understand the displayed information because the displayed information is naturally mapped with the original action of the remote family member.

III. Implementation

The proposed system concept was first discussed in

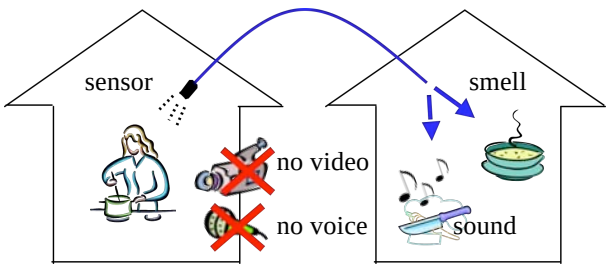

Fig. 1. System concept. Only information of person's behavior is transmitted and information suggesting the results of the behavior is displayed. No direct information of person nor behavior is sent.

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focus group interviews with 44 older adults. Both negative and positive opinions obtained were reflected on the improvement of the system design.

The system was then implemented as a network. Fig. 2 shows the configuration of the system. In each household, three personal computers (PCs) connected to the Internet are installed in three rooms: kitchen, bathroom, and bedroom, respectively. The PCs control the sensors installed in the rooms, retrieve sensory data representing behaviors of users in the rooms, and transmit sensory data to the server on the Internet every 60 seconds. The PCs also retrieve sensory data from the remote site that were stored on the server, and display corresponding information according to the scenarios through the local speakers and actuators: aroma display devices and heaters.

Based on the pilot observations of several subjects and persona analyses, a set of scenarios was extracted. Among them, twelve scenarios were chosen and implemented as programs in this study. Two examples of scenarios were: "when a person entered the bathroom, sound of opening and closing the bathroom door is heard," and "when a person is at the kitchen stove, smell of cooking food is displayed."

IV. Evaluation

The implemented system was first installed in two households of the authors and tested for its reliability and stability for one week. Stability of the system was monitored while the system was running for the test period. Based on the results of the test, the system was debugged and further tuned to be more stable.

The improved system was then evaluated by three groups of participants. Each group consisted of two households. One group consisted of a household of older parents over 70 years old and another of their son's family. The second group was a household of older mother in her fifties and another household of her son. The last group was a young couple living separately. The system was installed at two households of a group at a time. Participants were not given any instructions about operations nor interactions with the system. Instead, participants were asked to live their usual lives with the system for one week.

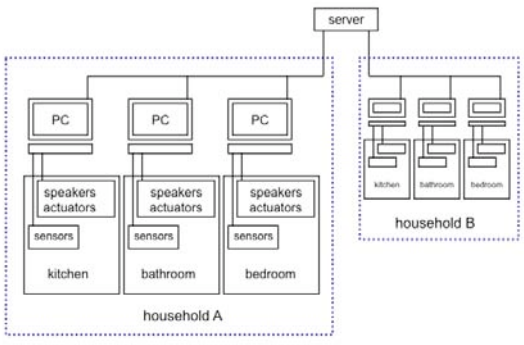

Fig. 2. Configuration of the implemented system. Three PCs per household transmit sensory data to the server on the Internet. PCs also retrieve sensory data from the remote site stored on the server and display corresponding information through the local speakers and actuators.

Quantitative data of sensor activations were recorded with timestamps on the server computer. After the one-week evaluation period, participants were asked to fulfill the questionnaire to probe their subjective evaluations of the system.

The results of subjective evaluation by the participants showed that participants could feel awareness of their counterpart, whereas the sense of their presence was not perceived as obtrusive. The participants did not report privacy issues. These results suggested that the proposed system was successful in giving the participants sense of awareness of their counterparts, while not being obtrusive nor violating privacy.

The participants also evaluated the information displayed by the system (i.e., sound, smell, warmth) as intuitive and easily understandable. Considering that participants did not have any explicit instructions about using the system, this system could convey intuitive and natural communication, which was also easy for older users.

Finally, participants reported that, with the system running in their households, they could feel their remote family members closer.

V. Discussion

The participants reported that the system could suggest the presence and behavior of their counterparts in an intuitive way, while they did not report privacy issues. Thus the proposed system was considered as successful to some extent to convey awareness of family members living far apart in unobtrusive way.

In this study, the system was designed and tested between two sites. However, the system can easily be extended to connect family members in more than two households.

Although the major goal of this system was not monitoring, the quantitative data suggested that this system could be also effective as the monitoring purpose. By analyzing the patterns of sensor activations in each household, it is possible to know whether a user in a household in active, or when the user tends to be. In order to extend the system for this purpose, combination with direct communication means (e.g. telephone) and/or alert systems should also be considered.

Finally, participants of evaluation study also suggested a number of design issues of the system to be improved, which should be addressed in future development.

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