PROBING ELDERS' NEEDS FOR SMART TECHNOLOGIES IN THE DOMESTIC ENVIRONMENT

SHENG-FEN CHIEN

Department of Architecture, National Cheng Kung University, Taiwan
schien@mail.ncku.edu.tw

Abstract. This paper presents an initial investigation into developing smart homes for the elderly. Smart homes refer to domestic living environments that equipped with "sensible" and "responsive" facilities, which employ smart technologies, to provide occupants a sound and comfortable living. Designers and sociologists have observed reluctances and even rejections to these technologies from the elderly. A Cultural Probes study shows that the elderly welcome new technologies but reject robotic companionships. In addition, a questionnaire survey concludes that smart technologies for home safety and security, energy conservation and usage monitoring, as well as health care and maintenance, are desirable.

Keywords. Smart home; the elderly; cultural probe; questionnaire; survey.

1. Introduction

Smart homes refer to domestic living environments that equipped with "sensible" and "responsive" facilities, which employ smart technologies, to provide occupants a sound and comfortable living. Technologists and advocators of smart technologies have demonstrated through many research systems and commercial products the immense benefit of these technologies, in particular, to the elderly (e.g., see: Stanford, 2002; Dewsbury, et al, 2003; Consolvo, et al, 2004; Mann, 2004; Kriglstein and Wallner, 2005). Nevertheless, designers and sociologists have observed reluctances and even rejections to these technologies from the elderly. Are the elders' reluctances and rejections caused by the complexity or poor design of new projects? Or, could it be that there are simply no needs for some of the new projects?

To address the issue of employing smart technologies in the domestic environment for the elderly, this research starts by investigating their needs. The investigation is conducted through a simplified ethnographical study, cultural probes (Gaver, Dunne and Pacenti, 1999; Gaver, et al, 2004), to examine the elders' attitudes toward their living environment, technologies and the future. In addition, a second investigation is conducted using questionnaires to survey the elders' attitudes toward smart technologies available at home. These findings will be used to formulate design guidelines for elder-friendly smart homes.

2. The Elderly and the Technology

There are many studies focus on older people's attitudes toward, perceptions of, and general usage of new or innovative technologies. Although the results are not in clear agreement altogether, they show some general trends. At the macro-level, considering the elderly in general, the elderly are less positive toward new technology and less likely to use new

technology. Whereas at the micro-level, considering individual elderly persons, the elderly are eager to adopt new technology if the technology suits their needs.

The elderly are late adopters of new technology. Studies indicate that older adults, compared to the younger ones, show less interests in new products (Robertson, 1971; Brickfield, 1985), are unlikely to have used new products (Kerschner and Chelsvig, 1984), and are less likely to shop on the Internet (Akhter, 2003). These results agree with the observation that the elderly cling to proven products, and may reject new products that are "futuristic and distinctively different" (Uhl, Andrus and Poulsen, 1970).

However, other studies show that the elderly welcome necessary technologies. Gilly and Zeithaml (1985) report that the elderly adopt new technology when they thought it is "safer" and "more convenient," but reject it when the new technology is "too impersonal," "not as safe" and "not needed." Yang, Zhou and Chen (2005) find few significant differences between the older and the younger adults in new product purchases. In particular, studies using qualitative methods reveal that the elderly welcome new technology to enhance the quality of life in their homes (Zimmer and Chappell, 1999; Arnaert and Delesie, 2001; Demiris, et al., 2004; Morrell, Mayhorn and Echt, 2004; Mynatt, et al., 2004). Barriers to the use of new technology by the elderly are lack of information, need for training and assistance, lack of necessity in daily lives, and design problems (Zimmer and Chappell, 1999; Morrell, Mayhorn and Echt, 2004; Richardson, Weaver and Zorn, 2005; Cohen-Mansfield and Biddison, 2007).

Furthermore, what are necessary technologies for the elderly? Studies have proposed following categories where smart home technologies would benefit the elderly (Stanford, 2002; Demiris, et al., 2004; Mann, 2004; Mynatt, et al., 2004; Cohen-Mansfield and Biddison, 2007):
- safety: emergency help, prevention and detection of falls, stove and oven safety control;
- security: property security, intruder alarm;
- communication: contact with friends and family;
- health: monitoring of physiological parameters (e.g., blood pressure, glucose levels); and
- assistance: automatic lighting, reminder system.

Are these necessary smart home technologies for the elderly? What are the issues that prevent the elderly from using smart home technologies? This research tries to address these two questions using both quantitative and qualitative methods.

3. Cultural Probes

Cultural Probes were developed by a group of designers (Gaver, Dunne and Pacenti, 1999; Gaver, et al, 2004) to explore how to better integrate older participants into the everyday life of their communities. Given the similarity of this study with the initial cultural probes, a pilot study utilizing a pared-down version of the original probes was tested to examine the elders' attitudes toward their living environment, technologies and the future. Seven participants, living in metropolitan areas, four males and three females, between 60 and 80 years of age, were recruited for the pilot study. A probe package, containing postcards, camera, maps, audio recorder and diary, was delivered to each participant. Each participant was given four weeks to complete the probes independently. At the end of the time period, the package was collected by the investigators.

All seven probe packages were completed and collected (Figure 1). However, photos and audio recordings were excluded from the analysis due to poor quality. The data showed that these elderly welcome new technologies but reject robotic companionships. A broader cultural probes investigation is currently underway, in which 150 participants, aged 45 and above, were selected based on the location, economic and educational background. An initial analysis is expected by March 2008.

Figure 1. Data collected from cultural probes

4. Questionnaire Survey

The questionnaire survey was conducted as part of a larger survey concerning issues of social welfare, health care, economic well-being, human resources, transportation and communication, and housing in the aging society. Prior to the survey, a pilot study had been tested using online questionnaire. Its result indicated that smart technologies for home safety and security, energy conservation and usage monitoring, as well as health care and maintenance, are desirable. However, smart technologies for communications between family members or for entertainments are not popular and could be kept minimum at home.

The universe of this questionnaire survey was all residents, aged 45 and above, in Taiwan. A sample of 2500 residents was selected and interviewed. The questionnaire was administered with the assistance of an interviewer. A total of 2453 cases were used in this study. Selected demographic characteristics for the sample are provided in Table 1.

TABLE 1. Demographic Characteristics of the Sample

	N	%
Age		
45-64	1143	(46.6)
65 and more	1310	(53.4)
Gender		
Male	1200	(48.9)
Female	1253	(51.1)
Total	2453	(100.0)

For the initial analysis, t-test analysis was used to compare elderly and nonelderly cases on their knowledge and desire of smart home technologies. Broadband internet connection, wireless internet connection, and safety alarm system showed significant association between age and awareness of the technology. In terms of the desire, only communications did not show a significant association between age and the desire of the technology. The data (see Table 2) suggest that the elderly have less awareness of some of the technologies than those of younger adults. In addition, the elderly have less desire for the smart home technologies than those of younger adults.

TABLE 2. Description of Measures

	elderly	nonelderly
	percent answering "yes"	
Knowledge (ownership)		
Do you have the following service/facility at home?		
Broadband internet connection	40.38	70.60
Wireless internet connection	7.02	18.81
Emergency call system	1.53	2.36
Safety alarm system	4.05	7.87
Web based health care management	0.08	0.26
Remote/online physician diagnosis	0.00	0.09
Multimedia recreation	93.82	93.35
None	1.60	1.84
Desire		
Which of the smart technologies will be needed in your home?		
Home and property security	16.41	33.25
Safety	19.08	32.55
Health care	23.13	37.88
House work automation	4.35	10.50
Communications	7.10	12.34
Recreation and leisure	8.55	20.47
Energy conservation and regeneration	11.91	28.35
None (no needs)	45.34	33.95

Giving the significant association of age and the ownership of broadband internet connection, wireless internet connection, and safety alarm system technologies, the correlations of these and the desire are analyzed (see Table 3). In general, the awareness of network technologies is associated with the desire of new technologies. This association is more prevalent in the nonelderly age group.

TABLE 3. Correlations of Selected Measures[*]

Correlations	broadband		wireless		safety alarm	
	elderly	nonelderly	elderly	nonelderly	elderly	nonelderly
Home and property security	20.98***	36.43***	27.17	39.53**	43.40***	50.00**
Safety	21.55	35.94***	22.83	40.00**	50.94***	46.67**
Health care	25.52	40.15**	35.87**	44.65**	43.40**	46.67
House work automation	5.67	10.66	10.87**	13.02**	11.32	16.67
Communications	8.88**	14.62***	13.04	15.35	9.43	18.89
Recreation and leisure	11.72**	22.92**	14.13	23.72	11.32	35.56**
Energy conservation and regeneration	14.18**	30.98**	19.57	31.63	20.75	41.11**

* Concurrency of knowledge and desire in percentage.

** Coefficient significant at $p < 0.05$.

*** Coefficient significant at $p < 0.001$.

5. Smart Homes for the Elderly

At the time of this writing, neither the cultural probes study nor the questionnaire survey provides a conclusive result. However, based on pilot studies, initial data analysis of the questionnaire survey, as well as related literature, a proposal of the elder-friendly smart homes is formulated. Smart homes for the elderly should be safe, warm, and green.

A safe environment concerns both safety and security issues that are fundamental to the physical well-being of the elderly. Smart technologies that provide home security and personal safety monitoring and alarms are identified by the elderly to be necessary (e.g., Stanford, 2002; Demiris, et al., 2004; Mann, 2004). A warm environment concerns the liveliness and loveliness of the place. Smart technologies that support gatherings of friends and families of the elderly, though not directly requested but hinted by the elderly. The elderly reject technologies that replace or reduce human contacts (Mynatt, et al., 2004). Therefore, smart technologies should bring people physically together. Lastly, a green environment concerns the sustainability and economy issues. Smart technologies that help to reduce waste production, and energy consumption are also desirable by the elderly.

This paper presents an initial investigation into developing smart homes for the elderly. The initial analysis concurs with some literature showing that the elderly welcome new technology when it's necessary. Their needs are observed in the initial analysis, as well as in literature, to be health care and maintenance, home safety and security, and energy conservation. The final results of cultural probes and questionnaire analysis hope to bring further details of these needs.

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