Exploring Use Cases of Smart Presence for Retirement Communities

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Abstract. The goal of this study was to understand what employees of continuing care retirement communities (CCRC) think about the smart presence technology. To better understand their perceptions of the benefits, concerns, and adoption criteria for smart presence systems we have conducted a needs assessment with CCRC employees (N = 23) who were given first-hand experience operating the smart presence system, BEAM, as a local and a pilot user. From the interview data, the most commonly mentioned use case was interaction with others such as doctors, staff, and patients, family, friends, and guests and conduct/attend meetings. From the questionnaire data, the highest uses cases were entertainment (e.g. playing games), interaction for CCRC group activities, and receive remote visits and tours. Findings from this study can guide designers in identifying ways in which smart presence can be integrated into a CCRC environment and used by the employees. Future directions are also considered.

Keywords: Performance · Design · Human factors

1 Introduction

Smart presence technology allows individuals to communicate and interact with each other without being physically in the same space. The use of this technology has historically been in the workplace; however, there is potential for smart presence technology to be used in retirement communities. As we explore the uses of this technology in retirement communities, we must consider the acceptance of smart presence technology by the employees (e.g., nurses, staff, administration). Retirement community employees' perspectives of smart presence technology will influence their own as well as the older adults' adoption rate, as well as the nature the system may be used. Furthermore, by understanding the user's needs, designers can develop user-centered and user friendly systems. Retirement communities, broadly defined, include nursing homes, assisted living facilities, independent living and continuing care retirement communities (CCRCs). For this research, the retirement communities of interest were CCRCs. CCRCs were chosen because smart presence can impact a range of residents and employees that require/offer a range of medical care.

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1.1 Defining Older Adults and Continuing Care Retirement Communities (CCRCs)

Individuals over the age of 65 are typically categorized as older adults. However, it is important to note that individual differences exist and the group of people over 65 years of age is very diverse. Thus, we can think about older adults as two major categories: (1) the younger-old group that is comprised of older adults between the ages of 65 and 75, and (2) the older-old group that is comprised of older adults over the age of 75 years old. This categorization is necessary as there are huge differences in capabilities and limitations between the groups (i.e. a 65 year old versus an 85 year old). Between 2000 and 2010, the population over age 65 grew at 15.5 %, a faster rate than the population under age 45. Overall, the population in the older ages grew at a faster rate than the population in the younger ages [1].

Older adults live in various housing arrangements. Most live in their home with a spouse while approximately 30 % live alone. Women aged 85 and older are most likely to live alone. Almost 50 % of women over age 75 live alone [2]. About 32 % of older adults live with other relatives [3]. There is a small percentage of older adults who live in institutional care (i.e., nursing homes, assisted living) and a majority of those residents are 85 years of age or older [2, 4]. People are living longer, remaining more active into older age, and staying in their homes longer before finding the need for institutional care.

One approach to providing care for the duration of older adulthood is continuing care retirement communities (CCRCs). CCRCs are communities for older adults that meet a wide range of needs. Healthy and independent older adult residents are able to live in apartments, condominiums, or homes depending on the individual community. With this approach, the CCRC offers a community where neighbors are at the same life stage and residents can feel at ease and secure. As a person ages and needs change, the CCRC is designed to meet those new needs. For example, CCRCs offer assisted living for persons needing some assistance with activities of daily living (ADLs), and they have skilled care for those who may need more intensive care. There are many benefits to living in this type of setting. The senior never needs to leave what they come to identify as their community allowing them to age-in-place. Aging-in place is a goal for many older adults; meaning they have the ability to age in their own home and/or community safely [5–7]. Living in one setting for the duration of one's remaining life, such as in a CCRC, means having the assurance that guidance and assistance will be provided in each step of the aging process. Lastly, family and friends can feel comfortable knowing their loved one has care and housing regardless of future changes in ability.

1.2 Smart Presence for Older Adults and Health Care

Promoting health and independence in later years requires more than access to adequate housing. Assistive technology has much promise in increasing older adults quality of life. One such technology is smart presence. Smart presence systems are used to foster communication among individuals using audio and video via a teleoperated device [8].

It offers the sensation of being present at a given location without physically being there. Video conferencing simultaneously transfers audio and video in two or more locations. With this setup, users interact with each other using a stationary apparatus. Unlike traditional video conferencing technologies, smart presence technologies such as the BEAM offer much more including mobility through teleoperation control. Currently the BEAM (and similar devices) are primarily used in the work place allowing companies to interact with others (i.e. clients, employees and teammates) as a means to conduct business in different locations. Although smart presence technology was originally designed and marketed for office settings, there is potential for use cases outside of the work place.

Older adults typically prefer to age-in-place and smart presence technologies have the potential to assist them in completing tasks they cannot perform of choose not to perform. Thus possibly helping older adults maintain their independence by reducing healthcare needs, providing everyday assistance and promoting social interaction [8]. Smart presence has potential for increase social interaction and social connectedness. Social connectedness is the concept in which an individual is actively involved with others or activities in which the involvement promotes comfort and wellbeing and reduces anxiety [9, 10]. Social connectedness is vital for successful aging as it can directly affect a person's probability of disease and disease-related disability, cognitive and physical function and active engagement with life.

In addition to being beneficial to older adults, there is potential for smart presence to positively impact health care workers that work in CCRCs. The general nature of smart presence makes it simple to transfer its application from office environments to other domains. The smart presence devices has been proven useful for meetings as well as conducting conversations while doing something as simple as walking down a hallway [11]. However, little research has investigated the use of smart presence in CCRC settings. It is important to understand how smart presence might fit into the CCRC health care setting, because without the support and buy-in from CCRC employees, the system may never be used to its fullest potential. Thus, we aim to identify specific use cases for smart presence as an initial step in assessing how to best implement this technology.

2 Goals of Research

It is critical that a human computer interaction (HCI) needs assessment is conducted on CCRC employees to better understand how smart presence can be deployed into this market. For this HCI needs assessment, we employed a multi-method approach and collected both quantitative and qualitative data. The quantitative data from the questionnaires provided an indication of how participants' felt the BEAM could be used. The qualitative data from the structured interviews helped us understand the user's perceptions to use smart presence technology. This is the first study dedicated for use specifically in CCRCS. This paper focuses on understanding CCRC employees' views on how a smart presence system may be used.

3 Methods

3.1 Participants

There were 23 participants in this study, 74 % identified themselves as White/Caucasian, 17 % as Black/African American, and 9 % as other. Of the total number of participants, 6 were male and 17 female. The average age of participants was 51.31 years with the ages ranging from 24-70 years of age (SD = 12.66). All participants were employees of CCRCs. The average number of years working in geriatrics was between 1-41 years (M = 13.24, SD = 10.93). Their positions within the company span across four categories: Administration, Activities, Nursing and Other (see Table 1).

Table 1. Work area/position

Area	Count
Administration *(includes 11 Directors)*	11
Activities *(includes 1 activities coordinator, excludes 3 directors of activity services)*	1
Nursing *(includes 1 RN, 1 LPN & 3 CNAs)*	5
Other *(includes 2 Chaplains, 1 Marketing employee, 1 Human Resources employee, 1 IT Support Engineer & 1 Office Manager)*	6

3.2 Platform

In this study, we used two Suitable Technologies BEAM Pro smart presence systems. Going beyond traditional video conferencing products, BEAM removes the constraints of a screen by coupling high-end video and audio with the freedom of mobility. This combination provides a rich experience that connects people. Using two BEAM smart presence systems, participants were able to see the BEAM driven on site (as a local user), and were able to drive a BEAM residing off site (as a pilot user). This gave participants the opportunity to experience the clarity, usability, and capabilities of the system.

3.3 Demonstrations

Two demonstrations were used in this study to allow participants to experience the BEAM both as a local and pilot user. In the local demonstration, a secondary researcher controlled the BEAM and held a conversation with the participant, located in the CCRC (see Fig. 1). The conversation included topics about the participant's day, their job, etc. During this demo, participants had a chance to see the BEAM design, screen size, video/audio quality, and mobility.

Next, during the second demonstration, the participants logged into a BEAM located remotely in a USC office (see Fig. 2). The participants interacted with a researcher, who gave instructions to drive the BEAM through an obstacle course.

Fig. 1. Participant as local user

Fig. 2. Participant as pilot user

The obstacle course consisted of items and furniture commonly found in work and CCRC settings (such as tables, chairs, trashcans) as well as traffic cones and tape on the floor to indicate the direction the participants moved the BEAM. This set up was used to ensure consistency and control across all participants. A similar experience with BEAM is critical for comparing data across participants.

3.4 Materials

Interview Script. We developed a five-part interview script to collect qualitative and quantitative data regarding CCRC employees' preferences for using the BEAM system in their facility. The design of the interview script followed the methodology provided by Fisk and colleagues [12] and included a systematic development of the interview questions, materials, selection of the interview environment, recruitment of participants, and training of interview moderators. The interviews were conducted one-on-one, in a closed office or conference room. The script was semi-structured, meaning that there were a set order of questions, however, we did not restrict the participant if he/she diverted topic and discussed new ideas during the interview.

Questionnaires. The participants completed the usage checklist questionnaire. This Likert questionnaire captured participants' opinions about the feasibility of using the BEAM in CCRCs for a variety of administration, activities, nursing, and resident use tasks. For each given task, participants indicated their level of agreement for usage of the BEAM. For example, the checklist stated "I would use BEAM to…Conduct/attend meetings" and participants selected one of the answer choices: 1 = strongly disagree, 2 = disagree, 3 = neither agree or disagree, 4 = agree, or 5 = strongly agree.

3.5 Procedure

On arrival to the interview, participants provided written informed consent. They were informed that the discussion would be digitally recorded and later transcribed for analysis. The moderator then discussed the goals and topic of the interview, and allowed the participant to complete the pre-demonstration questionnaire regarding their

opinion of the BEAM. The interview then followed a semi-structured order so that all participants would have the same flow of discussion:

- Formal introduction of researcher and co-researchers
- Demonstration of the BEAM; participant as a local user, followed by participant as a pilot user
- Discussion regarding the participants reactions to BEAM (e.g. How would you find the BEAM beneficial to you? Do you feel the BEAM can make an impact on the residents? How often do you think you would use the BEAM?)
- Post-demonstration questionnaire

At the conclusion of the semi-structured interview, the participants were thanked and compensated monetarily for their time. Only interview data about use cases are included in this report.

4 Results

4.1 Data Analysis

The interview transcripts were analyzed according to a coding scheme to identify patterns and themes from the discussions. To do this, first the audio recordings were transcribed verbatim with the participant's personal information omitted. Next, transcripts were segmented into units of analysis. A segment was defined as a statement or description that included the following dimensions: any utterance in which a thought, feeling, or opinion was related to attitudes and acceptance toward smart presence. Additionally, segments were created for any utterance that represented a potential use case.

Next, a coding scheme was developed to categorize each segment. A coding scheme is an organized categorization of the information in the interviews. The coding scheme was largely organized as benefits and concerns for use of the smart presence in CCRCs. The coding scheme was based on both the literature and the nature of the participant comments. In other words, it included themes already known to be related to attitudes about or use of smart presence [8]. Also an iterative category generation strategy was used. In this approach, the first segment was coded either on a category already included in the coding scheme, or assigned a new category label determined by the researcher that described the general idea of that segment (i.e., a bottom-up approach).

Coders were calibrated by conducting three rounds of independent coding on the same four randomly selected transcripts. Each round was followed by discussion of discrepancies and revision to the coding definitions. The final round of reliability resulted in an average of 87 % agreement between the two coders. Percent agreement was calculated as the percentage at which different coders agreed and remained consistent with their assignment of particular codes to particular data. There is no standard or base percentage of agreement among qualitative researchers, but 85 % seems to be a minimal acceptable benchmark [13]. After inter-coder agreement was met, the remaining transcripts were divided among the two coders to code independently.

The questionnaire data was entered into the statistical software SPSS and analyzed using both descriptive and nonparametric statistics. The criterion of $p < .05$ was used to determine statistical significance.

4.2 Understand CCRC Employees' Views on How a Smart Presence System May Be Used

Use Cases Mentioned in Interview. After operating the BEAM as a pilot and local user, participants were asked to consider uses for the BEAM in their role at the CCRC. Figure 3 depicts the mentioned use cases for BEAM in CCRCs by CCRC employees and the percentage of participants who mentioned each particular use case.

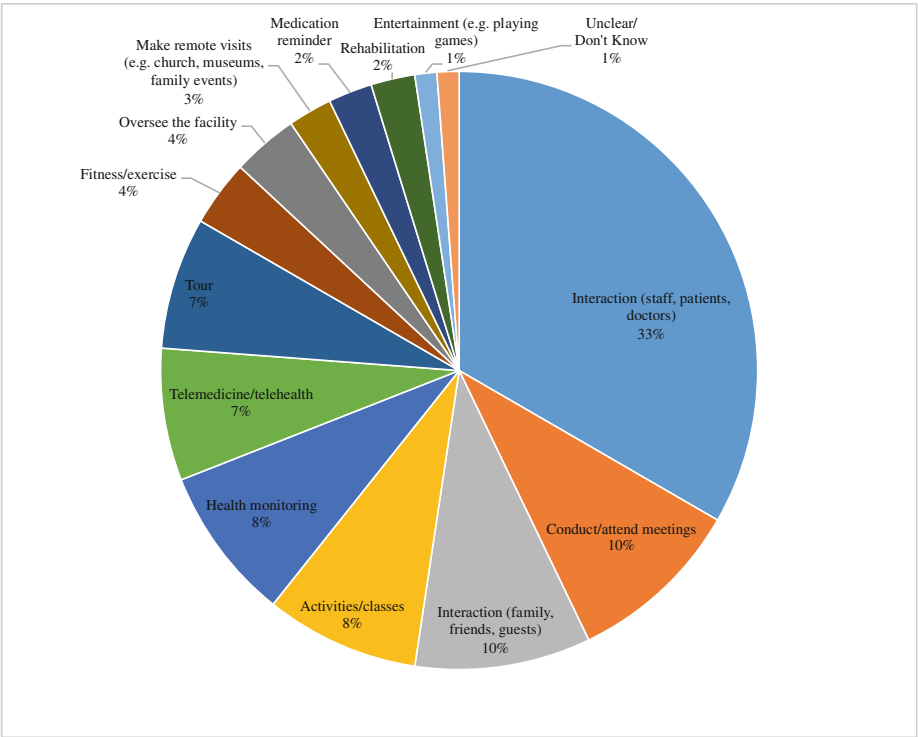

Fig. 3. Use cases (percentages represent number of times mentioned)

The most commonly mentioned use case was heath care-based interaction with doctors, staff, and patients. The two second highest use case categories (tied) were social interaction with others such as family, friends, and guests, as well as to use the BEAM to conduct/attend meetings. Overall, participants indicated that the BEAM would be most used for interaction with others. Although the aforementioned use cases were the most commonly mentioned, nearly half of the remaining responses ranged in nature. Participants expressed interest in using the BEAM for a variety of uses, such health monitoring, holding classes, and telemedicine.

BEAM Usage Checklist Questionnaire. In this questionnaire, we pre-identified 22 use cases, split them into categories: administration, activities, nursing, and resident use. We asked participants to indicate their level of agreement for using the BEAM to

complete each task. The mean responses are depicted in Fig. 4. As the figure conveys, participants thought that the BEAM can be used for a variety of tasks. Each task mean was rated above a 3.0 (3 = neither agree nor disagree), indicating an openness to use the BEAM for all 22 tasks.

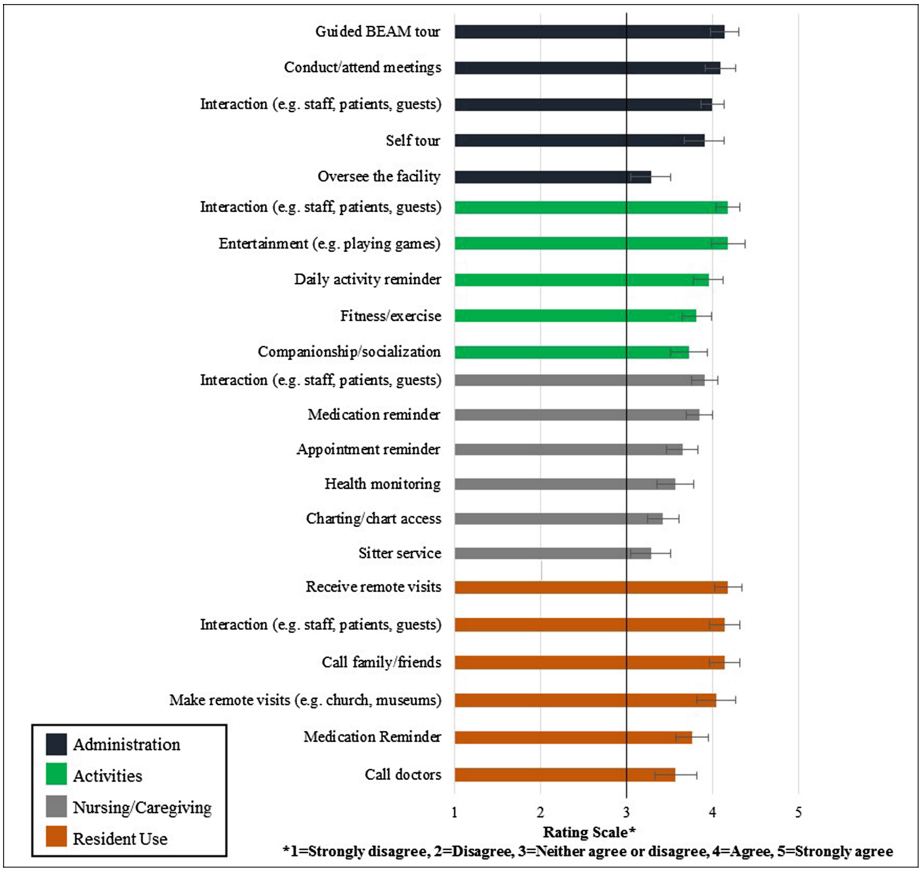

Fig. 4. BEAM usage checklist

Below we list the top 5 use cases chosen from this checklist. Some tasks were tied for the number one and two slot.

1. Entertainment (e.g. playing games) (M = 4.18, SE = 0.19),

   Interaction (e.g. staff, patients, guests) for activities (M = 4.18, SE = 0.14),
   Receive remote visits (M = 4.18, SE = 0.16);

2. Guided BEAM tour (M = 4.14, SE = 0.17),

   Call family/friends (M = 4.14, SE = 0.18),
   Interaction (e.g. staff, patients, guests) for resident use (M = 4.14, SE = 0.18);

3. Conduct/attend meetings (M = 4.09, SE = 0.17);
4. Make remote visits (e.g. church, museums) (M = 4.05, SE = 0.22); and
5. Interaction (e.g. staff, patients, guests) for administration (M = 4.00, SE = 0.14).

5 Discussion

The BEAM smart presence system has the potential to be beneficial for use in CCRCs. However, without first assessing users' opinions and willingness to use such systems, there is a risk of deploying systems that may not be adopted by the intended population. Qualitative research methods, such as interviews, coupled with quantitative methods, such as questionnaires, provide the appropriate methodology to conduct needs assessments. Findings from needs assessments help us to understand user requirements, attitudes and acceptance. This work focused on experience with the actual device, BEAM. Participants interacted with the BEAM, both as a pilot and local user, and made responses to interview questions and questionnaires with the specific system in mind.

These results gave insight into use cases for BEAM smart presence in CCRCs and the reasoning for their thoughts. The data from the BEAM Usage Checklist suggested that CCRC employees find the BEAM useful across several areas in their facility. It appeared that employees saw the BEAM most useful for residents to visit family and friends when they otherwise could not due to mobility impairments or geographic barriers. Using the robot for this purpose differs from previous studies that investigated smart presence use by other populations. For example, with a sample of older adults, Beer and Takayama [8] found users were focused on using smart presence for efficiency or effort saving (e.g., not having to drive); Tsui et al. [11] assessed people in the workplace and identified use cases for conference room meetings and moving hallway conversations. One of our CCRC participants said, "I'm thinking one cool thing we've talked about here, especially when there are people in assisted living where they can't get out of their bed…". Another mentioned, "family members if they wanted to meet their mom's caregiver, you know, that would be a nice way for them to meet them and check in on mom and things of that nature."

Conducting needs assessment and user studies should be iterative. Although the current study provides insight to this user population's suggested uses for this system, it is critical for future work to be conducted to ensure that future designs are effective. In this study, we learned the use of smart presence from the employee's perspective; however, it will be useful to review the attitudes of the residents and family members who will most likely benefit from smart presence. In fact, the goals of retirement communities are centered on the residents' needs and wellbeing. The participants made it clear that the facility's primary purpose is to accommodate the residents. In terms of methodology, it would be ideal if future work could also provide long-term experience with a smart presence system applied to the top use cases mentioned in this study. In addition to having the interviews, this would enable longitudinal and ethnographic studies that can use observations to learn about how smart presence can be used in retirement communities. It is important to ensure that the technology fits well into the

environmental workspace, so longer-term studies would be critical in assessing sustained adoption.

Finally, future studies could incorporate usability aspects such as situation awareness, mental maps, immersion, and social connectedness as measures to assess whether BEAM is "just like being there." The present study provides ample evidence that the technology would be welcomed into retirement communities (attitudinal and intentional acceptance); next steps to assess adoption and actual long-term system use will prove to be just as exciting.

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