Guidelines for the use of Smart Home Technology for Elderly People

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ABSTRACT

New technology and smart homes have the potential to enhance standard of living, safety, and take care of older ones in house. The elderly and disabled can be monitored with various intelligent devices. Sensors can be ingrained into their home for continuous quality help and non-obtrusive malady hindrance. Sensor-embedded homes, or smart homes, cannot solely assist individuals with reduced physical functions, however they facilitate resolving the social isolation they face. However, we do not yet know how older people’s perceptions of these technologies may vary, in particular how views based on experience of actual use may differ from those related to anticipated use. We also do not know how older people living independently might view technology that may be of future rather than current value to them. The paper has explored older people’s views of smart home monitoring technology and compares between people with direct experience and people without. Support that, what guidelines they may want to follow while using it. From this study, one will ascertain totally different understandings by mature individuals, acceptance will increase over time and with use. Also relating to privacy, trust, usability, and more concerns about utility. This study concluded the views about the technical feasibility, affordability, impact on relationships, and about the engagement and competencies of those who would view the monitoring data to use into the design field for future use specially for elderly people.

Keywords: Home Healthcare, Smart homes, Elderly people, Technology acceptance, Digital Health.

1. INTRODUCTION

According to the law, a "senior citizen" means any person being a citizen of India, who has attained the age of sixty years or above. According to Population Census 2011 there are nearly 104 million elderly persons (aged 60 years or above) in India. There will be over 319 million elderly by 2050, threefold the number identified by the Census in 2011, according to the Longitudinal Ageing Study of India (LASI).

In the 2011 census, the 60+ population accounted for 8.6% of population, accounting for 104 million elderly people. Growing at around 3% annually, the number will rise to 319 million in 2050. While 75% of them suffer from one or the other chronic disease, 40% have one or the other disability and 20% have issues related to mental health, said the report prepared by the International Institute for Population Sciences, (IIPS), Mumbai in collaboration with the Harvard School of Public Health, the University of Southern California, the United Nations Population Fund (UNFPA) and the National Institute on Ageing [2]. One way to avoid institutionalizing older persons (or a minimum of to defer it as long as possible) and scale back voluted medical prices is through technology. We tend to not solely cure health problems, however conjointly promote well being in all stages of life. Particularly, technology will facilitate persons age reception in safety and independence. For several years, home automation has been thought of as an extremely promising world for developing technologies [3]. Information Technology could become a great tool for early identification of changing conditions and early intervention, still as for current made-to-order watching. So-called “smart home” applications use sensors and alternative devices and telecommunication options to reinforce residents’ safety and monitor their health condition and overall well-being. Many pilots worldwide have explored smart home technologies for the aged. The SmartBo project in Sweden, for example, explores home-based technology for elders with quality impairments and cognitive disabilities, together with devices and sensors that manage lighting, windows, and water shops, still as visual and tactile sign devices and speech synthesizers [5]. In France, a smart home initiative examines the use of infrared motion sensors connected to a wireless network to spot abnormal behavior of patients with Alzheimer’s illness. In the US, the Aware house is exploring the utilization of sensors and helpful technologies to change older adults to measure severally. These and lots of alternative products have advanced the research.
agenda of ambient power-assisted living and have explored principles of omnipresent computing for the house environment and older adults. However, most initiatives are unit primarily demonstrations of technological prospects. A lot of work still has to be done in addressing the potential end-users’ wants and expectations. The wants of elders are a unit completely different from the general population and therefore the teams generally investigated in human-computer interaction studies [4,5]. The success of smart home applications will rely on the extent to which their design and implementation follows some rules or guidelines instead of experimenting on active or passive participants in the monitoring end users to reach their goals and make products out of it. The aim of this paper is to simply provide guidelines for the use of smart home technology that will help designers or engineers to create a product or idea for elderly people who live most of the time alone considering their medical conditions.

2. OLDER PEOPLE’S PERSPECTIVES ON SMART HOME TECHNOLOGY

In around two recent systematic reviews, the authors conclude that there’s associate absence of literature that investigates older people’s experiences of living with sensible home technology or involves them within the design of the technology. [1] Of these, Lee and Kim highlight the importance of attention to psychological additionally as physical independence and Turjamaa and colleagues highlight the absence of analysis that involves older individuals in the design of the technology [6,7].

A range of concerns have been identified as possible barriers to adoption of smart home technology. These include usability, accessibility, reliability, trust, stigma, control, privacy, lack of human response, burden to others, lack of perceived need, and affordability[12, 13, 17, 18, 19]. For instance, Mann and colleagues found, in a survey conducted with 661 older people with chronic physical conditions, that 56.3% of them did not think the smart home technology would be beneficial to them, and 59.3% were not interested in buying such a system[20]. Coughlin and colleagues conducted a workshop and focus group with 30 leaders in ageing advocacy and ageing services. They reported that monitoring technologies have a positive impact on older people’s feelings of safety but that dependence on technology might present a threat to older people’s dignity[12] (Coughlin et al., 2007). [Similarly, any other papers review showing no trust on smart home tech.] Many studies have been conducted in labs in the older people’s perspective of smart home technology have taken place such as the user requirement or evaluation phases[6] (Lee and Kim, 2019).

In addition, living in a smart home can trigger new behaviours that may be different from those that are part of routine life without such technology. Thus, it is possible that there is a difference between views of those who have previously used technology compared with those who are potential users [21,22](Venkatesh et al., 2011; Yang et al., 2018). Understanding and characterising the details of these differences may provide vital information for future development of technology that is acceptable. Few studies have investigated users’ perception of commercially available smart home devices [19,22]. For most of these research studies, privacy and security were still the main concerns of users, and these were in addition to the lack of interoperability, complexity, cost of use and lack of perceived utility[6] (Lee and Kim, 2019).

Overall, there is a need for more research that focuses on older people’s experiences as smart home users. Importantly, there is a lack of research that explores the experiences of older people who are living independently with little support in place and comparing their experiences with those of people especially younger generation who have not lived with technology. Characterising and comparing views about smart home technology may provide a foundation for future development of approaches that enable people to accept technology, and that may help technology design to take account of views during its design.

3. OBJECTIVES

The main objective of this study is to provide guidelines for the use of smart home technology for elderly people in Indian context. To assist older people to live well and easily and be self-dependent at their homes. Our study was designed to explore these objectives and to inform future work to inform the design of smart home technology that accounts for older people’s voices.

4. GERONTECHNOLOGY AND SMART HOMES

“Geronotechnology” is a term that combines gerontology and technology, coined to describe an interdisciplinary field of science for “designing technology and environment for independent living and social participation of older persons in good health, comfort and safety” [8]. The term “smart home” refers to a special kind of home or residence equipped with sensors and actuators, integrated into the infrastructure of the residence, intended to monitor the context of the inhabitant to improve his or her experience at home [9,11]. Smart homes can enable older adults to live independently at home longer and reduce their reliance on informal or formal caregivers, or allow caregivers to better care for older adults. These technologies have the potential to provide a cost-efficient approach to enhance one’s quality of life and help older adults live safely in their homes [10]. A smart home can potentially provide a variety of services spanning from simple task automation (e.g., room-temperature control), to analysis or prediction of the location of a resident, to behaviour or health status recognition of an occupant living at home, with subsequent transmission of collected data for remote monitoring. In health care, there are two key applications for smart homes: “(a) home automation: remote or automatic control of devices, appliances, or systems at home to enhance an occupant’s quality of life, or to manage energy consumption; and (b) monitoring wellness: monitoring an occupant’s health-status to maintain his or her well-being” [10,p. 4].

5. METHOD

5.1 Search strategy

The following databases were searched in March 2021. The following databases were searched: MEDLINE or MEDLARS, Web of Science, CINAHL, Scopus, MedicineNet, PubMed, Nursing Reference Center, Cochrane Central Register of Controlled Trials, Inspec, Compendex, SociINDEX, PsychINFO, Old age homes and Sociological Abstracts. These databases were chosen as they cover a broad range of disciplines ranging from health to social sciences and the life sciences. A variety of search terms synonymous with keywords such as ‘elderly’ and ‘smart homes’ were combined using Boolean logic. An example of the search strategy utilized for the MEDLINE search is given in table 1.
Also a focus group discussion has been conducted with elderly group of 13 people. 6 of them were living alone due to some family issues and the remaining 7 were living with their kids and grandkids. So the whole group has been divided into 2 for focused discussion about the health and social issues they were facing. The data collected from the discussion is shown in the fig. 2 and the elderly people enjoying discussion have shown in the fig.1.

5.2 Selection Criteria
The selection criteria for this review are shown in table 2. Articles were included if they were published in English, in a peer reviewed text, and were available as full works. Because of the rapid progression in technology and the relative lack of information in earlier years [23], articles published before January 2004 were excluded. This study was interested in original information regarding the effectiveness or feasibility of smart-home technologies. Accordingly, the search was limited to intervention or feasibility studies.

There are multiple forms of technology that may help to assist older adults in their home environments. It was beyond the scope of this paper to review the robotics, gaming or social inclusion literature. We have reviewed these separately. Instead, the focus of this paper was specifically on types of technology that can be used in a home environment which either interacts with or provides direct information to the user without the need for another individual. The role of smart home technologies is often to assist residents by performing a task they are no longer able to do. In this way, many smart-home technologies should be able to work independent of the people who reside in the house. As a result the level of assistance has not been reported in this study. Due to the heterogeneity of results and the lack of randomized controlled trials, a meta-analysis was not feasible in this study. Instead a summative synthesis of results was performed [24].

Table 1: Example of search strategy for MEDLINE or MEDRALS.

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Synonyms</th>
</tr>
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<tbody>
<tr>
<td>Elderly</td>
<td>Middle aged or Aged or Aged, 80 and over or Age* or Aging or Elder* or “Older adult***” or “Older person” or “Older people***”</td>
</tr>
<tr>
<td>Smart home</td>
<td>“Smart home***” or “ambient assisted living” or “ubiquitous home***” or “ubiquitous technology***” or “electronic assistive technology***” or “social alarm” or “telecare social alert platform***” or “environmental control system***” or “automated home environment***” or “telehomecare or “Home Automation”</td>
</tr>
</tbody>
</table>

Note: Synonyms for the two words combined to create search idea

Table 2: Inclusion and exclusion criteria.

<table>
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<tr>
<th>Inclusion Criteria</th>
<th>Exclusion Criteria</th>
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<tbody>
<tr>
<td>● Assessed smart-home technologies.</td>
<td>● Published before January 2004.</td>
</tr>
<tr>
<td>● Published in English and available in full-text from peer review journals.</td>
<td>● Set in other environments such as nursing homes or rehabilitation centers.</td>
</tr>
<tr>
<td>● Assessed effectiveness or feasibility.</td>
<td>● Books and abstracts from conference presentations.</td>
</tr>
<tr>
<td>● Set in a home environment.</td>
<td>● Studies focussed on tele-health, tele-medicine or tele-rehabilitation. Narrative reviews and other systematic reviews</td>
</tr>
<tr>
<td>● Included participants aged ≥ 45 years.</td>
<td>● Robotics and other advanced data due to time bound</td>
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From the above image we can understand that the authors have conducted focus group discussions, interviews and surveys in different regions for several months. Using this method, we conducted a focus group discussion between 13 elderly male people to get the data about what they feel about smart home technology, if they would provide what kind of easy handling they wish, what kind of physical problems they face daily and will they accept the home technology.
6. DISCUSSION
From the discussion conducted between selected focus groups, the data collected has shown in the table below. Around 75% of the elderly in India suffer from one or the other chronic disease, 40% have a disability and 20% go through issues related to mental health, revealed the India Report on Longitudinal Ageing Study of India (LASI) Wave-1 released by the union health ministry on Wednesday.[2]

Table 3: Common medical conditions in elderly people.

<table>
<thead>
<tr>
<th>Condition</th>
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<tbody>
<tr>
<td>Arthritis</td>
<td>Asthma</td>
<td>Blindness</td>
<td>Cancer</td>
</tr>
<tr>
<td>Chronic Bronchitis</td>
<td>Chronic Kidney Disease</td>
<td>Coronary Heart Disease</td>
<td>Deep Vein Thrombosis</td>
</tr>
<tr>
<td>Dementia</td>
<td>Diabetes</td>
<td>Epilepsy</td>
<td>High Cholesterol</td>
</tr>
<tr>
<td>Hypertension</td>
<td>Motor Neurone Disease</td>
<td>Multiple Sclerosis</td>
<td>Osteoporosis</td>
</tr>
<tr>
<td>Paget’s Disease of Bone</td>
<td>Parkinson’s Disease</td>
<td>Shingles</td>
<td>Stroke</td>
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</table>

7. GUIDELINES
The following guidelines can be followed by designers to create new smart home technology products for elderly people to make their living easier and these are based on the literature review and methods conducted to collect data from this study.

1. Older people living alone have mostly caretakers or nurses taking care of them [24]. So, a designer who is willing to create any product has to think in both ways from the user's perspective as well as the caretaker's perspective.
2. Older people with chronic diseases like heart patients or cancer patients mostly spend their days sleeping or in sitting positions due to their weakening bodies, in that case smart home technology can be a wonderful help for them. From the discussion we understood that the user will gladly use a product which can be converted in such a manner that a sitting person can easily convert the chair into a sleepable form like bed with just the help of a single button. Designers should consider this as an opportunity.
3. Patients with Arthritis have symptoms like joint pain, tenderness and stiffness, Restricted movement, Inflammation in and around the joints etc. In such difficulties users avoid walking alone, they need support. This support can be given by smart home products such as for example walking sticks with sensors and remote controls. Designers can use door switches controls, movement sensors, bed load cells, and individual tracking badges for users without complex features.[25]
4. Elderly people are most concerned about usability, confidentiality and privacy.
5. While designing products for Asthma patients, with symptoms such as coughing, A tight sensation in the chest,breathlessness and a constant use of inhaler spray, users stay indoors even if they have good health so tracking systems and voice activated applications can work in their favour.
6. Sensors can be used including bed sensors, gait monitor, stove sensor, motion sensor and video sensor with very simple user interface.
7. Various sensors including motion, pressure temperature sensors throughout the facility can be a good option.
8. Sensors and cameras-minimal description because of security trust issues.
9. Also Sensors to detect electricity use to determine activities, optical fall sensors and wearable fall sensors can be provided by designers.
10. Floor tracking system, remote monitoring system, voice activated commands, smart wave, smart doors, Speech-driven environmental control systems,Standard set of sensors – movement and door entry point, Electronic sensor and user interface eg sensors for door, presence and kitchen utensils, Assistive technologies such as devices for planning and reminders, cell phones, GPS (mostly for Dementia sufferers), and a remote control. Sensors dispersed around the home to detect ADLs. Including on beds, chairs, attached to panic buttons and kitchen and living room appliances the description on sensors should followed exactly in the elderly peoples’ experiences for feasibility, participations and activity tracking purpose.[24]
11. Impact on adherence to medication plan has Multimedia healthcare system that incorporates an online medication plan, recognition of medicine information and advice, coupled with a reminder system for user group.[24]

12. For effectiveness of smart-home technologies Multiple sensors, remote controls and security systems at homes.[24]

13. Acceptance and feasibility again studied into unattended Autonomous Surveillance System (incorporating sensors and voice controls).[24]

8. CONCLUSION

The use of technology applications and tools in home health care raises a number of issues that human factors expertise is called on to address. The guidelines address the issues of privacy and confidentiality; usability; data transmission and interoperability; and policy, economic, and ethical considerations. These are the restrictions. Elderly people have to first accept the use of technology and get blessed with simple use of smart home products to improve the quality of life. There is tremendous future scope in this study to make products which are really usable and made just as per understandings of the elderly people.

9. REFERENCES


