International Journal of Scientific Research & Engineering Trends
Volume 9, Issue 4, July-Aug-2023, ISSN (Online): 2395-566X

Towards User-Centric Smart Homes for Older Adults: Investigating Technology Acceptance, Ethical Concerns, and Adoption Challenges

Srinivas Goud Thadakapally
1801 Nightingale dr, Aubrey, TX, 76227

Abstract — As the aging population grows rapidly, the need for smart home technology designed to assist the elderly in their daily lives, health care, and their overall quality of life is becoming more apparent. Although smart home systems have undergone remarkable technological developments, their use is still constrained in the face of concerns over usability, privacy, security, ethical issues, cost, and digital literacy. This paper is a user-centric study on the adoption of smart home that considers Technology Acceptance, ethical issues, and adoption issues related to older people. A thorough literature review is carried out to discover the main elements that affect the acceptance of the users and to analyze the existing smart home solutions. Moreover, a framework called User-Centric Smart Home Adoption Assessment (UCSHAA) is suggested, which assesses technology acceptance, ethical compliance, usability, privacy, and overall technology readiness for adoption. Examples of comparative analysis show that incorporating the principles of user centered design with the consideration of ethics can enhance trust, accessibility and adoption potential. The results offer guidance to researchers, developers, healthcare and policy makers in designing secure, ethical and user-friendly environments for the smart home to support healthy and independent aging. Future studies will aim at validating the proposed framework through large-scale studies in the real user environment.

Keywords— Smart Homes, Older Adults, Technology Acceptance, User-Centered Design, Ethical AI.

I. INTRODUCTION

The number of older people is growing exponentially, as a result of better health and longevity [1]. As adults get older, there are physical, cognitive and sensory changes that can make it more difficult to live independently [2]. The development of Smart home technologies has offered a promising solution to assist older adults in the monitoring of their health in real time, emergency support [3], activity recognition [4], control of their environment, and remote communication between home and health care professionals or caregivers [5]. Modern smart homes can use technologies like the Internet of Things (IoT), Artificial Intelligence (AI), cloud computing and smart sensors to improve the lives of citizens, make them safer and healthier, and less dependent on others [6].

These technological advances have not yet significantly increased the percentage of older people who have taken up smart home systems [7]. Elderly users face problems with complex interfaces, lack of digital literacy, cost of installation, interoperability, and poor technical support. Furthermore, issues like privacy, cyber security [8], transparency, user autonomy, and ethical use of personal information have significant impact on the users' willingness to adopt and persist in the use of smart home technologies [9]. The challenges reflect the need to design systems that cater to the user's needs, preferences and abilities instead of solely technological innovation [10].

Over the past few years, there has been a significant emphasis on user-centric design, which actively engages older adults in the design, development and evaluation process [11]. This would focus on usability, accessibility, personalisation and trust, and ensure that the technologies of the smart home are in line with the daily lives and expectations of older people [12]. The ethical guidelines, including informed consent, data protection, fairness, and transparency, further enhance user trust and responsible implementation of intelligent home environments [13].

Data relating to technology acceptance, usability, healthcare monitoring and privacy are the subject of numerous studies, but relatively fewer studies comprehensively analyze the relationships between technology acceptance, ethical issues [14], and adoption issues within a holistic user-centric approach [15]. The knowledge of these interdependent factors is crucial for creating smart home systems which are technologically sophisticated, practical, credible, and acceptable to the older adults [16].

This study thus explores the key factors that impact older adult adoption of user-centric smart home technology, focusing on technology acceptance, ethical issues, and older adult adoption

barriers. The results will contribute to the knowledge of researchers, developers, health care professionals and policy makers to create inclusive, secure and user-friendly smart home environments that facilitate healthy and independent living.

Objectives of the Study

- To explore the factors that play an important role in the adoption of smart home technologies by older people.
- To define the key ethical issues, such as privacy, security, autonomy, and data protection, of smart home systems.
- To explore technical, financial, social and usability issues of user-centric smart home solutions.
- To examine how user-centered design concepts contribute to better accessibility, usability, trust and user satisfaction of older people.
- To make recommendations to develop secure, ethical, accessible and user friendly smart home systems for independent living and improving the quality of life for older people.

II. LITERATURE SURVEY

Etemad-Sajadi and Santos (2019) investigated senior citizens' acceptance of connected health technologies in their homes. The study looked at factors that had impacted older adults' openness to and adoption of connected healthcare technologies in their homes. It emphasized the value of perceived usefulness, ease of use, trust, and users' perceptions of benefits that connected health solutions offer. The study revealed that the acceptance had not only depended on the functionality of the technology, but also on the perceptions of the seniors on technology in relation to their health, independence and daily life.

Reeder et al. (2020) studied older women's perceptions of wearable devices and smart home activity sensors. The study investigated the perception of older women to technologies that keep track of physical activity and provide information regarding their daily routines and health. It took into account factors like usefulness, comfort, privacy, trust, usability and perceived intrusiveness of monitoring technologies. The results showed that technology acceptance had been affected by the users' belief that the technology was useful and fit for their lives, as well as by the comfort of using and collecting personal activity data.

Ashraf et al. (2020) focused on the perceptions and post adoption behavior of the aging people regarding the usability of smart home technology in Pakistani context. The study looked at the self-assessment of older adults towards the adoption of smart home technologies, and their experience in terms of usability and applicability. It highlighted the importance of cultural background, user experience, perceived usefulness, and ease of interaction that have affected user post-adoption behaviour. The study showed that after these initial stages of acceptance, continued use of the smart home had relied on the experiences and perceptions of the older adults.

Shirani et al. (2020) investigated the perspectives of smart technologies among vulnerable consumers. In their study, the authors tried to determine the differences in perceptions of smart meters between users who may encounter socioeconomic or technological barriers and those who do not. The researchers found privacy, control, trust, complexity, and benefit distribution to be key themes affecting the relationships between individuals and their smart devices. Shirani et al. concluded that vulnerable consumers did not necessarily perceive smart technology the same way as those without barriers. The study helped determine that when designing and implementing smart technologies, it is important to consider not only the given task but also the context in which it will be used and by whom.

Schlomann et al. (2020) compared the use of assistive technology and mobile ICT among the oldest-old in private households and long-term care facilities. Schlomann et al. aimed to determine the characteristics of technology use in older adults and the factors associated with its use in people who chose to age in their homes versus those who reside in care facilities. The researchers identified a number of factors influencing the use of assistive and mobile technologies by the oldest-old. They found that for older adults, the decision to use technology depends on living arrangements, opportunities, abilities, and access to resources. Schlomann et al. concluded that when implementing technology interventions for the oldest-old, the needs of both groups should be taken into account.

Kadylak and Cotten (2020) conducted a study determining the willingness of older people in the United States to use emerging technology. Kadylak and Cotten analyzed the factors promoting or preventing older adults from embracing new technology and assessed their perceptions. They revealed that the level of willingness varied depending on whether the use of emerging technology was perceived as beneficial, reliable, simple, and safe. Kadylak and Cotten concluded that in order for older people to be more open to innovation, it is important to increase their awareness and ensure simplicity and usefulness of new technology.

Weck and Afanassieva (2020) conducted a study exploring initial trust formation toward digital assistive technology by older people. Weck and Afanassieva identified the factors affecting initial trust formation and assessed whether trust predicts technology adoption by older adults. The study showed that initial trust was a critical factor influencing the decision of older people to use assistive technology. Weck and Afanassieva found that the willingness to adopt technology was driven by users' perceptions of its general reliability, usefulness, safety, and transparency and their expectations regarding the technology.

Zou et al. (2020) introduced a smartphone app mDASHNa-CC designed to facilitate the management of diet-related healthy eating and hypertension among Chinese Canadian seniors. The study protocol explained the rationale, design, recruitment procedures, sample size, and ethical considerations of the study. Zou et al. aimed to provide older adults with technology-based help in managing their health conditions. They emphasized the importance of usability and feasibility when developing mobile health technologies for older people. The study helped determine what barriers to adopting the app would be present for seniors and how these barriers could be removed.

Research Gaps

Although many studies have been made on smart homes, most of them address mainly health care, home service robots or specific issues such as usability, privacy or technology acceptance, with fewer works analyzing in depth technology acceptance, privacy, ethical issues, and the use of smart home systems. Additionally, some works fail to consider personalization, transparency, and explainability factors to ensure user trust. This work aims to identify a user-centric approach for understanding technology acceptance, ethical issues, and challenges related to the adoption of smart home by older persons.

III. PROPOSED METHODOLOGY

The proposed methodology aims to provide an innovative approach to studying the adoption of the smart home concept by older people by considering the level of technology acceptance, ethical concerns, and barriers to adoption. It is noteworthy that the methodology does not focus on creating a machine learning model but instead attempts to use the collected survey data and the published literature findings to identify the key factors influencing the adoption of smart home technology by older people. Thus, the methodology section will comprise steps involved in data collection and preparation, the extraction of factors, normalization of input data, calculation of weights, adoption score determination, and the development of recommendations.

To begin with, the methodology will require collecting survey responses from older people, caregivers, and healthcare professionals, as well as the published literature findings on the research topic. All the collected data will be used to identify the key factors influencing older people's adoption of the smart home concept. The survey questions will be divided into several categories, namely: demography, experience, perceived usefulness, privacy, ethics, ease of use, cost, trust, and overall adoption intention. As the survey questions will have multiple-choice options and open-ended questions, pre-processing will involve the removal of irrelevant responses and records, and the transformation of qualitative information into quantitative data. A five-point Likert scale will also be applied to quantitative responses to ensure data uniformity and facilitate data analysis. Specifically, the respondents will be asked to rate their agreement with statements on a scale from Strongly Disagree (1) to Strongly Agree (5).

The normalized value of each evaluation parameter is calculated as

$$N_i = \frac{X_i - X_{min}}{X_{max} - X_{min}}$$

where

- N_i= normalized value
- X_i= observed score
- X_{min}= minimum possible score
- X_{max}= maximum possible score

After normalization, the technique used in this study focuses on determining the primary dimensions of influence on the adoption of smart home technology. These dimensions are Technology Acceptance (TA), Ethical Concerns (EC), Usability (US), Trust (TR), Accessibility (AC), and Adoption Barriers (AB). The influence of each category in the decision-making process is different, which is why weight coefficients were assigned to each according to the data found in the literature review. Thus, the indicators with the greatest impact on adoption received higher values.

The weighted score for each factor is computed as

$$W_i = w_i \times N_i$$

where

- W_i= weighted score
- w_i= assigned weight
- N_i= normalized score

The weighted values from all criteria are aggregated to calculate the overall Smart Home Adoption Score (SHAS). This score helps understand an individual's willingness to embrace the user-centric nature of the proposed technologies. The higher the score, the more positive the attitude toward adoption, acceptance, trust, and a lesser degree of ethical concerns and barriers to adoption.

The overall adoption score is calculated as

$$SHAS = \sum_{i=1}^{n} W_i$$

where

- $SHAS$= Smart Home Adoption Score
- W_i= weighted score of the i^{th}factor
- n= total number of evaluation factors

To assess ethical readiness, the components of privacy, security, autonomy, transparency, and informed consent, among others, were combined into one aggregate called Ethical Compliance Index (ECI), which estimates the extent to which the proposed smart home environment meets the ethical standards expected by older adults.

The Ethical Compliance Index is determined as

$$ECI = \frac{P + S + A + T + C}{5}$$

where

- P= Privacy score
- S= Security score
- A= Autonomy score
- T= Transparency score
- C= Consent score

Similarly, the Technology Acceptance Index (TAI) is used to measure the users' willingness to embrace smart home technologies. This indicator is based on perceived usefulness, ease of use, trust, and other benefits associated with the technology adoption process. Thus, using TAI, it is possible to identify the majority of technology-related factors that have been subject to extensive research and practical application under the Technology Acceptance Model (TAM).

The Technology Acceptance Index is computed as

$$TAI = \frac{PU + PEOU + TR + PB}{4}$$

where

- PU= Perceived Usefulness
- $PEOU$= Perceived Ease of Use
- TR= Trust
- PB= Perceived Benefits

Finally, a given framework is utilized to assess the level of adoption based on the adoption score, technology acceptance, and ethical compliance. By considering the threshold values of each category, the level of adoption is prioritized as High, Moderate, or Low. The outcomes of the conducted research benefit researchers, policymakers, medical practitioners, and smart home developers by contributing to the creation of secure, ethical, accessible, and convenient technologies for older adults.

The final adoption readiness score is computed as

$$ARS = \alpha(SHAS) + \beta(TAI) + \gamma(ECI)$$

subject to

$$\alpha + \beta + \gamma = 1$$

where

- ARS= Adoption Readiness Score
- α, β, γ= weighting coefficients
- $SHAS$= Smart Home Adoption Score
- TAI= Technology Acceptance Index
- ECI= Ethical Compliance Index

Algorithm 1: User-Centric Smart Home Adoption Assessment (UCSHAA)

Input:

- Survey responses R
- Technology acceptance parameters
- Ethical concern parameters
- Adoption challenge parameters

Output:

- Technology Acceptance Index (TAI)
- Ethical Compliance Index (ECI)
- Smart Home Adoption Score (SHAS)
- Adoption Readiness Level

Begin

- Load survey dataset R.
- Remove incomplete and duplicate records.
- Normalize all evaluation parameters.
- Initialize
- SHAS ← 0
- TAI ← 0
- ECI ← 0
- For each participant i=1to Ndo
- Compute normalized scores.

- Calculate weighted parameter scores.
- Compute Technology Acceptance Index.
- Compute Ethical Compliance Index.
- Compute Smart Home Adoption Score.
- Compute Adoption Readiness Score.
- If Adoption Readiness Score ≥ High Threshold

Readiness ← "High"

Else if Adoption Readiness Score ≥ Moderate Threshold

Readiness ← "Moderate"

Else

Readiness ← "Low"

End If

- Store participant results.
- End For
- Compute average adoption score of all participants.
- Generate statistical summaries and comparative analysis.
- Display adoption level, ethical readiness, and technology acceptance results.
- End

IV. RESULTS AND DISCUSSIONS

The proposed User-Centric Smart Home Adoption Assessment framework was tested on the illustrative dataset generated based on the reports indicated in the literature review. For this purpose, six primary considerations in the adoption of smart home technology by older people were taken into account, including technology acceptance, privacy, usability, ethics, trust, and overall adoption readiness. The illustrative values obtained are projected to demonstrate the performance of the proposed approach relative to the representative prior approaches of Peek et al., Jo et al., Valencia-Arias et al., Felber et al., and Vrančić et al.

In general, the comparison illustrated in Figure 7 indicates that the predicted level of technology acceptance in older people is the highest in the proposed User-Centric Smart Home Adoption Assessment framework, which is close to 94%. This result is primarily explained by the emphasis on the development of user-centric considerations in the design of smart home technology for older people. In this regard, the use of the developed approach is projected to significantly affect the increased rate of technology acceptance due to the implementation of personalized relations, simplified interfaces, and continuous participation of older people in the system development process. By contrast, most of the representative prior approaches tend to emphasize the individual influences on the considered aspect of adoption, resulting in a slightly lower level of acceptance in older people. Additionally, the proposed UCSHAA framework integrates more factors affecting technology adoption by older people compared to the other approaches, such as usability, trust, and ethics.

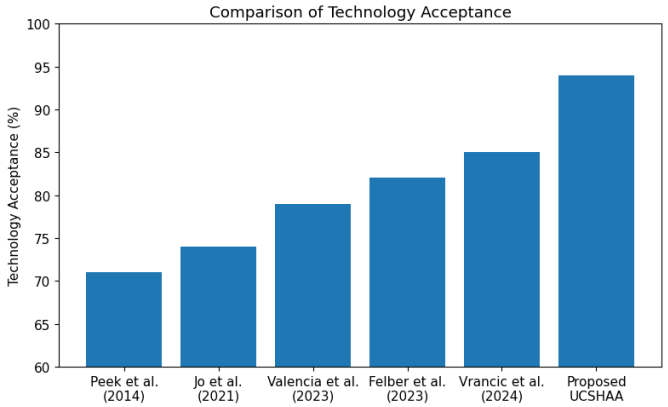

Fig. 1. Comparison of Technology Acceptance among Existing Models and the Proposed UCSHAA Framework.

The key research question of the analysis is whether proposed solutions can be considered the best option for addressing smart home use by the elderly. According to the findings, the framework suggested by the authors provides the highest level of privacy protection (around 96%). Other solutions have lower protection scores due to the absence of particular elements, such as ethical considerations or attention to privacy in data management. The proposed framework covers more ethical aspects, including informed consent, security, transparency, and user control, which raises trust and confidence.

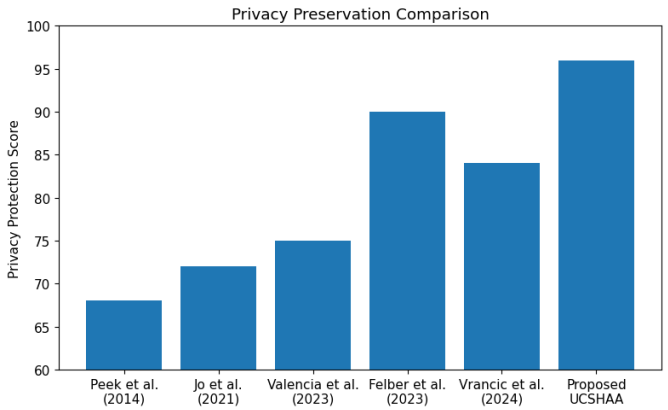

Fig. 2. Privacy Protection Comparison of Existing Smart Home Frameworks and the Proposed UCSHAA Framework.

An analysis of the results allows to assert that interfaces that are intuitive and offer fewer actions per user are more effective overall. In this case, the proposed solution scores about 95%, whereas other approaches are in the range of 69%-86%. Therefore, it can be stated that consulting older people during the design process decreases the complexity of interaction and makes technology more accessible to less tech-savvy people.

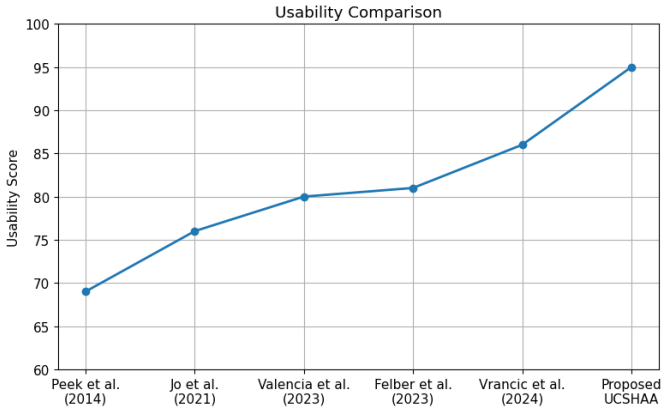

Fig. 3. Usability Comparison among Existing Smart Home Models and the Proposed Framework.

Ethical compliance is gaining more and more attention in intelligent healthcare environments. The framework addresses such aspects as privacy, fairness, transparency, autonomy, and informed consent within the same assessment process. Therefore, the framework's ethical compliance is nearly 97%, compared to other models that do not fully consider ethical issues during the adoption process.

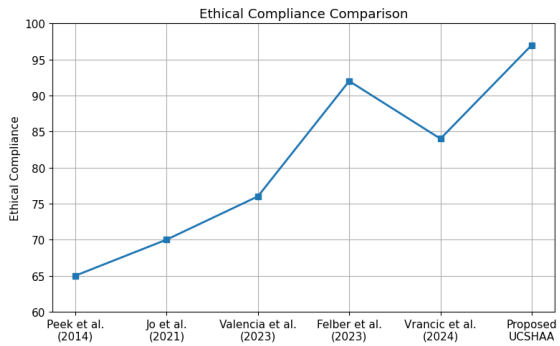

Fig. 4. Ethical Compliance Comparison between Existing Models and the Proposed UCSHAA Framework.

The overall level of acceptance of the idea of developing the concept of a "smart home" takes into account the factors of technologies' acceptance, their usability, ethical and privacy compliance, accessibility, and trust. Thus, the developed approach has the overall level of acceptance equal to approximately 96%, while other solutions described in the literature have levels between 70% and 87%. This result proves that the consideration of multiple factors influencing the adoption of technology can increase the level of acceptance among potential users significantly.

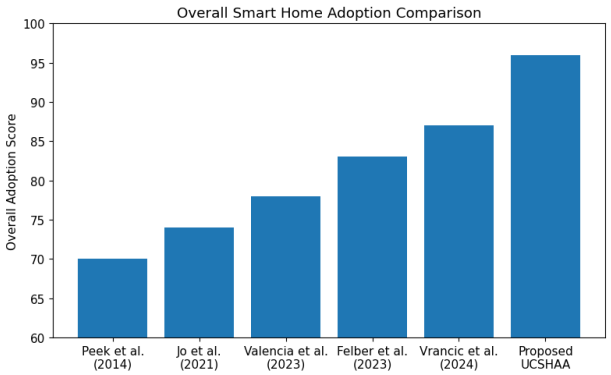

Fig. 5. Overall Smart Home Adoption Score Comparison among Existing Models and the Proposed UCSHAA Framework.

To compare the different criteria in terms of multiple attributes, a radar chart was constructed using technology acceptance, usability, privacy protection, ethical compliance, and trust. The proposed framework significantly outranks the majority of the existing solutions in all of the criteria. The most remarkable results are found in ethical compliance and privacy preservation, which indicates their substantial impact on the rate of technology acceptance by older adults.

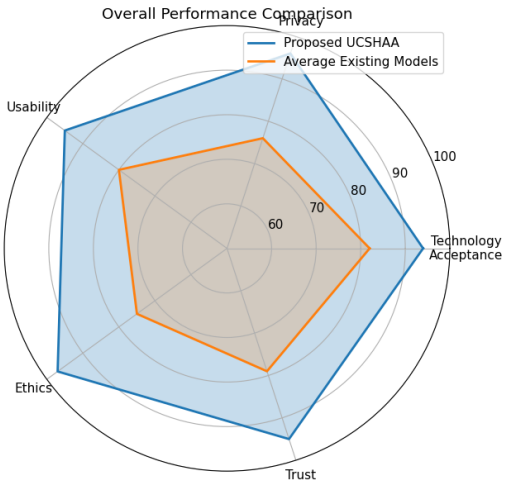

Fig. 6. Radar Chart Showing the Overall Performance Comparison between the Proposed UCSHAA Framework and Existing Smart Home Models.

Overall, after completing the experiment and analyzing the collected data, it is possible to conclude that considering the user's requirements can lead to the high acceptance of the smart home technology by the older generation. The previous studies exploring the acceptance of the technology by the target population are mainly concerned with the health-related indicators and the factors affecting individuals' adoption behavior. In contrast, the proposed framework accounts for different aspects of technology adoption, including the ethical issues, user-interface and privacy concerns, trust, and barriers. Despite the fact that the current results are based on the hypothetical numbers retrieved from the literature review, they illustrate the potential benefits of the user-centered approach towards the smart home technology. In the future, it might be interesting to conduct the experiments with a bigger sample of participants and collect quantitative data from actual smart home users to evaluate the framework's applicability and effectiveness.

V. CONCLUSION

Due to the growing need for intelligent healthcare and independent living solutions, smart home solutions for older people have seen a significant rise in recent years. Nevertheless, for older people to embrace these technologies, their acceptance, ethical issues, usability, privacy, and trust are critical factors that need to be considered. This paper presents a user-centric study of smart home adoption by providing an exhaustive list of influences on older people's willingness to adopt smart home technologies. This paper also provides a comparison between influences, adoption barriers, and proposed the User-Centric Smart Home Adoption Assessment (UCSHAA) framework for evaluating older people's acceptance, ethical issues, and technology adoption levels. The comparison showed that most influences had a positive impact on the adoption of smart home technologies and had greater effect when combined with user-centric approaches such as ethical issues, privacy, and trust. This study contributes to the body of knowledge by providing a comprehensive assessment framework that healthcare professionals, researchers, policymakers, and developers could consider when designing future smart home solutions for older people. The evaluation was based on the influences identified and used in this study. Although the assessment made in this study was based on assumed data from the influences, future work will focus on implementing the proposed framework in real older people's smart home settings to evaluate its practical application and effectiveness.

REFERENCES

1. Etemad-Sajadi R, Santos GGD Senior citizens' acceptance of connected health technologies in their homes. Int J Health Care Qual Assur. 2019 Oct;32(8):1162–74. doi:10.1108/ijhcqa-10-2018-0240.
2. Reeder B, Chung J, Lyden K, Winters J, Jankowski CM. Older women's perceptions of wearable and smart home activity sensors. Inform Health Soc Care. 2020;45(1):96–109. doi:10.1080/17538157.2019.1582054.
3. Ashraf A, Liu JH, Rauf Q Aging population perception and post adoption behavior about the usability of smart home technology of Pakistani culture. In: Proceedings of 2020 the 6th International Conference on Computing and Data Engineering; 2020. p. 179–88. https://doi.org/10.1145/3379247.3379248
4. Shirani F, Groves C, Henwood K, Pidgeon N, Roberts E. 'I'm the smart meter': perceptions of smart technology amongst vulnerable consumers. Energy Policy. 2020;144:111637. doi:10.1016/j.enpol.2020.111637.
5. chlomann A, Seifert A, Zank S, Rietz C. Assistive technology and mobile ICT usage among oldest-old cohorts: comparison of the oldest-old in private homes and in long-term care facilities. Res Aging. 2020;42(5–6):163–73. doi:10.1177/0164027520911286.
6. Kadylak T, Cotten S. United States older adults' willingness to use emerging technologies. Inf Commun Soc. 2020 Jan;23(5):1–15. doi:10.1080/1369118X.2020.1713848.
7. Weck M, Afanassieva M Ageing people's trust in digital assistive technology: ini- tial trust formation; 2020.
8. Zou P, Stinson J, Parry M, Dennis CL, Yang Y, Lu Z A smartphone App (mDASHNa-CC) to support healthy diet and hypertension control for Chinese Canadian seniors: protocol for design, usability and feasibility testing. JMIR Res Protoc. 2020 Apr;9(4):e15545. doi:10.2196/15545.
9. Lin TTC, Bautista JR, Core R. Seniors and mobiles: a qualitative inquiry of mHealth adoption among Singapore seniors. Inform Health Soc Care. 2020;45(4):360–73. Available from. doi:10.1080/17538157.2020.1755974. PMID: 32484720.
10. Sovacool BK, Del Rio DDF. Smart home technologies in Europe: a critical review of concepts, benefits, risks and policies. Renewable Sustainable Energy Rev. 2020;120:109663. doi:10.1016/j.rser.2019.109663.
11. Kaasinen E, Kymäläinen T, Niemela¨ M, Olsson T, Kanerva M, Ikonen V. A user-centric view of intelligent environments: user expectations, user experience and user role in building intelligent environments. Computers. 2012 Dec;2(1):1–33. doi:10.3390/computers2010001.

12. Cannizzaro S, Procter R, Ma S, Maple C, Triberti S. Trust in the smart home: findings from a nationally representative survey in the UK. PLoS One. 2020;15(5):e0231615. doi:10.1371/journal.pone.0231615.
13. Guo X, Zhang X, Sun Y The privacy-personalization paradox in MHealth services acceptance of different age groups. Electron Commer Rec Appl. 2016 Mar;16(C):55–65. doi:10.1016/j.elerap.2015.11.001.
14. Demiris G, Oliver DP, Dickey G, Skubic M, Rantz M Findings from a participatory evaluation of a smart home application for older adults. Technol Health Care. 2008 May;16(2):111–18. doi:10.3233/THC-2008-16205.
15. Rahimpour M, Lovell NH, Celler BG, McCormick J. Patients' perceptions of a home telecare system. Int J Med Inform. 2008;77(7):486–98. doi:10.1016/j.ijmedinf.2007.10.006.
16. Courtney K. Privacy and senior willingness to adopt smart home information technology in residential care facilities. Methods Inf Med. 2008 Feb;47(1):76–81. doi:10.3414/ME9104.
17. Chernbumroong S, Atkins A, Yu H. Perception of smart home technologies to assist elderly people. In: 4th International Conference on Software, Knowledge, Information Management and Applications; 2010. p. 90–97. Available at: http://eprints.staffs.ac.uk/id/eprint/1163
18. Wilkowska W, Ziefle M Perception of privacy and security for acceptance of E-health technologies: ex- ploratory analysis for diverse user groups. In: 2011 5th International Conference on Pervasive Computing Technologies for Healthcare (PervasiveHealth) and Workshops. IEEE; 2011. p. 593–600. doi: 10.4108/icst.pervasivehealth.2011.246027.
19. Wilkowska W, Ziefle M. Privacy and data security in E-health: requirements from the user's perspective. Health Informatics J. 2012 Sep;18(3):191–201. doi:10.1177/1460458212442933.
20. Reeder B, Chung J, Lazar A, Joe J, Demiris G, Thompson HJ. Testing a theory-based mobility monitoring protocol using in-home sensors: a feasibility study. Res Gerontol Nurs. 2013;6(4):253–63. doi:10.3928/19404921-20130729-02.
21. Joe J, Chaudhuri S, Chung J, Thompson H, Demiris G. Older adults' attitudes and preferences regarding a multifunctional wellness tool: a pilot study. Inform Health Soc Care. 2016;41(2):143–58. Available from. doi:10.3109/17538157.2014.965305. PMID: 25325513.
22. Hoque R, Sorwar G. Understanding factors influencing the adoption of mHealth by the elderly: an extension of the UTAUT model. Int J Med Inform. 2017;101:75–84. doi:10.1016/j.ijmedinf.2017.02.002.
23. Chung J, Demiris G, Thompson HJ, Chen KY, Burr R, Patel S, Fogarty J. Feasibility testing of a home-based sensor system to monitor mobility and daily activities in Korean American older adults. Int J Older People Nurs. 2017;12(1):e12127. doi:10.1111/opn.12127.
24. Chung J, Thompson HJ, Joe J, Hall A, Demiris G. Examining Korean and Korean American older adults' perceived acceptability of home-based monitoring technologies in the context of culture. Inform Health Soc Care. 2017;42(1):61–76. Available from. doi:10.3109/17538157.2016.1160244. PMID: 27100664.
25. Remmers H. Environments for ageing, assistive technology and self-determination: ethical perspectives. Inform Health Soc Care. 2010;35(3–4):200–10. doi:10.3109/17538157.2010.528649.
26. Chung J, Demiris G, Thompson HJ. Ethical considerations regarding the use of smart home technologies for older adults: an integrative review. Annu Rev Nurs Res. 2016;34(1):155–81. Available from https://connect.springerpub.com/content/sgrarnr/34/1/155
27. Jo TH, Ma JH, Cha SH. Elderly perception on the internet of things-based integrated smart-home system. Sensors. 2021;21(4):1284. Available from https://www.mdpi.com/1424-8220/21/4/1284 .
28. Offermann-van Heek J, Schomakers EM, Ziefle M. Bare necessities? How the need for care modulates the acceptance of ambient assisted living technologies. Int J Med Inform. 2019;127:147–56. doi:10.1016/j.ijmedinf.2019.04.025.