Technology Acceptance of Older People (55+) in Complex Sociotechnical Systems such as Smart Homes

Lucie Schmidt
Department of Industrial Engineering
Ernst-Abbe-Hochschule Jena
Jena, Germany
e-mail: lucie.schmidt@eah-jena.de

***Abstract*—The emergence of Smart Homes is driven by increasing digitization and individual living conditions, which can improve living comfort, safety, and energy efficiency. Smart Homes can maintain home autonomy and quality of life in old age, but their implementation requires high technology acceptance from users. This study aims to investigate the interdependencies between older (55+) users and complex sociotechnical systems in the living environment, such as Smart Homes, to determine the significance of acceptance factors and particularly the influence of digital literacy on it. The research, as part of a dissertation, includes quantitative surveys and qualitative interviews to identify the factors that strongly influence the acceptance of technology by older adults. The goal is to develop a relevant theory and tailor technical solutions to the diverse needs of users, ultimately increasing technology acceptance and positively influencing the design of such systems.**

Keywords-Technology Acceptance; Smart Home.

I. INTRODUCTION

Increasing digitization and individual living conditions influence housing preferences and lead to the emergence of Smart Homes, which can improve living comfort, safety, and energy efficiency. Smart Homes can help maintain home autonomy and quality of life in old age, but their implementation requires high technology acceptance from users. Therefore, designing Smart Homes to meet individual needs and abilities is crucial for successful implementation. Non-use of connected technology may lead to higher costs and assisted living forms in the future. The challenge is to design technology adequately for older adults and sensitize society to their difficulties in dealing with technology [1]. For example, the use of a Tangible User Interfaces (TUI) application has the potential to enhance technology acceptance among older individuals and potentially improve their quality of life [2].

Consequently, the research question arises to find a model that is considering multigenerationality and digital literacy, as well as aimed at a holistic integrated use of technology including all relevant factors to predict technology acceptance of older adults (55+) regarding complex socio-technical systems in the living environment. Furthermore, it is intended to determine the importance of acceptance factors in such a setting for older adults. The aim is to have a positive impact on the development and implementation of technology to bring the greatest possible benefit to society.

Section II of this paper provides an overview of the theoretical foundations, including diffusion theory, innovation resistance theory, Fogg Behavior Model, Uses and Gratifications Theory, Gibson's Affordance Theory, Technology Acceptance Model (TAM), and Unified Theory of Acceptance and Use of Technology (UTAUT), to understand Smart Home acceptance among older adults. Section III reviews the current state of technology acceptance research, emphasizing the need for representative samples. In Section IV, the objective is to investigate the interdependencies between older users and sociotechnical systems, focusing on acceptance factors and the impact of digital literacy. Section V outlines the research design involving quantitative surveys and qualitative interviews to identify influential factors and develop a comprehensive theory. Section VI introduces a mixed-method approach, combining literature review, quantitative surveys, and qualitative interviews, to analyze the acceptance of Smart Homes among older adults. Section VII concludes the paper by summarizing the research objectives and outlining potential avenues for future work.

II. THEORETICAL BACKGROUND

The theoretical background for the acceptance of Smart Homes by older adults is described by various theories. Regarding this, the diffusion theory describes the processes that are associated with the introduction of innovations in a social system [2]. The innovation resistance theory deals with reasons why people resist or reject innovations [3]. The Fogg Behavior Model describes factors that influence a person's behavior [4]. The Uses and Gratifications Theory, in turn, states that the choice of media depends on the individual needs and interests they want to satisfy [5]. Gibson's Affordance Theory states that objects in an individual's environment are perceived not only by their physical properties but also by their potential for action or affordances [6]. The TAM by Davis from 1989 describes perceived ease of use and usefulness as central acceptance-building variables [7]. The UTAUT expands on TAM and identifies additional factors that influence technology usage intention. Gender, age, experience, and voluntariness of use also affect the intensity of these factors [8]. As all models are established, widely used, and specifically designed for

 ISBN: 978-1-68558-071-1

investigating acceptance, they will also be considered in the context of the dissertation.

III. STATE OF THE ART

The state of the art on technology acceptance research is heterogeneous and encompasses various research strands ranging from individual user acceptance to societal acceptance of technologies. The topic of technology acceptance of older people in Smart Homes can be classified within the movement of technology assessment, which deals with the impact of technologies on society and the environment [9].

The TAM as a key model in this context has been confirmed by numerous studies, but there are still many unexplored areas of application that could contribute to the predictive validity of TAM. Future research should focus on the moderating role of individual variables, the inclusion of additional variables in the model, the investigation of actual usage, and the relationships between actual usage and objective outcome measures, as well as the older adult population as a target group. The examination of more representative samples of older adults is essential, as previous studies often only include relatively young and highly educated participants [10].

In general, the topic of technology acceptance is being continued today in other contexts, such as innovation research, and is sometimes referred to using other terms such as technology dialogue or technology openness [11]. Nonetheless, the question of how new technologies are received, evaluated, and classified by potential users, consumers, and the public remains relevant [12].

IV. OBJECTIVE AND RESEARCH QUESTION

The dissertation aims to investigate the interdependencies between older (55+) users and complex sociotechnical systems in the living environment, specifically Smart Homes comprising Smart Home and Ambient Assisted Living (AAL) applications. The focus is on examining the acceptance of these systems and understanding the significance of acceptance factors, including the influence of digital literacy. Rather than focusing solely on specific components, the study emphasizes the integration of various elements (e.g., voice recognition, touch-sensitive devices) within a Smart Home system. The goal is to develop a comprehensive understanding of the interplay between aging in a technological society and technology acquisition and acceptance. Additionally, the study investigates the potential for positively influencing the acceptance of complex sociotechnical systems, such as Smart Homes. This research aids in developing relevant theoretical frameworks, and facilitates the customization of technical solutions to meet the diverse needs of end-users, ultimately enhancing technology acceptance and informing system design. The study's insights provide valuable guidance for technology creators, including user interface design, usability improvement, and support and training provision to enhance digital literacy among older adults.

V. RESEARCH DESIGN

In the empirical part, quantitative surveys and qualitative interviews are conducted to identify the factors that strongly influence the acceptance of technology by older adults. First, a literature review is conducted to identify existing tools and studies on technology acceptance. The identified factors are then examined in a quantitative questionnaire design before serving as a starting point for an exploratory design based on grounded theory. Qualitative interviews are conducted to gain a deep understanding of the technology use and related conditions of older participants. The data is systematically analyzed to develop the theory. Knowledge gain occurs through iterative data collection and analysis. This process continues until theoretical saturation, the point at which sufficient information is available and no new insights are gained. Subsequently, an evaluation of the theory is conducted with a control group in either the same or an equivalent setting. The aim is to recognize the theory's pros and cons and enhance it as required to attain a superior comprehension of the investigated phenomenon.

VI. METHODOLOGY

In the dissertation, a mixed-method approach is chosen as a methodology, which consists of a literature review, a quantitative survey, and a Grounded Theory. This combined approach is often chosen when it comes to examining a complex phenomenon from different perspectives and gaining a more comprehensive understanding. Conducting a quantitative survey is considered particularly suitable for surveying many individuals and establishing measurable variables in relation to each other. Grounded Theory, in turn, enables the discovery of new theories based on empirically obtained data by providing insights into users' experiences, attitudes, and beliefs. Overall, Grounded Theory is a flexible and adaptable data analysis procedure that is well-suited for complex phenomena, as well as to consider the participants' perspective and capture the complexity of social processes and interactions [13]. The combination of both approaches obtains a more comprehensive picture of technology acceptance.

The research design consists of several steps. Firstly, the specifics and developments of technology applications in Smart Homes are described. Secondly, a literature review is conducted to identify existing theories and models related to technology acceptance. Relevant literature sources are evaluated to extract significant factors. In the third step, a quantitative questionnaire design is developed to examine the identified factors. A representative sample of older adults is surveyed, and the data is statistically analyzed. The fourth step involves using the quantitative results as a starting point for qualitative interviews. Grounded Theory is applied to extract new insights from the data and advance theory building. The fifth and final step entails evaluating the theory. A test is conducted to identify the strengths and weaknesses of the theory and improve it if necessary.

 ISBN: 978-1-68558-071-1

VII. CONCLUSION AND FUTURE WORK

In conclusion, this study employs a mixed-method approach to identify influential factors impacting the acceptance of Smart Homes among older adults. The findings will provide valuable insights into the interdependencies between older users and sociotechnical systems, offering a comprehensive understanding of this relationship. In addition, these findings will guide technology creators in designing user-friendly interfaces, improving usability, and delivering effective support and training for older adults.

To further advance the field, future research should focus on the practical application of these findings in real-world settings. Evaluating the effectiveness of implementing technology and its impact on the quality of life for older adults is crucial.

By bridging the gap between research and practice, this study aims to contribute to the development of age-friendly technologies and empower older adults to fully embrace the benefits of living in a technologically advanced society.

ACKNOWLEDGMENT

The doctorate takes place as part of the project Multi-Generation Smart Community (mGeSCo). The project is funded by the Carl Zeiss Foundation.

REFERENCES

[1] A. Seifert, „Digital transformation in the households of older people“, Journal for Gerontology and Geriatrics, vol. 55, no. 4, pp. 305–311, 2022, DOI: 10.1007/s00391-021-01897-5, [retrieved: 05, 2023]

[2] W. K. Bong, A. Bergland, and W. Chen, “Technology Acceptance and Quality of Life among Older People Using a TUI Application,” International Journal of Environmental Research and Public Health, vol. 16, no. 23, p. 4706, 2019, doi: 10.3390/ijerph16234706, [retrieved: 06, 2023]

[3] E. M. Rogers, “Diffusion of Innovations.”, Journal of Minimally Invasive Gynecology, vol. 14, no. 6, Riverside: Free Press, 2003, DOI: 10.1016/j.jmig.2007.07.001

[4] S. Ram and J. N. Sheth, “Consumer Resistance to Innovations: The Marketing Problem and its solutions.”, Journal of Consumer Marketing, vol. 6, no. 2, pp. 5–14, 1989, 10.1108/EUM0000000002542, [retrieved: 06, 2023]

[5] B. J. Fogg, “A behavior model for persuasive design.” In: Samir Chatterjee (Hg.): Proceedings of the 4th International Conference on Persuasive Technology. Claremont California USA. Association for Computing Machinery. New York: ACM, pp. 1–7, 2009.

[6] E. Katz, J. G. Blumler, and M. Gurevitch, “Uses and Gratifications Research.”, The Public Opinion Quarterly, vol. 37, no. 4, pp. 509–523, 1973, Available from: http://www.jstor.org/stable/2747854, [retrieved: 06, 2023]

[7] J. J. Gibson, “The ecological approach to visual perception.” Psychology Press, 1st ed., Taylor and Francis, 1986, DOI: 10.4324/9781315740218

[8] F. D. Davis, “Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology.”, MIS Quarterly, vol. 13, no. 3, pp. 319, 1989, DOI: 10.2307/249008

[9] V. Venkatesh, M. G. Morris, G. B. Davis, and F. D. Davis, “User Acceptance of Information Technology: Toward a Unified View”, MIS Quarterl, vol. 27, no. 3, pp. 425, 2003.

[10] M. Schäfer and D. Keppler, “Models of technology-oriented acceptance research”, Technical University of Berlin, 2013, DOI: 10.14279/DEPOSITONCE-4461

[11] N. Marangunić and A. Granić, “Technology acceptance model: a literature review from 1986 to 2013”, Univ. Access Inf. Soc., vol. 14, no. 1, pp. 81–95, 2015.

[12] F. Gloede and L. Hennen, “Acceptance of technology as a subject of scientific and political discussion” TATuP, vol. 14, no. 3, pp. 4–12 , 2005 [retrieved: 06, 2023]

[13] O. Renn, “Technology acceptance: Lessons and conclusions of acceptance research for coping with technical change”, TATuP, vol. 14, no. 3, pp. 29–38, 2005, DOI: 10.14512/tatup.14.3.29

[14] M. Birks, K. Hoare, and J. Mills, “Grounded Theory: The FAQs”, International Journal of Qualitative Methods, vol. 18, 2019, DOI: 10.1177/1609406919882535

 ISBN: 978-1-68558-071-1