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SMART HOME FEATURES TO ENHANCE ELDERLY WELL-BEING AND QUALITY OF LIFE IN MALAYSIA: A SCOPING REVIEW

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Abstract

This paper examines smart home features designed for elderly-friendly housing environments, aiming to improve the quality of life and well-being of older adults through technology. Using Arksey and O'Malley's (2005) scoping review framework, 9 peer-reviewed studies published between 2021 and 2025 were systematically reviewed. The findings categorise smart home features into five key themes: (1) Safety and Security, (2) Health Monitoring, (3) Comfort and Accessibility, (4) Social and Cognitive Well-Being, and (5) Energy Efficiency. The review emphasises the significance of designing a housing environment with the integration of technologies that are adaptable to the physical, psychological, and social needs of elderly users. This paper provides a current synthesis of smart home research related to ageing populations. It offers a framework that can guide housing design, innovation, and policy, and user-centred design practices in ageing societies. Although not limited to a single country, the findings are especially relevant for rapidly ageing societies like Malaysia. Further validation from domain experts and stakeholders is needed to confirm the relevance and applicability of the identified smart home features in actual implementation contexts.

Keywords: Smart home technology, Quality of Life, Well-being, Elderly, Scoping review

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INTRODUCTION

Malaysia is experiencing a significant demographic shift, with the elderly population expected to reach 15.3% by 2030, qualifying the country as an "aged nation" (Jailani et al., 2023). According to WHO projections on an ageing population, these demographic changes make the development of elderly-friendly environments more critical than ever (WHO, 2024). As the ageing population grows, so does the urgency to develop living environments that ensure safety, independence, and improved quality of life and overall well-being as they age (Tu & Zhou, 2025). Ageing in place, supported by assistive technologies, has become a preferred approach due to its benefits in autonomy and emotional well-being.

Effective implementation of smart home technology in Malaysia requires consideration of unique socio-cultural factors, affordability, and the digital readiness of the elderly. Wearable and IoT-based devices designed for the Malaysian context have already demonstrated promising results in reducing energy costs and enhancing user control of home appliances, reflecting the feasibility of scalable, elderly-friendly smart solutions (Zaman et al., 2021; Phua et al., 2021).

In Malaysia, studies have shown that the elderly place high importance on emergency contact systems and basic home automation, which are among the most desired smart features in senior-friendly living spaces (Tan et al., 2021). Indirectly, it lines up with the Malaysian government's smart city and ageing policy initiatives to support the development of inclusive smart environments aligned with sustainable development goals (Jailani et al., 2023). These systems are increasingly seen as part of holistic strategies to support independence and well-being in later life.

This paper aims to explore how smart home features can be tailored to the elderly's quality of life and well-being. The main findings on the significant smart home features for the elderly: (1) Safety and Security, (2) Health Monitoring, (3) Comfort and Accessibility, (4) Social and Cognitive Well-Being, and (5) Energy Efficiency, contributes to extension of knowledge on ageing-in-place and elderly quality of life in specifically. This finding innovates future-ready design elements for the elderly-friendly housing environments that align with the Sustainable Development Goals on Smart Cities.

Although the previous studies have explored on how to use the smart technologies for elderly, there are several gaps remain in the existing literature. From the review, many studies mostly focus on the technical development of smart devices rather than examining how these technologies contribute to the overall well-being and quality of life of elderly individuals. In addition, the existing literature often investigates individual technologies such as health monitoring systems or security devices without providing a comprehensive

synthesis of smart home features that support ageing in place. The literature has also focused on international contexts without a critical analysis of the relevance of smart home technologies for the ageing population of Malaysia. Therefore, a scoping review is required to synthesise on current research and identify key smart home features that can enhance elderly well-being and quality of life, particularly in the context of elderly-friendly housing environments.

LITERATURE REVIEW

Smart Home Technologies for the Elderly

Smart home technologies provide significant benefits for the elderly by enabling safer and more independent living environments. This feature offers innovative solutions tailored to support ageing individuals by integrating tools such as fall detection systems, voice-controlled devices, and remote health monitoring systems (Tu & Zhou, 2025; Alhmoud & Ismail, 2024). This allows older adults to control electrical appliances with minimal physical effort, significantly reducing their energy costs while maintaining convenience and autonomy (Zaman et al., 2021). More advanced smart home systems integrate fall detection, biometric monitoring, and remote communication tools that can help to prevent accidents and enable faster emergency response. According to a previous study by Aggar et al. (2022), the integration of technology into healthcare is increasing, and Smart Home technology should be considered as a healthcare strategy to support older people living at home. These technologies not only assist in daily living, but also contribute to reducing accidents, increasing security, and supporting mental and physical well-being, particularly for elderly people who are socially isolated or living alone (Wang et al., 2024; Seven & Dirik, 2023).

Quality of Life and Well-Being for the Elderly

The World Health Organisation (WHO) defines quality of life (QoL) as "*an individual's perception of their position in life in the context of the culture and value systems in which they live, and in relation to their goals, expectations, standards, and concerns.*" To specifically evaluate the Quality of Life of the elderly, WHO developed the WHOQOL-OLD module, which concerns crucial health-related issues in old age (Liu et al, 2020). These include the main domains of QoL, physical health, psychological state, social relationships, independence, and environmental conditions.

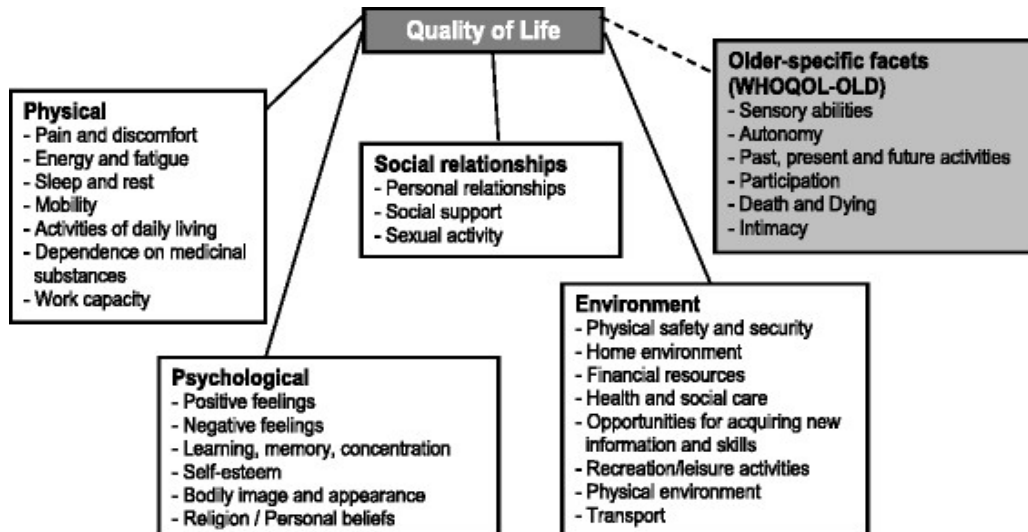


Figure 1: WHOQOL-BREF and WHOQOL-OLD

The well-being of elderly individuals encompasses not only physical health but also emotional, psychological, and social dimensions (Ooi et al., 2021). The implementation of smart home technologies has a strong positive influence on the overall QoL and well-being of elderly populations. One major factor is the sense of autonomy and security provided by systems such as emergency contact alerts, which are highly valued by the previous study (Tan et al., 2021). Furthermore, environmental and social factors such as neighbourhood safety and opportunities for independent living play a critical role in perceived life satisfaction, as found in studies of elderly residents across Malaysia (Jaffer et al., 2023). To support this, previous studies have shown evidence that psychological health scored highest among the QoL domains, indicating that emotional well-being and mental engagement are central to elderly life satisfaction (Kuppusamy, 2024). Integration of smart applications designed to support elderly productivity, emotional engagement, and social interaction has been proposed as tools for improving broader aspects of well-being in ageing populations (Nasution & Ibrahim, 2021).

RESEARCH METHODOLOGY

Scoping Review Methodology

This study employed a scoping review methodology to systematically explore the qualitative evidence on smart home features that support elderly quality of life and well-being in a housing environment. Scoping reviews are designed to map the conceptual boundaries and key themes in an emerging research field. This

approach is especially relevant when dealing with diverse types of data and study designs, or when aiming to clarify working definitions and identify knowledge gaps (Arksey & O'Malley, 2005). The objective of this scoping review was to comprehensively itemise what features are considered meaningful and beneficial for elderly life satisfaction.

Following the established framework by Arksey and O'Malley (2005), this review went through four iterative stages: (1) identification of relevant studies, (2) screening for eligibility based on predefined inclusion criteria, (3) assessment of full texts for topical relevance, and (4) final inclusion of articles for synthesis and thematic analysis. Each step was proposed to ensure transparency and rigour, allowing for reproducibility and consistency in mapping the information.

Identification

A broad search was conducted across academic databases such as Scopus and Web of Science. The search strategy utilised Boolean operators and specific key terms to maximise precision. This search was selected for its wide coverage of peer-reviewed journals in healthcare, technology, architecture, and social sciences. Keyword combinations were used in this scoping review, as shown in Table 1.

Table 1: Keyword searching strategy for the scoping review	
Themes	Search Terms
Population	"elderly"
Concept	("smart" OR "technology") AND ("features" OR "elements" OR "attributes")
Context	"Quality of life" AND "elderly friendly" AND ("home" OR "housing")

A total of 90 records were retrieved after executing the initial database queries. To maintain relevance and currency, search filters limited the results to peer-reviewed journal articles that were published between 2021 and 2025. This limitation yielded a total of 33 relevant articles.

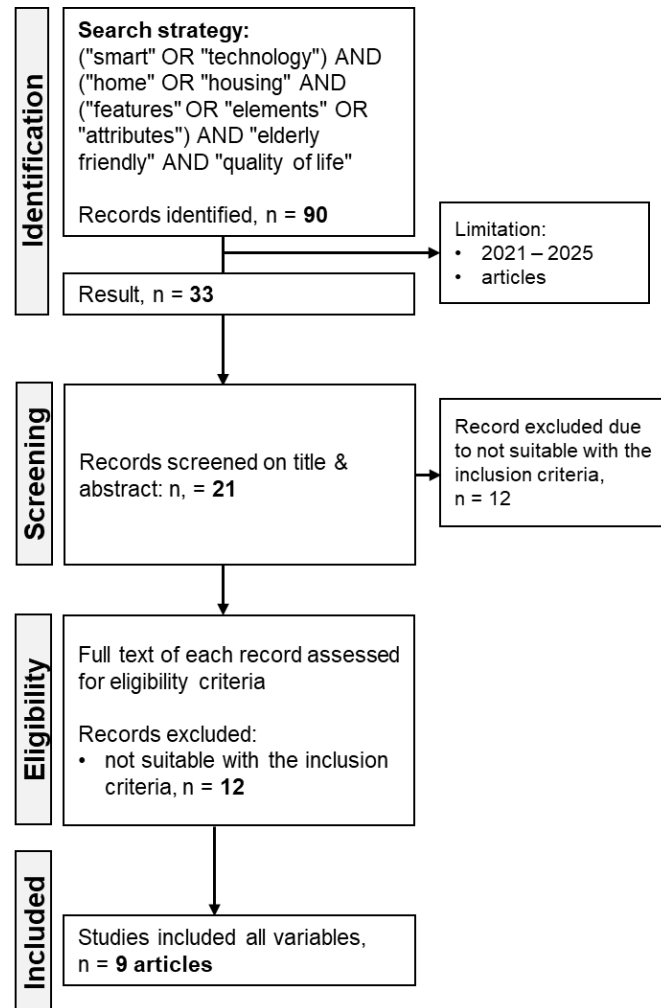


Figure 2: Flow diagram of the study selection process

Screening

Initial screening involved title and abstract review to determine initial eligibility. This process was guided by predefined inclusion and exclusion criteria. Studies were excluded if they were focused on purely technical aspects without human subject perspectives or unrelated environments. This process led to the removal of 12 articles, leaving 21 studies that met the basic relevance criteria. These articles were then subjected to a more detailed full-text evaluation in the eligibility stage. The criteria of inclusion and exclusion for the search are presented in Table 2.

Table 2: Criteria of Inclusion and Exclusion

Inclusion	Exclusion
• Population aged 60 years and older, including caregivers where relevant. • Direct relevance to smart home technologies in supporting elderly well-being. • Addresses quality of life, usability, acceptance, or daily-life impacts.	• Studies without a focus on older adults or without disaggregated data. • Focusing on technical specs without user context. • Lacks relevance to human experience or quality of life.

Eligibility

Each of the 21 full-text articles was examined. As a result, 12 were excluded after thorough assessment. The reasons for exclusion included findings that were not relevant to the scope of the study and nonfulfillment of the previously established inclusion criteria.

Inclusion

9 articles were ultimately included in this review. These studies met all the inclusion criteria. 9 selected studies represent a diversity of regional contexts (e.g., South Korea, China, Jordan, Taiwan), research designs (e.g., grounded theory, field surveys, simulation), and smart home technologies (e.g., voice assistants, environmental sensors, digital companions, health monitors). Table 3 summarises the Smart Home Features for the Elderly Quality of Life and Well-Being explored within 9 studies.

Table 3: Summary of the Scoping Review

Smart Home Features for the Elderly's Quality of Life and Well-Being in Malaysia									
Main Features and Sub-Features	Jo et al., 2021	Wang et al., 2023	Oh., 2024	Alhmoud & Ismail., 2024	Shie et al., 2024	Zhou et al., 2024	Zhao & Li., 2024	Yang et al., 2025	Tu & Zhou., 2025
Safety and Security									
Intelligent door locks (e.g., Entry door camera, blinking entry screen, door sensors, automatic doors)	•	•	•					•	•
Automatic lighting	•	•	•					•	•
Floors sensor detection	•	•	•					•	•
Health Monitoring									
Medication reminders	•		•	•	•	•	•		
Activity tracking	•		•	•	•	•	•		
Smart medical services	•		•	•	•	•	•		
Comfort and Accessibility									
Smart appliances and interfaces (e.g., voice control)			•						
Smart lighting			•						
Voice control			•						
Smart curtains			•						
Social and Cognitive Well-Being									
Communication tools			•			•		•	
Video calling			•			•		•	
Memory games			•			•		•	
Digital companions			•			•		•	
Energy Efficiency									
Solar panels			•	•					
Equipment checks			•	•					
Heating and cooling automation			•	•					
Smart meters			•	•					

ANALYSIS AND DISCUSSIONS

This paper provides qualitative insights into how older adults engage with smart home technologies and how such features influence their daily routines, health behaviour, and their emotional well-being safely. The findings (Table 3) were thematically coded and analysed into five (5) themes: (1) Safety and Security, (2) Health Monitoring, (3) Comfort and Accessibility, (4) Social and Cognitive Well-

Being, and (5) Energy Efficiency. With the assistance of AI, Figure 2 was generated to illustrate the synthesised themes.

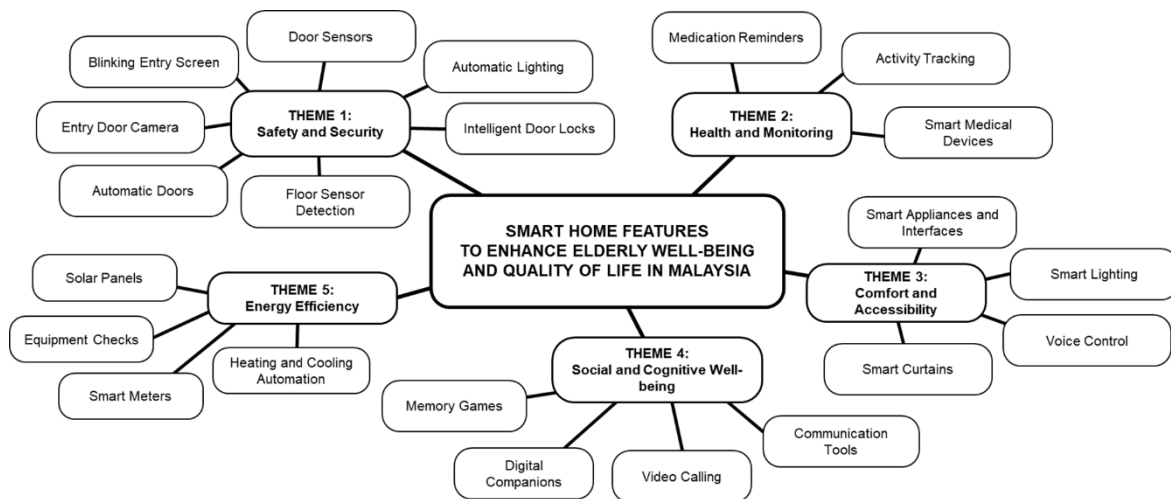


Figure 2: Smart Home Features to Enhance Elderly Well-Being and Quality of Life

Safety and Security

Recent papers (2021-2025) reveal that Safety and Security features for Elderly Smart Home are Intelligent door locks (e.g., Entry door camera, blinking entry screen, door sensors, automatic doors), Automatic lighting, and Floors sensor detection. The findings consistently emphasised the importance of Safety and Security features that prevent falls, facilitate emergency response, and reduce environmental hazards. Fall detection systems, including floor sensors, wearable alert devices, and automatic alarms, were the most frequently cited technologies for fostering independence while maintaining safety for the elderly, especially for individuals living independently or managing chronic health conditions (Oh, 2024; Tu & Zhou, 2025).

Besides these, sensor-enabled doors, intelligent locks, and entry door cameras were also valued, offering both physical and psychological reassurance by providing a safe, comfortable, and convenient living environment for the elderly (Wang et al., 2023). Automatic lighting systems, especially motion detection, were seen as a powerful tool for preventing accidents (Oh, 2024). These features highlight how smart home systems serve not just as passive structures but as active participants in ensuring security and autonomy for ageing individuals.

Health Monitoring

Next, recent paper (2021-2025) also shows Health Monitoring features for Elderly Smart Home are medication reminder, activity tracking and smart medical services. Health-related smart technologies emerged as a second major theme, reflecting the growing interest in real-time monitoring of older adults' physical condition. Smart medical devices such as wearable blood pressure monitors, pulse sensors, and biomedical tracking systems enable elderly users to monitor their health metrics without frequent clinical visits (Jo et al., 2021). Such systems were reported to allow users by providing them with greater insight and control over their daily health management (Oh, 2024; Shie et al., 2024).

Additionally, medication reminders and activity tracking systems were highly praised for improving medication adherence and reducing caregiver or healthcare professional burden to detect any abnormalities (Mohammed et al., 2019, as cited in Oh, 202). These reminders helped structure daily routines and minimise the risk of missed doses, especially among users with cognitive decline or multiple medications. Notably, user preference leaned toward minimally intrusive solutions that blended into the home environment to avoid any excessive data input, which could discourage use. This aligns with a broader trend toward ambient assisted living systems that passively gather data while preserving user dignity and comfort (Alhmoud & Ismail, 2024).

Comfort and Accessibility

Regarding the Comfort and Accessibility features for Elderly Smart Home, there is only one (1) study stated the significant on smart appliances and interfaces, smart lighting, voice control and smart curtains in Elderly Smart Home features. Smart technologies that prioritised user comfort and followed principles of universal design were especially considered beneficial by older adults. These features were recognised for their inclusivity in accommodating diverse abilities and supporting independent living. Smart appliances, including voice-controlled lighting, automated curtains, and climate control systems, stood out as features that reduced physical strain and enabled effortless environmental adjustments (Oh, 2024). These findings also expressed a strong preference for interfaces designed for clarity, including devices with large text, simple navigation menus, and tactile feedback. These design features not only made appliances easier to use but also reduced feelings of frustration and dependency on others (Wang et al., 2023).

Social and Cognitive Well-Being

Three (3) papers (2021-2025) from the recent papers show the Social and Cognitive Well-Being features for Elderly Smart Home are communication tools, video calling, memory games and digital companions. Smart home systems also

played a critical role in enhancing the social engagement and emotional well-being of older adults' overall quality of life. Technologies such as communication tools, including video calling platforms, voice messaging systems, and smart assistants, were recognised in reducing loneliness and maintaining social connections, especially during periods of isolation (Oh, 2024; Ren & Chai, 2025). These systems, whether through reminders, voice interactions, or routine guidance, were perceived as supportive and comforting presences, especially for individuals living alone. While not always explicitly framed as tools for mental health, these technologies performed essential roles in preserving emotional expression, memory stimulation, and a sense of companionship.

Energy Efficiency

Lastly, there are two (2) study from the recent papers (2021-2025) shows the Energy Efficiency features for Elderly Smart Home are solar panels, equipment checks, heating and cooling automation and smart meters. Although often overlooked in discussions of eldercare, energy management systems were valued for their contributions to comfort, cost control, and environmental sustainability. Devices such as solar panels and intelligent energy meters allowed elderly users to maintain comfortable indoor conditions while minimising utility bills (Oh, 2024; Alhmoud & Ismail, 2024). Moreover, automated heating and cooling systems that adjusted to room occupancy or time of day were appreciated for reducing the need for manual control (Jo et al., 2021; Oh, 2024; Alhmoud & Ismail, 2024). Their integration into elderly-friendly smart homes reflects a holistic approach that includes financial security and environmental stability as dimensions of quality of life.

CONCLUSION

This paper synthesised qualitative findings, allowing for a deeper understanding of the lived experiences and technology preferences of older adults. This scoping review outlined five themes of smart home technology that hold potential for supporting the ageing process: (1) Safety and Security, (2) Health Monitoring, (3) Comfort and Accessibility, (4) Social and Cognitive Well-Being, and (5) Energy Efficiency. These categories reflect not only functional needs but also psychological and emotional dimensions essential for ageing in place. The present study makes a significant contribution to the body of knowledge by bringing together the available knowledge under five important categories of smart home technology for the well-being and quality of life of the elderly. Therefore, the present review creates a better understanding of the integration of smart homes with elderly-friendly housing, which is significant for the aging society of Malaysia.

The reviewed studies highlight that older adults value technologies that are intuitive, non-intrusive, and responsive to changing physical and cognitive conditions (Oh, 2024; Shie et al., 2024; Tu & Zhou, 2025). Devices that automate routine tasks, monitor health metrics passively, and support communication without requiring high digital literacy are more likely to be adopted and sustained over time (Oh, 2024; Shie et al., 2024). Equally important are features that foster emotional well-being, such as digital companionship, social connectivity, and personalised environmental control, which collectively enhance users' sense of autonomy, mobility, and comfort (Ren & Chai, 2025; Alhmoud & Ismail, 2024).

These findings include important implications for design practice. Smart home technologies must move beyond focusing solely on technical performance and instead adopt a user-centred design approach. This includes making the systems easy to use, allowing users to adjust settings to their preferences, and ensuring the technology aligns with their cultural background and values (Tu & Zhou, 2025). Effective implementation of smart home technologies depends on adequate education and training for both older adults and their caregivers. Advanced systems may fail to deliver meaningful outcomes if users are not properly guided in their use. Therefore, training interventions must be tailored to accommodate varying levels of digital literacy. This is especially important in underserved or rural communities, where access to support and familiarity with technology may be limited (Oh, 2024).

Despite the useful insights generated from this scoping review, several limitations should be acknowledged. It should be noted that this review only identified nine studies, and this could limit the overall scope of this review. In addition, this review only focused on studies published in two databases: Scopus and Web of Science. Most of these studies were carried out in different countries, such as South Korea, China, Jordan, and Taiwan. Thus, this unavailability of studies on Smart Home Features in Malaysian context shows the research gap especially focussing on the elderly needs that will be addressed with the preliminary findings based on the conceptual framework derived from the scoping reviews findings of this paper.

Future reviews may benefit from using multiple databases, expanding inclusion criteria, and integrating quality assessment tools to enhance the comprehensiveness of the findings. This review highlights several areas for future research, such as longitudinal studies to evaluate how smart home technologies influence the elderly's quality of life and well-being over time. Researchers should examine how socioeconomic status, education, and living arrangements affect adoption patterns and preferences. Investigating these contextual factors will contribute to more equitable and sustainable integration of smart technologies into elderly housing.

In addition, the findings of this study offer a practical implication of practice for multiple stakeholders especially to the policymakers in Malaysia from the conceptual framework on the Smart Home features for Elderly derived from this study. The tabulated smart home features significantly will serve as guidance for both, the Ministry of Housing and Local Government and real estate developers in ensuring the success delivery of age-friendly living environments provision with user-centred smart home technologies, that support independent living of ageing community in Malaysia. Accessible homes for the elderly housing consumers can be improved with the new innovations of smart home features based on the focussed determinations between the needs and preferences of the elderly as the end-users for inclusive smart housing supporting the Sustainable Development Goals (SDG) smart cities initiatives.

Finally, the main findings are aligned with the aim of this study, which explores smart home features tailored to the needs for the elderly's quality of life and well-being. With the focus on dignity, independence, and ease of use, the smart technologies play a meaningful role in facilitating older people to live well as they aged. Therefore, future studies should actively engage with the experts, caregivers, and older adults to evaluate whether these smart home features fulfil the needs based on the elderly daily living experiences. Stakeholders' involvement in relevant future studies is crucial to ensure the smart home solutions are not only technically effective but also market-driven, user-friendly, and supportive for the older adults' actual lifestyles. Besides that, more detailed research in extension from this study can be conducted to benefit other categories of elderly based on the frailty. For example, further study on smart home features for dementia or post stroke patients among elderly that will be useful for the design of safer home environment.

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