Design Principles of User Interfaces for the Elderly in Health Smart Homes

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Abstract

The global trend of increasing longevity has brought an enormous challenge in developing smart technologies to preserve independence and quality of life among the elderly in their own residence. The homes we live in have been transformed into smart environments. Most studies on smart home for the elderly have focused on enabling technologies for aging friendly smart environments such as health telematics, fall detection and action recognition. With an emphasis on the health of the elderly, the concept of ‘health smart home’ was introduced as a variation of the smart home. Numerous research projects on health smart homes have implemented a variety of prototypes and described the state-of-the-art of smart systems etc. However, there is little research on the elderly’s interaction and experience in smart homes using systematic methods and evaluation metrics. The interactions of the elderly with digital devices, further, with the smart space should be intuitive otherwise the smart space will become an uncomfortable place, thus displeasing the elderly. The focus of this paper is on user interfaces in intelligent services, especially, targeted to support the elderly healthy home life. The aim of this paper is to develop design principles of the user interfaces for the elderly in smart homes. Through a critical review on the representative design principles for the elderly, we extracted specific criteria related to usability and user experience, and then structuralized them into a framework of user interfaces for the elderly. For identifying features of the aging friendly interfaces, we considered the elderly reduced abilities with a focus on assistive technologies for supporting their healthy housing life. The proposed framework could be a basis for the perspectives of future research directions on user interfaces for the elderly in smart environments.

Keywords: Health Smart Home, Elderly, Design Principles, User Interface
1. Introduction

Our inhabited spaces have been recently occupied with a wide range of smart devices, which is intended to provide more comfortable, safe, and economical life to people. The homes we live in have been transformed into smart environments. Compared with younger adults smart environments might have more potential for older adults who have suffered from uncomfortable daily life because of their reduced cognitive, psychological and physical capabilities. Most studies on smart home for the elderly have focused on enabling technologies for aging friendly smart environments such as health telematics, fall detection and action recognition. With an emphasis on the health of the elderly, the concept of ‘health smart home’ was introduced as a variation of the smart home. Numerous research projects on health smart homes have implemented a variety of prototypes and described the state-of-the-art of smart systems etc [1, 2]. However, the elderly are not familiar to digital technologies, further, have difficulties in handling digital systems properly because of their reduced cognitive and physical abilities. Thus, usability and user experiences (UX) are the essential issues to be considered for the development of the health smart homes which are intended to support the elderly’s smart living. The problem is that there is little research on the elderly’s interaction and experience in health smart homes using systematic methods and evaluation metrics. The interactions of the elderly with digital devices, further, with the smart space should be intuitive otherwise the smart space will become an uncomfortable place, thus displeasing the elderly. The focus of this paper is on user interfaces for intelligent services, especially, targeted to support the elderly healthy home life. To develop design principles of the user interfaces for the elderly in health smart homes, we firstly reviewed previous research on user interfaces in intelligent technologies and picked up critical criteria related to the usability and UX in the user interfaces. Further we reviewed five representative design guidelines for the elderly’s environment targeting the elderly healthy home life and drew out specific criteria associated with the elderly’s reduced abilities. We structuralized the extracted criteria from the previous research and guidelines into a framework of user interfaces for the elderly. For identifying features of the aging friendly interfaces, we considered the elderly’s reduced physical, cognitive and psychological conditions with a focus on assistive technologies for supporting their healthy housing life. The proposed framework and design principles could be a basis for the perspectives of future research directions on user interfaces for the elderly in smart environments.

2. Background

2.1 Enhancing the Quality of Life through Smart Technology

Recently, telemedicine has adopted wireless and mobile internet applications. This movement from desktop platforms to wireless and mobile configurations would affect future healthcare significantly. Further, telecommunications and biomedical computing advances would also enhance the current methodologies of telemedicine and telecare systems [3,4]. Advancements in sensor technology and wireless communications give opportunities to new models for healthcare and wellness management tools, enabling independent living and improvement of quality of life for individuals. Most studies for healthcare have concentrated on health monitoring at home by reporting initiatives taken to build systems, not provide data about the usefulness of the approach [2]. With an emphasis on mobility, wearable biomedical
healthcare systems have become one of important research areas in smart technologies. The wearable medical computer in general connects various sensors to detect the patients’ vital signs, in particular, wearable biosensors permit continuous cardiovascular monitoring. The benefits of these wearable computing may be realized in the diagnosis and treatment of a number of major diseases because it is helpful for managing and monitoring patients [5, 6]. In addition, environment-type robot systems have been much developed based on the process of computer and network technology. These systems are the most popular area in smart home research and the representative projects are Smart Room [7], Intelligent Room [8], Easy Living [9], Aware Home [10], and Neural Network House[11]. The approach of making an environment intelligent has attracted many researchers. By combining ubiquitous technologies, smart environments can extend humans’ ability and support humans’ activities [12]. Above all, the smart environments can provide a safe and comfortable environment for home healthcare. However, with more subsystems and the higher complexity of them, they tend to become inconvenient for the elderly to access and control them with [13]. To enhance the comfort and security of the elderly practically, the development of user-friendly devices is critical with the advancement of technologies [1]. The way of interaction between the elderly and the systems is a significant research issue in the design of user interfaces.

2.2 Design principles of the User Interface

The most important issue for the development of user interfaces is how the HCI can be intuitive and natural. Norman [14] proposed that the naturalness of interaction could be accomplished by considering human’s disposition, physical similarities and cultural criteria, but visuality and affordance play the most critical role for the HCI. Shneiderman [15] emphasized the concept of the direct manipulation for enabling the natural use of the interfaces. These research on user interfaces have been developed based on theories in cognitive science, emphasizing human’s perception, rational decisions, and human behaviors [16]. More recently, two concepts, embodied experience and embodied, are emphasized by being associated with Tangible User Interface (TUI) in the HCI domain. TUIs allow tactile manipulation and physical expressiveness by coupling digital information with physical objects and environments. With computing moving beyond the desktop, ‘intelligent’ devices spread into all areas of our life and work. Applications previously not considered ‘interfaces’ are turning into computing interfaces, further, such computing is increasingly embedded in physical environments [17]. TUIs might have the potential for supporting the elderly’s usability and UX because they could be more accessible and encourage the elderly to use smart systems for their independent home living. The elderly could learn how to use the TUIs intuitively based on their everyday skills in life. Ishii and Ullmer [18] mentioned about three features for the TUIs; computational coupling of tangible representations to underlying digital information and computation; embodiment of mechanisms for interactive control with tangible representations; and perceptual coupling of tangible representations to dynamic intangible representations. Hornecker [19] proposed that tangible interaction is associated with systems that rely on embodied interaction, tangible manipulation, physical representation of data, and embededness in real space. He contributes to understanding the user experience of tangible interaction, and provides perspectives for considering the social aspects of tangible interaction. Jacob et al.[20] proposed a framework for post-WIMP (window, icon, menu, point device) interface on the reality-based interaction (RBI). The RBI
can be explained by four notions; native physics; body awareness & skills; environment awareness & skills, and social awareness & skill. Further, Koleva [21] and Ghazali [22] proposed design principles emphasizing the movement and functions of the systems, such as transformation, sensing of interaction, configurability, autonomy, tangible transition etc.

**Table 1**

Key Properties of Tangible User Interface

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<td>· Manipulation</td>
<td>· Native Physics</td>
<td>· Autonomy</td>
<td>· Exposed State</td>
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<td>· Embodiment of Mechanisms for Interactive Control</td>
<td>· Embodied Facilitation</td>
<td>· Environment Awareness and Skills</td>
<td>· Sensing of Interaction</td>
<td>· Tangible Transition</td>
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<td>· Spatial Interaction</td>
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<td>· Transformation</td>
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2.3 Environmental Assessment Tools for the Elderly

There have been environmental assessment tools for the elderly. The five representative ones were as follows: the Multiphasic Environmental Assessment Protocol (MEAP) [23]; the Nursing Unit Rating Scale (NURS) [24]; and the Professional Environmental Assessment Protocol (PEAP) [25]; the Environmental Audit Tool (EAT) [26]; the Evaluation of Older People’s Living Environments (EVOLVE) [27]. These evaluation tools are effective in assessing the physical environment, thus can be used at the design stage and for the evaluation of existing buildings. The scales of MEAP were designed to assess residential environments for older people ranging from congregate housing to nursing homes. They described the personal and social characteristics of residents then related these factors to the architectural, policy and social climate resources of their settings. The MEAP has five parts: physical and architectural features, policy and program information, resident and staff information, sheltered care environment scale. In particular, the physical-architectural feature dimensions, which are related to our research, consists of nine categories as shown in table 2 [28]. The NURS [24] defines six global constructs theorized to influence how people with dementia adapt to institutional environments as shown in table 2. These constructs could be linked to adaptation through theories of environmental press or stress, affecting behavioral outcomes in the people with dementia. The PEAP [29] is designed to be completed by raters who possess substantial knowledge and expertise in person-environment design research. The PEAP considers three levels of physical setting; fixed or structural features including those such as overall unit area and floor plan; semi-fixed features including less permanent
architectural elements such as prosthetic devices or handrails; and non-fixed features including the presence of wall hangings and other props that decorate the environment. In addition, the PEAP assesses nine dimensions of the environment as shown in table 2. The EAT is the environmental assessment tools for the evaluation of Australian residential facilities for people with dementia. The availability of an extensive review of the environmental design literature undertaken for the Primary Dementia Collaborative Research Centre [30] has prompted some small revisions to the original tool. A care environment aimed at maintaining the abilities of people with dementia should be meet the ten requirements as shown in table 2. The EVOLVE is a tool for evaluating the design of housing for older people. It is used to assess how well a building contributes to the physical support and personal well-being of older people. It conceptually split into two categories: universal housing needs that apply to people of all ages, and those needs which particularly apply to older people. In particular, our research is interested in the seven domains supporting for older age as shown in table 2.

Table 2
Critical Concepts for the Assessment of Environment Design for the Elderly

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<td>· Safe and Secure</td>
<td>· Accessibility</td>
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<td>· Physical amenities</td>
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<td>· Physical support</td>
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<td>· Social-recreational Aids</td>
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<td>· Privacy</td>
<td>· Simple</td>
<td>· Sensory support</td>
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<td>· Prosthetic aids</td>
<td>· Complexity</td>
<td>· Stimulation</td>
<td>· Visual access</td>
<td>· Dementia support</td>
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<td>· Orientational aids</td>
<td>· Control/Tolerant</td>
<td>· Support of self-care</td>
<td>· Important stimuli</td>
<td>· Health and Safety</td>
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<td>· Safety features</td>
<td>· Continuity</td>
<td>· Opportunities for control</td>
<td>· Planned wandering</td>
<td>· Security</td>
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<td>· Architectural choice</td>
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<td>· Continuity of self</td>
<td>· Be familiar</td>
<td>· Working care</td>
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<td>· Space availability</td>
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<td>· Facilitation of social contact</td>
<td>· Privacy and community</td>
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3. Design Principles of the User Interface for the Elderly

To develop a framework for design principles of the user interfaces supporting the usability and UX of the elderly, we firstly investigated the key properties and concepts associated with TUIs in the HCI domain. In addition, we also analyzed five evaluation tools for the facilities or environments for the elderly in order to obtain more relevant design criteria for the elderly, which are insufficient in the associated concepts with TUIs. Based on the result of the critical reviews of the HCI concepts and design criteria for the elderly, we developed a framework for the design principles of the user interface for the elderly. The proposed framework is divided into two main dimensions; tangible interface properties; supportive interface properties.

Table 3
A Framework for Design Principles of User Interface

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<tr>
<th>Tangible Interface Properties</th>
<th>Supportive Interface Properties</th>
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<tr>
<td><strong>Manipulation</strong></td>
<td><strong>Digital Literacy</strong></td>
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<tr>
<td>Distinct tactile qualities, which are typically manipulated. Users can grab, feel, and move ‘the important stuff’</td>
<td>The degree which capability enables users to understand and utilize digital resources such as computing and media.</td>
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<tr>
<td><strong>Intuitiveness</strong></td>
<td><strong>Accessibility</strong></td>
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<tr>
<td>Manipulating in a natural way without referring to a manual or learning process</td>
<td>The degree which design feature enables users to move freely around the systems without assistance</td>
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<tr>
<td><strong>Representation</strong></td>
<td><strong>Physical and Sensory Support</strong></td>
</tr>
<tr>
<td>The physical and digital representations employed by interaction systems, their expressiveness and legibility</td>
<td>The degree to which design feature enables users to have independence and supports sensory impairments (i.e. sight loss, hearing difficulties)</td>
</tr>
<tr>
<td><strong>Context Awareness</strong></td>
<td><strong>Simplicity</strong></td>
</tr>
<tr>
<td>A sense of their surroundings</td>
<td>The degree which the information is easy to understand</td>
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<tr>
<td><strong>Spatial Interaction</strong></td>
<td><strong>Safe and Security</strong></td>
</tr>
<tr>
<td>Skills for controlling and coordinating within their environment, while being aware of their own physical bodies.</td>
<td>The degree to which the system provides a safe and a secure environment which promotes good health</td>
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<td><strong>Social Interaction</strong></td>
<td><strong>Self Control</strong></td>
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<tr>
<td>Being aware of others in their environment and skills for interacting with them</td>
<td>The degree which capability enables users to control the system without assistance</td>
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<tr>
<td><strong>Stimulation</strong></td>
<td><strong>Stimulation</strong></td>
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<tr>
<td>The degree that promotes independent functioning/cognitive abilities</td>
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The former can be applied to all generation while the latter one is especially for the elderly. Tangible interface properties consists of six categories; manipulation, intuitiveness, representation, context-awareness, spatial interaction and social interaction. Supportive interface properties are composed of digital literacy, accessibility, physical and sensory support, simplicity, safe and security, self control, and stimulation as shown in table 3.

4. Conclusion and Discussion

The global trend of increasing longevity has brought an enormous challenge in developing smart technologies to preserve independence and quality of life among the elderly in their own residence. In the ubiquitous paradigm, this research proposed a conceptual framework for the design principles of the user interfaces in order to provide a smart environment for the elderly emphasizing UX. Previous research on user interfaces have targeted adults, thus they have proposed general usability criteria, methods, tools and procedures, not considering special conditions of the elderly. In addition, technologies and systems proposed for the elderly also have emphasized the hardware aspects of the systems. To fill this gap, rather than focusing on technologies overcoming dependence, this research emphasizes UX and HCI in order to provide customized smart services and interfaces to the elderly in their own residences. This study analyzed existing HCI concepts and design criteria related usability, and then developed a framework of the user interfaces for the elderly.

The proposed framework could be utilized as an aid to architects and providers, enabling the design and commissioning process to be underpinned by a firm evidence base. Further, it could enable the built environment to be evaluated and provide a rational basis for selection of alternative proposals. The proposed framework will be extended beyond the conceptual level to a more practical evaluation tool through further studies. For the next step, a form of checklist for the usability will be produced based on the conceptual framework. And then empirical studies will be conducted with the elderly using the evaluation tool. Through the result of the evaluation, the proposed tool could be elaborated by incorporating the feedbacks. Above all, older adults have different physical and psychological features from those of the young adults. Thus, various evaluation methods for the usability need to be considered for the elderly in order to develop a novel evaluation tool considering the elderly’ characteristics in the context of the use of the systems.

Acknowledgements

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References


[14] D.A. Norman, The invisible computer: why good products can fail, the personal computer is so complex, and information appliances are the solution, MIT Press, 1999.


Design Principles of User Interfaces for the Elderly in Health Smart Homes

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Department of Housing and Interior Design
Kyung Hee University

Introduction

• The homes we live in have been transformed into smart environments. Smart environments might have more potential for older adults who have suffered from uncomfortable daily life.

• The elderly are not familiar to digital technologies, further, have difficulties in handling digital systems properly. There is little research on the elderly’s interaction and experience in health smart homes using systematic methods and evaluation metrics.

• Usability and user experiences (UX) are the essential issues to be considered for the development of the health smart homes which are intended to support the elderly’s smart living.

• The focus of this paper is on user interfaces for intelligent services, especially, targeted to support the elderly healthy home life.
**02 Methods**

- This research aims to develop **design principles of the user interfaces for the elderly** in health smart homes.

- We firstly **reviewed previous research on user interfaces** in intelligent technologies and picked up **critical criteria** related to the **usability and UX** in the user interfaces.

- Further we **reviewed five representative design guidelines** for the environment design supporting the elderly healthy home life and drew out **specific criteria** associated with the elderly’s reduced abilities.

- We **structuralized those extracted criteria into a framework of user interfaces** for the elderly. We considered the elderly’s reduced physical, cognitive and psychological conditions with **a focus on assistive technologies** for supporting their healthy housing life.

- The proposed design principles could be a basis for the perspectives of future directions on user interfaces for the elderly in smart environments.

**03 Background**

3.1 Enhancing the Quality of Life through Smart Technology

- **Advancements in sensor technology** and **wireless communications** give opportunities to new models for healthcare and wellness management tools, enabling independent living and improvement of quality of life for individuals.

- With an emphasis on **mobility**, **wearable biomedical healthcare systems** have become one of important research areas in smart technologies.

- **By combining ubiquitous technologies**, smart environments can extend humans’ ability and support humans’ activities. However, with **more subsystems and the higher complexity of them**, they tend **to become inconvenient for the elderly** to access and control them with.

- To enhance the comfort and security of the elderly practically, **the development of user-friendly devices** is critical with the advancement of technologies. **The way of interaction between the elderly and the systems** is a **significant research issue** in the design of user interfaces.
3.2 Design principles of the User Interface

The most important issue for the development of user interfaces is how the HCI can be intuitive and natural. Norman proposed that the naturalness of interaction could be accomplished by considering human’s disposition, physical similarities and cultural criteria, but visuality and affordance play the most critical role for the HCI. Shneiderman emphasized the concept of the direct manipulation for enabling the natural use of the interfaces.

More recently, two concepts, embodied experience and embodied, are emphasized by being associated with Tangible User Interface. TUIs allow tactile manipulation and physical expressiveness by coupling digital information with physical objects and environments.

TUIs might have the potential for supporting the elderly’s usability and UX because the elderly could learn how to use the TUIs intuitively based on their everyday skills in life.

Ishii and Ullmer mentioned about three features for the TUIs: computational coupling of tangible representations; embodiment of mechanisms; and perceptual coupling of tangible representations. Hornecker proposed that tangible interaction is associated with systems that rely on embodied interaction, tangible manipulation, physical representation of data, and embeddedness in real space. Jacob et al. proposed a framework for post-WIMP interface on the reality-based interaction. Koleva and Ghazali proposed design principles emphasizing the movement

Hiroshi Ishii et al. (1997) - Computational Coupling of Tangible Representations
Eva Hornecker et al. (2006) - Manipulation
Robert J.K. Jacob et al. (2008) - Native Physics
Boriana Koleva et al. (2003) - Autonomy
Ghazali et al. (2004) - Exposed State

- Embodiment of Mechanisms for Interactive Control
- Perceptual Coupling of Tangible Representations
- Embodiment of Facilitation Representation Spatial Interaction
- Social Awareness and Skills
- Sensing of Interaction
- Configurability Transformation
- Lifetime of Link Transformation
- Native Physics Environment Awareness and Skills
- Body Awareness and Skills
- Autonomy
- Exposed State
- Tangible Transition
- Bounce Back
- Compliant Interaction

Background

03
3.3 Environmental Assessment Tools for the Elderly

- The five representative environmental assessment tools for the elderly were as follows: the Multiphasic Environmental Assessment Protocol (MEAP); the Nursing Unit Rating Scale (NURS); and the Professional Environmental Assessment Protocol (PEAP); the Environmental Audit Tool (EAT); the Evaluation of Older People’s Living Environments (EVOLVE).

- The scales of MEAP were designed to assess residential environments for older people ranging from congregate housing to nursing homes. They described the personal and social characteristics of residents then related these factors to the architectural, policy and social climate resources of their settings.

- The NURS defines six global constructs theorized to influence how people with dementia adapt to institutional environments. These constructs could be linked to adaptation through theories of environmental press or stress, affecting behavioral outcomes in the people with dementia.

- The PEAP is designed to be completed by raters who possess substantial knowledge and expertise in person-environment design research. The PEAP considers three levels of physical setting: fixed or structural features; semi-fixed; and non-fixed features.

- The EAT is the environmental assessment tools for the evaluation of Australian residential facilities for people with dementia. The availability of an extensive review of the environmental design literature undertaken has prompted some small revisions to the original tool.

- The EVOLVE is a tool for evaluating the design of housing for older people. It is used to assess how well a building contributes to the physical support and

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CSHeB 2013 Symposium
# 04 Design Principles of the User Interface for the Elderly

**Tangible Interface Properties**
- **Manipulation**: Distinct tactile qualities, which are typically manipulated. Users can grab, feel, and move “the important stuff”.
- **Intuitiveness**: Manipulating in a natural way without referring to a manual or learning process.
- **Representation**: The physical and digital representations employed by interaction systems, their expressiveness and legibility.
- **Context Awareness**: A sense of their surroundings.
- **Spatial Interaction**: Skills for controlling and coordinating within their environment, while being aware of their own physical bodies.
- **Social Interaction**: Being aware of others in their environment and skills for interacting with them.

**Supportive Interface Properties**
- **Digital Literacy**: The degree which capability enables users to understand and utilize digital resources such as computing and media.
- **Accessibility**: The degree which design feature enables users to move freely around the systems without assistance.
- **Physical and Sensory Support**: The degree to which design feature enables users to have independence and supports sensory impairments (i.e., sight loss, hearing difficulties).
- **Simplicity**: The degree which the information is easy to understand.
- **Safe and Security**: The degree to which the system provides a safe and a secure environment which promotes good health.
- **Self Control**: The degree which capability enables users to control the system without assistance.
- **Stimulation**: The degree that promotes independent functioning/cognitive abilities.

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# 05 Conclusion and Discussion

- The global trend of increasing longevity has brought an enormous challenge in developing smart technologies to preserve independence and quality of life among the elderly in their own residences.
- Previous research on user interfaces have targeted adults, so they have proposed general usability criteria, methods, tools etc., not considering special conditions of the elderly. In addition, technologies and systems proposed for the elderly also have emphasized the hardware aspects of the systems.
- To fill this gap, this research emphasizes UX and HCI in order to provide customized smart services and interfaces to the elderly in their own residences.
- The proposed framework will be extended beyond the conceptual level to a practical evaluation tool through further studies. For the next step, a form of checklist for the usability will be produced based on the framework. Then empirical studies will be conducted with the elderly using the evaluation tool.
- Various evaluation methods for the usability need to be considered for the elderly in order to develop a novel evaluation tool considering the elderly’ characteristics in the context of the use of the systems.