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Interactive Interface Design of Aging Smart Home Products Based on Perception Ability Evaluation

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ABSTRACT

Facing the population aging and product intelligence, comprehensively, systematically and accurately grasp the perception ability of the elderly, build a rule system for the design of smart home products suitable for the elderly, establish a practical basis for the design of smart home products for the elderly, and improve the quality of life of the elderly at home. The perception ability of the elderly is classified and summarized, and a questionnaire on the use status of smart home products for the elderly is compiled to investigate 30 elderly people aged 65-80. The survey data were analyzed by statistical methods to form user images and user use maps, as well as an evaluation system for the perception ability of the elderly. Visual ability, auditory ability, tactile ability, cognitive ability and psychological state are the main factors affecting the satisfaction evaluation of the interactive interface of smart home products for the elderly. According to the evaluation index system of perception ability, combined with the design practice cases, three interactive interface design methods of smart home products for the elderly, such as multi-sensory cognitive design, rough operation interaction design and emotional care design, are explored and summarized. The analysis of the design case verifies the effectiveness of the design method, and also shows the importance of user participation in the design process, as well as the role of simplicity, multi-sensory, rough operation and wizard in improving the satisfaction of elderly in using smart home products.

Keywords: smart home products, interactive interface, perception, evaluation system, design method.

INTRODUCTION

Background

With the background of an aging society, the elderly population is growing, and they frequently encounter a myriad of challenges including shifts in health status and diminishing self-care abilities in their daily lives. As an innovative technical solution, smart home products provide practical help for the elderly (Majumder et al., 2017). These products combine the Internet of Things (IoT), artificial intelligence (AI) and sensing technology to automatically monitor and adapt to the needs of the elderly and create a safer, more convenient and comfortable living environment for them (Zhang et al., 2020).

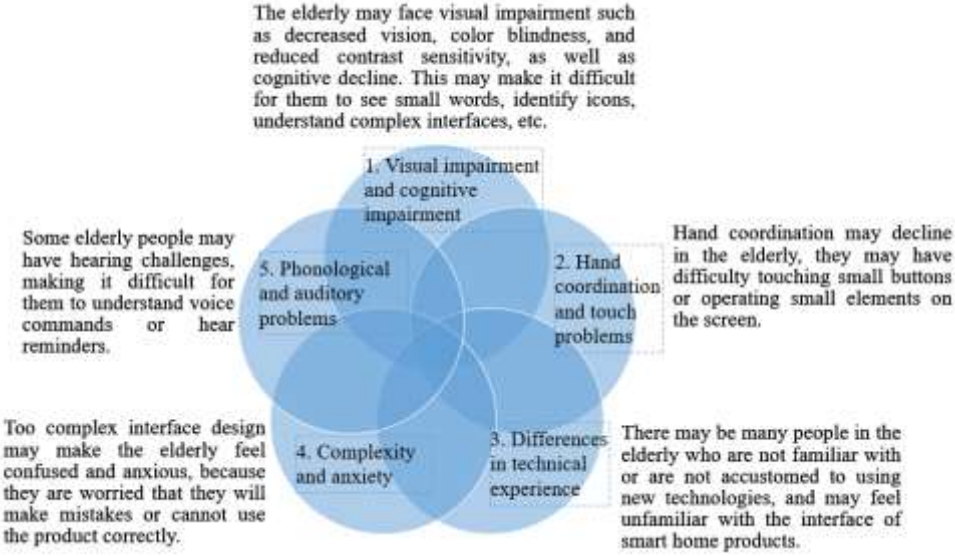
The role of smart home products in the lives of the elderly is reflected in many aspects (Maswadi et al., 2020). First of all, smart home products can real-time monitor the living conditions of the elderly through remote monitoring and alarm systems, such as sleep quality and activity, so as to help family members or nursing staff keep abreast of the situation of the elderly. Secondly, smart home products can provide medical support, such as regular medication reminders, health data tracking, etc., to help the elderly better manage health problems (Sooraj et al, 2020). In addition, smart home products can also optimize the living environment, such as intelligent lighting and temperature control systems, automatically adapt to the needs of the elderly and provide a more comfortable living experience.

In an aging society, social activities of older people may also be limited, and smart home products can help them maintain contact with family and friends through functions such as video calls and social media connections (Jo et al., 2021). In addition, smart home products can also provide emergency help functions, and the elderly can call for help in time when they encounter accidents or emergencies.

In general, smart home products play an active role in the lives of the elderly, creating a safer, more convenient and more comfortable living environment for them. By integrating advanced technologies, these products are expected to help older people maintain independence, reduce the burden on their families, and improve their quality of life. However, in order to achieve the best results, the design of smart home products requires an in-depth understanding of the needs and perceptions of the elderly to ensure that the products can truly meet their needs.

Challenge

In the process of using smart home products for the elderly, interactive interface design is a key challenge. The elderly may face multiple challenges, including decreased perception, unfamiliarity with technology, and increased cognitive burden (Coşar et al., 2020; Jo et al., 2021; Pal et al., 2019). These factors emphasize the need to consider the special needs and perception of the elderly when designing the interactive interface of smart home products, as shown in Figure 1.



Source: This study.

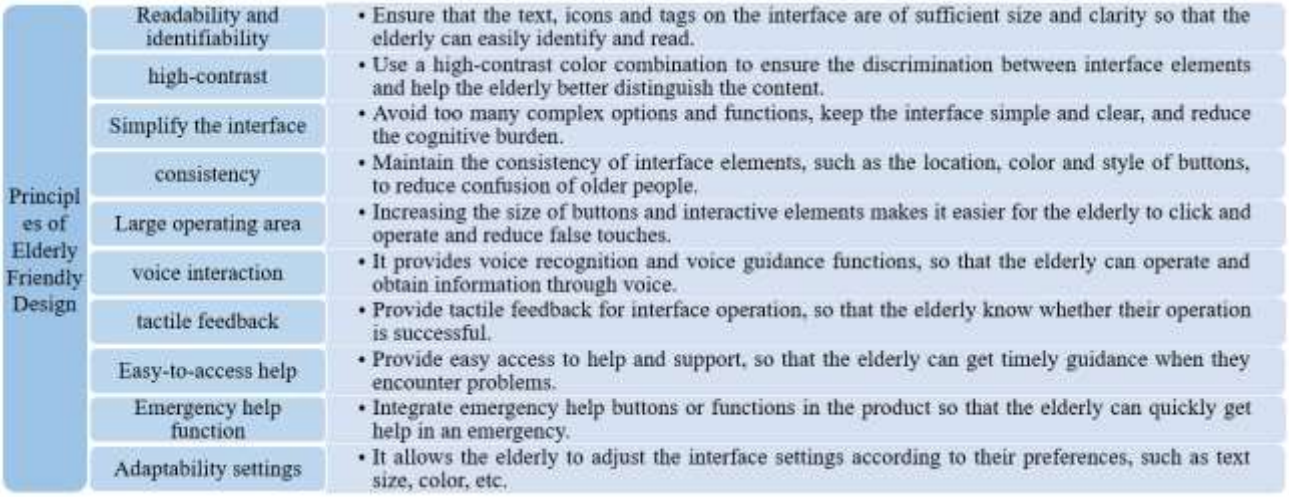
Figure 1: Perception and special needs of the elderly.

In tackling these challenges, a pivotal factor lies in comprehending the requirements, routines, and technological receptiveness of the elderly population. The interactive interface design of age-friendly smart home products should prioritize user-centered principles, ensuring that the products can seamlessly meet the needs of the elderly population (Zhou & Wang, 2023). However, there are still certain issues with the interactive interface design of age-friendly smart home products available in the market (Zhou et al., 2022). For instance, issues such as excessively complex interface operations, small fonts, and inappropriate color combinations significantly hamper the usability and user experience among the elderly population. These concerns even pose potential threats to the health and safety of elderly individuals.

RELATED WORK

Principles of Age-Friendly Design

The principles of age-friendly design refer to considering the unique needs and abilities of older individuals in the design of products, services, and environments, with the aim of creating interfaces and experiences better suited to their usage (Iancu, 2020). These principles are intended to ensure that older adults can utilize a variety of products with ease and safety, thereby enhancing their quality of life and independence. Common principles of age-friendly design (Fan et al., 2023; Zhu et al., 2022) are illustrated in Figure 2.



Source: This study.

Figure 2: Common elderly-friendly design principles.

The objective of age-friendly design principles is to develop products that align with the capabilities and needs of older individuals, enabling them to participate more effectively in social life and relish the convenience offered by technology. By adhering to these principles, designers can craft products that are notably more inclusive and user-friendly.

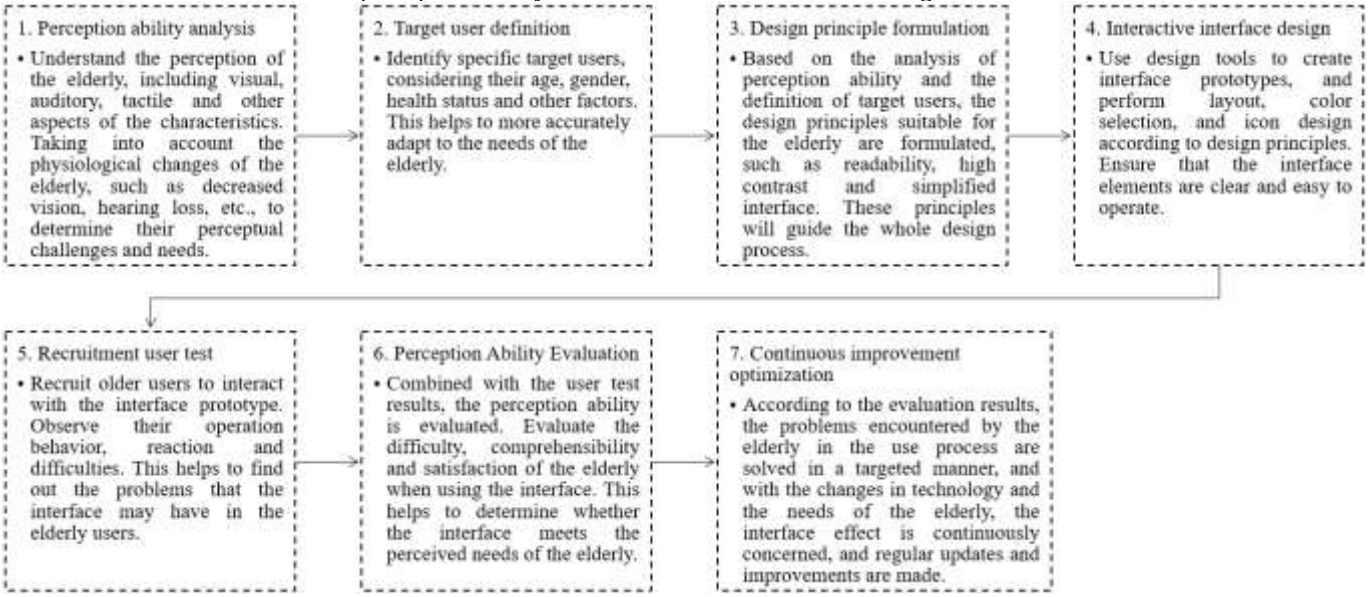
Age-Friendly Interface Design

Age-friendly interface design involves integrating human-computer interaction interface design with the specific needs and perceptual capabilities of older individuals. Its goal is to make product interfaces better suited for elderly use. Research in this domain primarily focuses on how to enhance usability and comprehensibility of interfaces, tailored to meet the special requirements of older adults, thus elevating their user experience. For instance, researchers have proposed a series of age-friendly interface design principles, including readability, ease of operation, streamlined interfaces, and larger buttons (Ruzic et al., 2016; Ruzic & Sanfod, 2017). They have also developed methods to assess the difficulty and satisfaction of older individuals while using interfaces, such as usability testing and focus group discussions (Ruzic et al., 2017; Granata et al., 2013). Additionally, some researchers focus on changes in the perceptual abilities of older adults, particularly in terms of vision and hearing issues. They explore how to accommodate older adults' visual needs, such as adjusting font sizes and color contrasts (De Barros et al., 2014). Simultaneously, they investigate the integration of audio guidance, voice interactions, and other features in interfaces to cater to hearing impairments (Fischer et al., 2019; Mitzner et al., 2010). Certain scholars are also dedicated to reducing cognitive load for older adults when using interfaces (Khawaja et al., 2014). They delve into simplifying interface layouts, providing clear labels and instructions, as well as offering easily understandable operational sequences. Research on age-friendly interface design also addresses how to provide training and support specifically tailored to older individuals, helping them become familiar with and adept at new technologies (Miraz et al., 2021). This could encompass user guides, video tutorials, and more. Moreover, researchers have applied accessibility testing and usability testing to age-friendly interface design to ensure the interface's user-friendliness for older adults (Coşar et al., 2020). These tests aid in identifying issues within the interface and guiding improvements. These studies aim to enhance the comfort and satisfaction of older adults when using technological products and services, assisting them in better adapting to the digital society.

Perceptual Ability Evaluation Method

The application of the design method based on perceptual ability evaluation in the elderly user group aims to optimize the design of products and interfaces by understanding the perceptual characteristics and needs of the elderly, so as to improve their user experience and the readability, comprehensibility and ease of use of the interface. This method emphasizes the perception of the elderly as a core design consideration, so as to create a product more suitable for their use.

The design based on the perceptual ability evaluation method is mainly divided into seven steps. The first step is the analysis of perceptual ability; the second step is the target user definition; the third step is the formulation of design principles; the fourth step is interactive interface design; the fifth step is to recruit user tests; the sixth step is perception ability evaluation; the seventh step is continuous optimization and improvement. This also corresponds to the design process and steps of the aging smart home interactive interface based on the perception ability evaluation method, as shown in Figure 3.



Source: This study.

Figure 3: Design process and steps.

This design method based on perceptual ability evaluation can help designers better understand the needs of the elderly and avoid ignoring their special circumstances in design. Through in-depth study of perception ability and design optimization based on the actual experience of the elderly, products and interfaces that are more suitable for the elderly can be created. In recent years, some researchers have conducted design effectiveness evaluation studies for the elderly (Li & Luximon, 2023). Focusing on improving the user experience, they recruited participants to participate in experiments to analyze the influencing factors of the

elderly's acceptance of intelligent virtual assistants (Liu et al., 2023), usability testing of mobile interface navigation, etc. (Li & Luximon, 2020).

The research on age-friendly interface design for smart home products will be conducted in three phases: preliminary, middle, and final. In the preliminary phase, we will initiate the research with user studies, combining methods like surveys and interviews, to deeply understand the perceptual abilities of older individuals. This will help us identify the challenges and needs they face in terms of perception, allowing us to accurately define the target user group. In the middle phase, based on the analysis of perceptual abilities and the definition of target users, we will formulate age-friendly design principles and employ design tools to complete the prototype design of the interactive interface. In the final phase, we will recruit older users for interactive testing to obtain feedback on perceptual capabilities. Subsequently, we will optimize the design further based on these evaluation results.

SMART HOME PRODUCT INTERFACE DESIGN PRINCIPLES

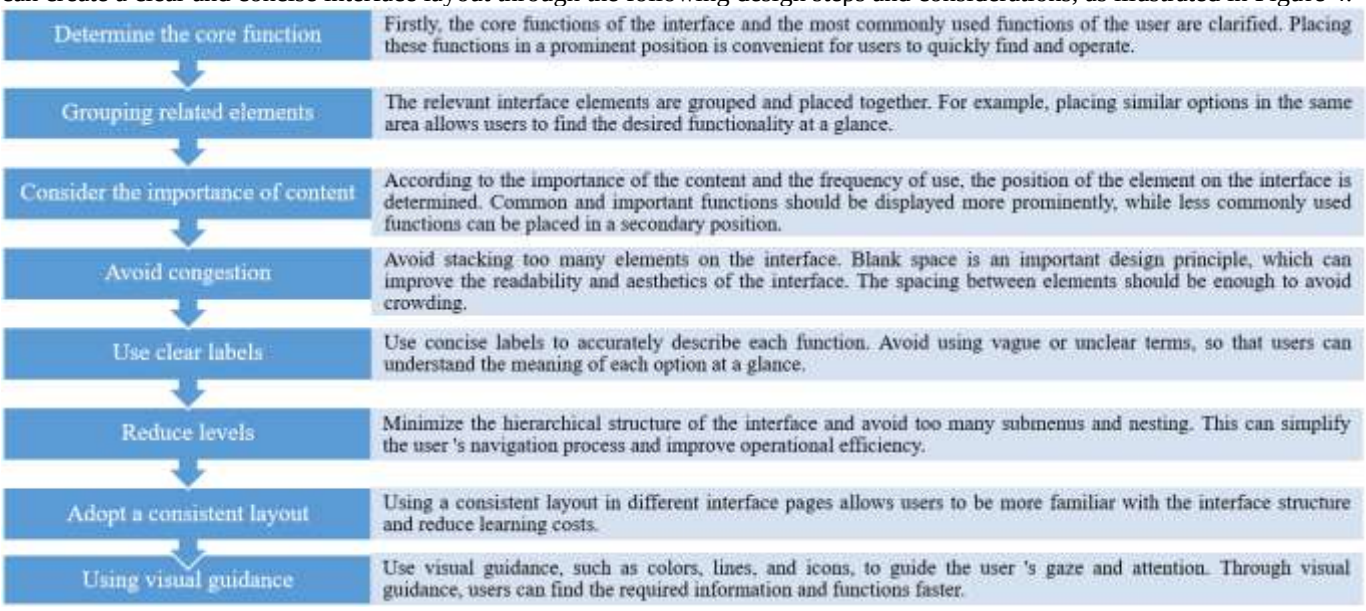
The core principles of smart home product interface design revolve around ensuring user-friendliness and usability, while also thoroughly considering the specific needs and perceptual capabilities of the user demographic. These principles can aid designers in creating more intuitive and user-desired smart home product interface designs, ultimately enhancing user experience and satisfaction. In short, the design of the interactive interface of smart home products should be user-oriented, follow the principle of aging, and emphasize the design concept of ease of use, accessibility and humanization.

The fundamental principles and methods of interaction design are indispensable parts in the design of smart home products. Concerning the fundamental principles of interaction design, firstly, interface consistency is crucial as it enables users to maintain familiarity and coherence across different scenarios (Punchoojit & Hongwarittorrn, 2017). Secondly, usability and accessibility are essential factors that must be considered when designing interactive interfaces for the elderly (Sauer et al., 2020). By considering user habits and the characteristics of smart home products, designers can enhance the user experience of the elderly by improving usability and accessibility. Additionally, scalability is another crucial design principle, which can ensure that the product has good sustainability and future development potential (Ni et al., 2022). Regarding interaction design methods, user research, task flow analysis, information architecture design and other methods are commonly employed approaches. These methods can assist designers in gaining in-depth insights into user needs and delivering an improved user experience.

In today's digital era, the importance of interface design has become increasingly prominent, particularly in terms of user experience and usability. Within the domain of smart home product interactive interface design, usability, readability, and clarity stand as crucial elements. When it comes to designing interactive interfaces of smart home products for elderly users, the principles can be primarily emphasized in three aspects. First, how to improve usability through a clear and concise interface layout; second, how to select appropriate icons and labels to enhance recognizability; third, how to augment readability via high-contrast colors and larger fonts.

Simple and Clear Interface Layout

A simple and clear interface layout is one of the important means to improve usability. A well-designed interface layout can make it easier for users to comprehend and interact with the interface, thus reducing confusion and erroneous actions. Designers can create a clear and concise interface layout through the following design steps and considerations, as illustrated in Figure 4.



Source: This study.

Figure 4: The design steps and precautions of the concise and clear interface layout.

A simple and clear interface layout can improve user satisfaction and efficiency. Throughout the design process, always take the user as the center and focusing on their needs and habits, so as to create interfaces that are user-friendly and aligned with user expectations.

Clear Icons and Labels

Choosing appropriate icons and labels is a crucial aspect of designing interface recognizability, as it significantly impacts users' comprehension of interface functions and options. This section will discuss how to select suitable icons and labels to enhance the recognizability of the interface.

Icon selection and design

Choosing appropriate icons is one of the core tasks in interface design. Well-chosen icons can visually convey functions, aiding users in swiftly comprehending and navigating the interface. When selecting and designing icons, several essential principles should be followed. Firstly, universality and intuitiveness: select widely recognized universal icons, such as search, settings, and favorites. These icons convey the same meanings across diverse languages and cultural backgrounds, helping eliminate communication barriers. Secondly, avoid ambiguity: choose icons that are less prone to ambiguity, ensuring their meanings remain clear in various contexts. The meaning of icons should not conflict with other functionalities to prevent user confusion. Additionally, simplicity and recognizability: icons should maintain simplicity and avoid excessive intricate details. Even in small sizes, icons should remain distinguishable. Clear outlines and distinct colors contribute to enhancing icon recognizability.

Selection and Expression of Labels

Labels, as textual interface elements, provide more detailed information and aid users in accurately understanding functions. When choosing and expressing labels, several factors need to be considered. Firstly, clarity and conciseness: labels should clearly describe functions using concise and accurate vocabulary. Labels should avoid ambiguity or vagueness to prevent user confusion. Secondly, alignment with user expectations: labels should align with user expectations, employing vocabulary and expressions familiar to users. This helps users swiftly comprehend and recognize functions. Additionally, language and cultural adaptation: if the interface is to be used in different regions, ensure the selected labels are appropriate in various language and cultural contexts. Avoid using region-specific or difficult-to-translate terms.

Color scheme and consistency

The color scheme plays a crucial role in the recognizability of icons and labels. Colors and shapes can assist users in quickly comprehending functions and meanings. During the design process, color consistency needs to be considered: the colors of icons and labels should align with the overall interface color scheme to maintain visual harmony. Additionally, colors can be used to emphasize essential functions or information. Furthermore, the significance of shapes should also be taken into account: the shape of an icon can convey a specific meaning, such as a lock shape indicating security or an arrow shape signifying navigation. The selection of shapes should correspond to the associated functions.

User testing and feedback

The ultimate goal of the design is to provide interfaces that align with user needs. During the design phase, conducting user testing to gather feedback from real users is essential. Through user testing, we can ascertain whether users can accurately comprehend and recognize the meanings of icons and labels. User feedback can guide us in adjusting icons and labels to make them more distinguishable and easily understandable.

In conclusion, selecting appropriate icons and labels to enhance interface recognizability requires a comprehensive consideration of factors such as universality, intuitiveness, clarity, and consistency. Through thoughtful design and user testing, we can create user-friendly interfaces, enhance user experience, and achieve higher quality interactions.

High Contrast and Large Fonts

The role of high contrast colors and large fonts in interface design is to enhance readability and accessibility, particularly for users with visual impairments or specific needs. The following will separately discuss the roles of high contrast colors and large fonts in improving readability.

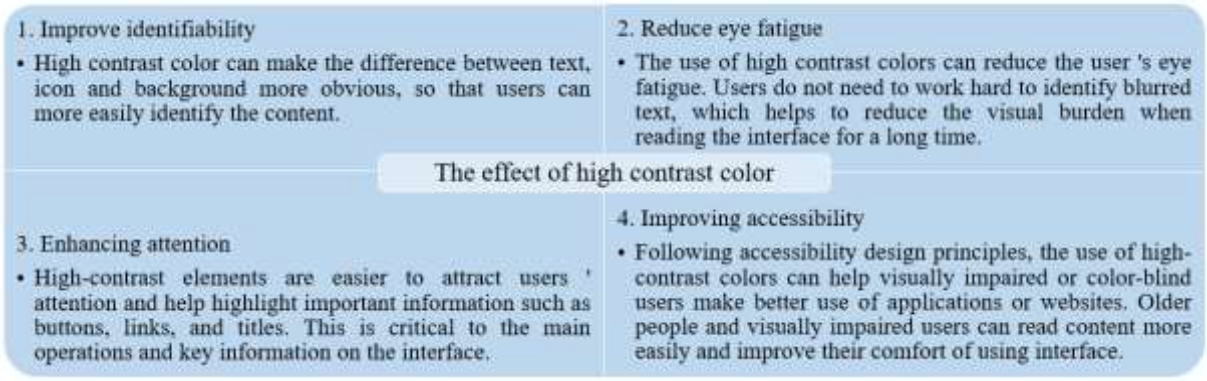
High contrast colors

High contrast colors refer to increasing the color difference between different elements, making them easier to distinguish. This is particularly crucial for users with visual impairments, color blindness, and elderly individuals. The role of high contrast colors in improving readability is shown in Figure 5.

Large fonts

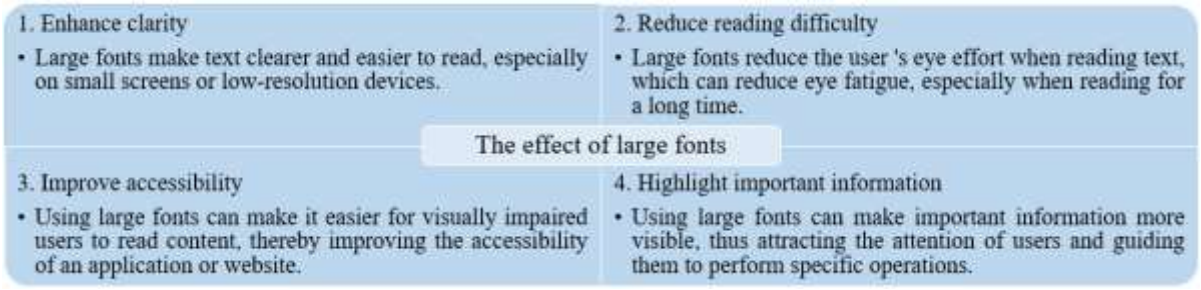
Using large fonts in interface design similarly improves readability and accessibility, especially for users with visual impairments, the elderly, or users on mobile devices. The role of large fonts in improving readability is illustrated in Figure 6.

In summary, the roles of high contrast colors and large fonts in interface design are to enhance readability and accessibility, ensuring that users can easily comprehend and interact with applications or websites. These design principles contribute to creating interfaces that are more user-friendly and easy-to-use, catering to the needs of diverse user groups.



Source: This study.

Figure 5: The Role of High Contrast Colors in Improving Readability.



Source: This study.

Figure 6: The Role of Large Fonts in Improving Readability.

DESIGN METHOD BASED ON PERCEPTUAL ABILITY EVALUATION

Analysis on the Characteristics of Perception Ability

The perceptual abilities of the elderly may exhibit certain characteristics and changes at the physiological, cognitive, and psychological levels. The physiological characteristics and cognitive abilities of the elderly are critically important for the design of age-friendly smart home products. Cognition involves a series of responses by which individuals perceive the objective world, primarily including five important processes of sensation, perception, memory, imagination and thinking. Through cognitive responses to stimuli, individuals process information and achieve self-regulation. With the increase of age, various physiological functions of the elderly start to decline, and their self-regulatory capacities gradually weaken. This is manifested in the following aspects: Firstly, the visual, auditory, tactile, and motor abilities of the elderly are affected to varying degrees. Design considerations should address these physiological characteristics by incorporating interfaces and control methods that cater to them. For instance, enlarging fonts, adjusting colors and brightness, and utilizing voice controls. Additionally, the cognitive abilities of the elderly are also impacted. Learning, memory, reaction time, and thinking abilities gradually decrease. Therefore, in interaction design, it's necessary to simplify operational procedures, reduce redundant information, use easy-to-understand icons and symbols, and lower barriers to usage and error rates.

Table 1: Analysis of the characteristics of the elderly perception ability and design countermeasures

Perception type	Characteristics analysis	Concrete problems	Countermeasures for aging design
Visual perception	Vision drop	Unable to see small words, low contrast colors, or details.	1.Large font; 2.High contrast color; 3.Reducing detail; 4.Replacing words with pictures
	Reduced light adaptability	When switching from a bright to a dark environment, it takes longer to adapt.	light compensation
Auditory perception ability	Hearing drop	Most of the elderly will have a certain decline in hearing, especially for high-frequency sound sensitivity weakened. This may affect speech comprehension and communication with people.	1.Multimodal interaction form 2.In voice interaction mode, the volume and speed can be adjusted
Tactile perception ability	Reduced tactile sensitivity	The ability of elderly to perceive subtle tactile differences is weakened.	1.Obvious concave-convex touch 2.'Tactile +' interactive form
Cognitive abilities	Processing speed slows down	The elderly need longer time to understand and make decisions.	Extend the waiting time
	Memory decline	It is more difficult for the elderly to remember complex instructions, passwords, etc.	1.Reduce the interface level 2.Guidance icon

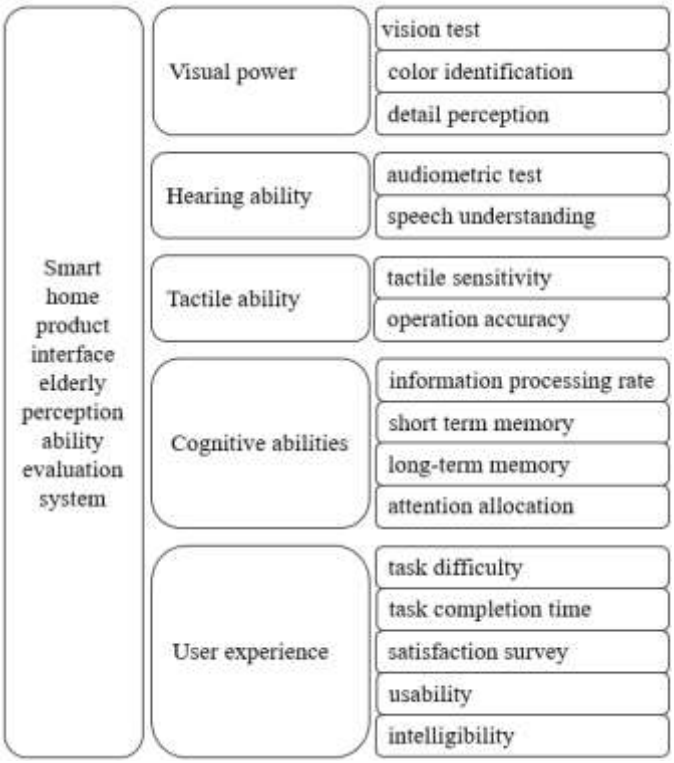
Exercise capacity	Decreased fine motor ability	Some operations that require accurate control of finger and wrist movements become more difficult.	1.increase the size of the icon 2.Increase the space between icons
Emotional and psychological	Decreased self-confidence	Due to changes in perception and motor skills, older people may feel less confident, especially when interacting with new technologies and new environments.	1.Natural interaction 2.Integration of old and new technologies
	Emotional reaction changes	Older people are more likely to be affected by emotions, which may affect their perception and experience of interfaces and applications.	1.Simulate the voice of relatives 2.Relaxing background music

Source: This study.

Taking a comprehensive view, the perceptual abilities of the elderly may undergo varying degrees of change and decline across multiple aspects. These changes need to be taken into consideration when designing age-friendly interfaces, in order to create interfaces that are easier for the elderly to comprehend and operate, thereby enhancing usability and user experience.

Perceptual Ability Evaluation Indicators

The indicators for evaluating the perceptual abilities of the elderly individuals cover visual, auditory, tactile and cognitive capabilities. These indicators assist designers in comprehending the elderly users' perceptual abilities across various domains and insightfully adapting to their needs. The evaluation of elderly individuals' perceptual abilities in a home environment primarily includes assessing the accessibility, ease of access, and completeness of perceptual abilities themselves, as well as subjective experiential evaluation after perceptual tasks are completed. The survey questionnaire consists of two parts: an evaluation of the elderly's perceived completion process of perceptual actions and a subjective experiential assessment by the participants after completing the perceptual tasks. Upon obtaining the corresponding data, through factor analysis and regression analysis, the relationship between objective perceptual abilities and subjective evaluations is analyzed, leading to the derivation of a perceptual ability evaluation framework for elderly individuals concerning smart home product interaction interfaces, as illustrated in Figure 7. By comprehensively utilizing these evaluation indicators, a holistic understanding of the elderly's perceptual abilities can be achieved, enabling designers to better grasp their needs and consequently develop interfaces and products that align with the characteristics of elderly users.



Source: This study.

Figure 7: Perceptual ability evaluation framework for elderly individuals.

Discussion on Design Methods

Based on the evaluation indicators of elderly users' perceptual abilities in the context of smart home product interfaces, and considering the current state of their perceptual abilities, this article derives three design methodologies for creating interfaces that cater to the perceptual abilities of the elderly. These methodologies are developed by integrating the evaluation indicators of perceptual abilities, aligning with interface interaction design principles, and drawing insights from case studies of smart home product designs for the elderly. Through analysis and synthesis, these design methodologies are formulated to integrate

perceptual ability evaluation indicators into the design process and create interfaces that are adapted to the perceptual abilities of the elderly.

Multi-sensory cognitive design method

The cognitive process involves information acquisition and recognition, as well as information processing and judgment. In product design for the elderly, it's essential to expand the cognitive threshold of the product, utilizing a comprehensive combination of sensory perception like auditory, visual, and tactile, promoting their mutual complementarity, and reducing the demands on declining abilities like memory. Based on the product usage scenarios, the optimal design of the cognitive path is realized through multi-sensory recognition, continuous guidance, effective assistance and other design methods to overcome the problems caused by the decline of cognitive ability.

Audio and visual aids can help users better understand and operate the interface by providing audio tips, voice interactions, and visual aids. Tactile and auditory aids can improve the accuracy of interface operations by adding feedback such as vibration or clicking sounds, and avoid users being frustrated by operational errors. Visual and tactile assistance can help users confirm the success of the operation through visual changes such as button bumps and color changes. In summary, design strategies that include high-contrast color schemes, large text fonts for visual design, adjustable audio options, clear and easy to understand voice prompts, user-friendly buttons and interface elements, and tactile feedback such as vibration or alert sounds can be applied from visual, auditory, and tactile perspectives. These strategies can expand the product's cognitive threshold, reduce the cognitive demands on users, and improve the usability of smart home product interfaces.

Rough operation interaction design method

Fine motor skills primarily involve the hands, and older adults often face difficulties with fine motor tasks due to factors like reduced vision, grip strength, and finger dexterity. In design, these challenges should be avoided whenever possible. In cases where fine motor tasks are unavoidable in product design, they can be addressed through auxiliary product design, simplifying fine motor actions into gross motor actions, and seeking alternative solutions. Simplifying fine motor actions into gross motor actions is the most commonly used and effective method in the design of products for older adults. In interface design, this method requires a deep understanding of the interaction actions themselves and multiple alternative solutions to achieve the goal of interaction.

The gross motor interaction design method focuses on the interface design for older adults and other users with limited operation abilities. It emphasizes simplifying operational steps, reducing cognitive burden, and improving usability to make digital products and interfaces more user-friendly for those who may have challenges related to vision, hearing, touch, and cognition. For example, on mobile devices or computers, providing a 'magnifier' mode for older users to enlarge content on the screen, making text, icons, and interface elements larger and clearer. Alternatively, when older users are using an application or device for the first time, providing a simplified setup wizard to guide them through basic configuration steps based on their preferences, such as language, font size, and notifications. By employing the gross motor interaction design method to optimize interface design according to the perceptual capabilities of older adults, digital products and applications become more accessible to them.

Emotional care design method

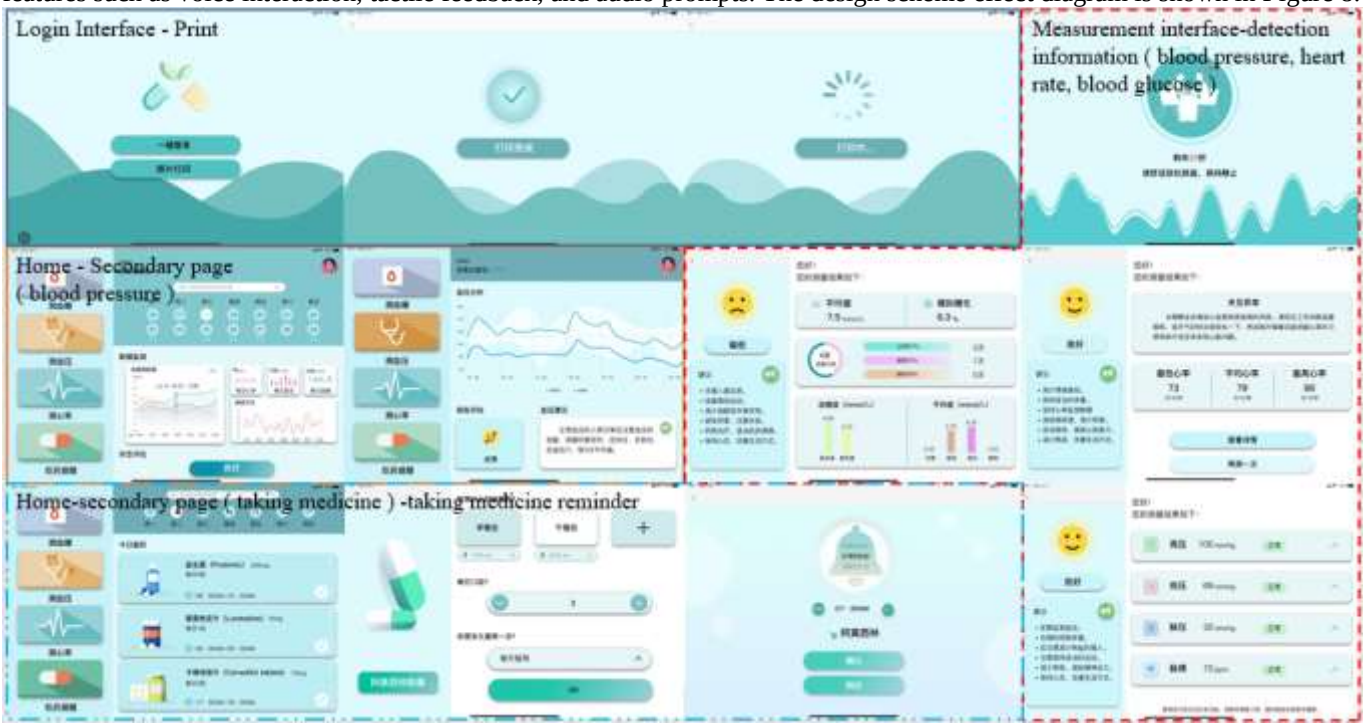
The Emotional Care Design method aims to achieve a comprehensive user experience and emphasizes the emotional connection between users and products. In interface design for the elderly, a comprehensive experience includes not only users' operational and cognitive abilities but also emotional experiences, so as to create a warmer, more welcoming, and enjoyable user experience. The goal of this method is to create products that establish an emotional connection with users, making them feel understood, respected, and cared for. The Emotional Care Design method can be applied in various fields, such as smart home products, mobile applications, medical devices, and especially when targeting older adults and users with special needs. It can improve user experiences, increase user satisfaction, and establish positive emotional connections.

User perceptual capability evaluation indicators can help understand the characteristics and limitations of users in different perceptual domains. By understanding the visual, auditory, tactile, cognitive abilities of older adults, interface and feature designs can be optimized accordingly using these evaluation indicators to enhance usability and comprehensibility. Firstly, emotional elements can be incorporated into the design. By applying user perceptual capability evaluation indicators, the Emotional Care Design method can integrate appropriate emotional elements into the design process to provide interfaces and experiences that align more closely with user expectations. Selecting suitable emotional elements, such as friendly icons, welcoming language expressions, warm colors, etc., can increase interface recognizability, readability, and usability. Secondly, responsive design with a focus on tactile feedback. Based on user perceptual capability evaluation indicators, design responsive interface elements to ensure that older users can easily click, swipe, or touch. Incorporate tactile feedback to provide users with positive tactile sensations during interactions, enhancing satisfaction. Additionally, personalized and guided interaction design can be employed. According to user perceptual capability evaluation indicators, provide personalized settings options, allowing older users to adjust based on their perceptual capabilities, reducing cognitive burdens. Design guided interactions to lead users in gradually adapting to the new interface, making their cognitive adjustment more comfortable.

DESIGN CASE AND CASE ANALYSIS

Intelligent Medical Box Interface Design Case

Interface design was carried out for a smart home medical box product for the elderly, based on the design methods mentioned earlier. In the design process, careful consideration was given to the characteristics of the perceptual abilities of older adults. The interface is kept simple and clear, with large text, a maximum of three layers for accessibility. Additionally, it incorporates features such as voice interaction, tactile feedback, and audio prompts. The design scheme effect diagram is shown in Figure 8.



Source: This study.

Figure 8: Intelligent medical box interface design effect diagram.

Design Case Analysis

At the beginning of the design, some well-known smart home brand products were selected, such as Google Nest Hub, Amazon Echo Show, Apple Home Pod and other interactive interfaces. From the aspects of user interface design, interactive operation design, functional design, accessibility design and user experience, it is found that some user interfaces have problems such as complex interface, cumbersome operation, too small font, untimely feedback, and dislike of the elderly. At the same time, some advantages and innovations are also found, such as voice interaction, beautiful interface and diverse functions.

In the design of the interactive interface of the intelligent medical box, the creative design points based on the evaluation of perceptual ability are mainly reflected in simplifying the interface level, blue-green color matching scheme, guiding icon, reasonable interface layout, icon size matching, visual and auditory linkage and other aspects.

First of all, on the basis of investigation and perception ability evaluation, the product function is analyzed hierarchically, and the design is in a three-tier interactive interface, such as the user login interface on the home page of the interface, which can realize one-click login and picture printing function. After clicking the picture print icon, there will be result prompts during the printing process or the completion of the printing. The interface after login is the main interface that integrates all the functions of the product. The layout of the main interface is simple. Through the guiding icon with picture and clear text, the user can enter the interface of 'blood glucose measurement', 'blood pressure measurement', 'heart rate measurement' and 'medication reminder' at a glance. The third layer of the measurement interface has a graphical visualization of the measurement tips, as well as with the 'smile' expression of the results suggest that both cordial and eye-catching. All the functions are realized in the three-layer interface, which greatly reduces the difficulty of operation and improves the ease of use of the interface. The use of guiding icons improves the readability and identifiability of the interface.

Secondly, the interface adopts a blue-green color scheme, and the warm and cold colors are balanced. Blue and green belong to cold colors, which are usually considered to have the characteristics of calmness, relaxation and comfort. Combining these two colors can achieve a balance between cold and warm colors, so that the interface looks neither too cold nor too warm, which is in line with the aesthetic preferences of elderly users. Blue-green color matching is not only natural and environmentally friendly, but also has high visual comfort, which makes users who use products or applications for a long time less likely to feel visual fatigue. Therefore, blue-green color matching has certain advantages in user experience. In addition, blue is usually associated with professionalism and credibility, so in many fields, the blue-green color scheme of the interface can convey the credibility and professionalism of the product. At the same time, blue-green is also easy to identify.

In addition, the case also uses a combination of graphic and voice sensory linkage design. Pronunciation results can help users with visual impairment or reading difficulties to obtain information more easily. At the same time, the graphic results can be

viewed by other users to meet various accessibility requirements. Moreover, users can choose whether to read text or listen to voice according to specific conditions and needs, which provides a more flexible user experience. And voice can also interact with users, such as answering questions or providing suggestions, thereby enhancing user engagement and interactivity.

RESULTS AND PROSPECTS

The application effect of the perception ability evaluation method in the interactive interface design of aging smart home products is significant. By integrating the perceptual ability evaluation method into the design process, we can better understand the capabilities and limitations of elderly users in different perception fields, so as to optimize the product interaction interface and provide a more suitable user experience for them. First, the perceptual ability evaluation method can help identify the visual, auditory, tactile and cognitive challenges of older users, so as to adjust the interface elements in a targeted manner and improve recognition, ease of use and readability. Secondly, based on the evaluation results of perception ability, the design can provide personalized setting options, so that elderly users can adjust the interface according to their own perception characteristics, so as to provide a more suitable user experience for them. Third, the perception ability evaluation method can guide the design team to choose the appropriate emotional elements, such as friendly icons, warm colors and friendly language expression, to enhance the emotional resonance between the elderly users and the products. Fourthly, by simplifying the interface design and reducing the operation steps according to the cognitive characteristics of the elderly users, the cognitive burden of the elderly users can be reduced, so that they can use smart home products more easily. Fifth, the combination of perceptual ability evaluation method and emotional care design method can create a more humane, warm and caring user experience, so that elderly users feel respected and valued.

In the future, further improvement and optimization of the interactive interface design of aging smart home products need to consider the perception characteristics, cognitive ability and emotional needs of elderly users, as well as the continuous development of technology and design trends. For example, try to introduce more gesture recognition and voice control technology, so that older users can interact with smart home products more naturally and reduce dependence on complex interfaces. Virtual reality (VR) and augmented reality (AR) technologies can also be used to create a more intuitive and visual interface to help older users better understand and operate product functions. And further emphasize the participation of elderly users in the design process, through user research, feedback collection and user testing, continue to optimize the product interaction interface to ensure that it meets the actual needs of elderly users. In conclusion, further improvements and optimizations in age-friendly smart home product interface design necessitate a comprehensive consideration of user needs and technological advancements. The goal is to create interfaces that are not only more user-friendly but also closely aligned with user preferences. With technology continually evolving and the aging population trend intensifying, ongoing design innovation will play an increasingly vital role in improving the quality of life for elderly users.

CONCLUSION

This study, based on interviews about user requirements for smart home product interfaces, analyzed the behavior, emotional changes, and pain points of elderly individuals during their use of smart home product interfaces. It identified the characteristics and changes in the perceptual abilities of older adults at the physiological, cognitive, and psychological levels, and summarized an evaluation system for the perceptual abilities of elderly individuals in smart home product interfaces. Building upon the principles of smart home product interface design, it explored design methods based on perceptual ability evaluations, providing a reference for the design of smart home product interfaces for the elderly.

Tailored to specific home product usage scenarios, aimed at improving the elderly user experience and based on the guarantee of function reachability, the study, guided by the results of perceptual ability evaluations, optimized cognitive pathways, implemented coarse operation-based interaction design, reduced the demands on cognition and fine motor skills, and used emotional care and other design methods. This resulted in the design of an elderly-friendly smart medical box interface. Overall, these efforts comprehensively enhanced elderly users' satisfaction with smart home product interfaces.

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