

# Interaction Design of Smart Home Products for Aging Governance

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**Abstract**— Aging has become a general trend in modern society. Through technological changes, smart home products in the home environment can solve many problems in the process of aging governance, provide an environment where everything is connected, and meet people's physical and psychological needs. But in general, smart home products are still in the early stage of development and "aging", many related problems are still there and the ecological environment is not yet formed. This paper analyzes and innovates smart home products for the elderly from the perspective of user needs, design rigid needs and so on, hoping more smart home products can be driven by technology and become more interactive and suitable for the elderly.

**Keywords**— Interaction; Smart home products; The elderly.

## I. FAMILIES AS AN IMPORTANT SCENE OF AGING GOVERNANCE

The phenomenon of population aging in China is intensifying with the change of the population structure. There are lots of research and analysis about the governance system devoted to the theme of aging in the academic circle, mainly focused on macro issues like economic development, birth rate, etc. On the whole, the level of healthy aging is higher in the south and lower in the north, while higher in the east and lower in the west. The overall construction level is low, and the development among regions is uneven. The construction of urban healthy aging in China is seriously lagging behind the urbanization process. The vast majority of urban infrastructure and public facilities serve healthy people, without considering the needs of special groups such as the elderly and the disabled. [1] This is not only related to the regional economic level and construction process, but also to the distribution of public resources in local communities. For example, megacities have a large number of migrants, and the competition for public health care resources is fierce. [2]

In the face of an aging society, China's pension system must be accelerated to improve and complete in line with the current situation. However, for different regions with long-term differences in development levels, it is necessary to realize the same level of service-oriented aging governance in public areas as soon as possible. It is also a major agenda that requires time for resource allocation, renovation and construction. At the same time, the ways in which individuals can change and optimize ageing governance at the family level are becoming easier and more feasible. Focusing on the micro-level of aging governance, the family is one of the important governance scenarios. With the increase of age and the decline of physical

function, the sphere of activities of the elderly is narrower than that of the young. For the elderly and the elderly with partial dementia, their home is their main living space. The residential area is much smaller than that of the community and society, and the factors that need to be considered in the design and planning are more controllable, and the targeted layout can be made according to the physical and psychological conditions of different elderly people more quickly and comprehensively, so as to achieve the effect of being suitable for the elderly. Especially in recent years, the outbreak of the Coronavirus pandemic has forced many people to stay in a specific indoor environment for a long time under various isolation measures. When the subjective initiative of individual behavior is amplified, the frequency of use of smart products increases, and the function of offline interpersonal communication is limited, which has concentrated on amplifying the common living problems of the elderly, such as hidden dangers of living alone, communication barriers, and difficulty in obtaining information. Therefore, even though the scope of the family is small, managing a suitable home environment for the elderly can greatly improve the quality of life of the elderly and achieve the effect of rapidly increasing the happiness of the elderly.

## II. HOME ENVIRONMENT CONSTRUCTION UNDER THE BACKGROUND OF INTELLIGENT COMMUNICATION

Technological changes have optimized the environment. Internet of Things, big data, cloud computing, artificial intelligence, 5G and others as the technical support in the era of intelligent communication, take the smart home as the carrier to provide a new dimension and level for the construction of the home environment.

On the whole, home construction needs to be considered and prepared from the perspectives of rest, social interaction, and daily life, while the background of the era of intelligent communication has affected the construction and layout of the home environment from these different perspectives. In the bedroom, the construction of the intelligent lighting system can measure the user's behavior pattern according to the sensor and change the brightness and light-off time according to the measured data; the intelligent indoor temperature adjustment can automatically adjust the working mode according to the room temperature and time period, so that people are always in a comfortable environment; the intelligent wake-up system can control the opening and closing of the curtains and the gradual wake-up of the alarm clock at the specified time, providing the most completely relaxing environment in the most biologically

suitable way. In the social-oriented living room, various intelligent voice systems combined with electronic screens provide people with customized entertainment channels. Whether it is a home KTV or a private theater, the existing smart devices can almost satisfy all entertainment needs without leaving home. In the field of daily life, intelligent robots with cleaning functions can be connected to the Internet and clean the floor according to the type of house floor and prevent collisions. The intelligent temperature control of the bathroom and a series of cooking functions in the kitchen can also be semi-automated at personal wishes.

The Internet of Everything provides not only the interconnection between objects, but also the interconnection between data, people and processes. [3] It allows the home environment to have the concept of "ecological circle". From the perspective of the scene ecology, in the smart home scene, the needs of consumers are complex and diverse, and no company can guarantee that it can meet all the needs. In order to realize the full-scene experience of scene personalization and ecological customization, it is inseparable from the construction of "ecosystem". [4] When the experience of different scenes can reflect the continuity, the light at the entrance will automatically light up when the door is opened; when the bedside light is turned on, the air conditioner automatically adjusts to sleep silent mode. The customization of these details will be able to optimize our living environment, simplify trivial matters and increase people's happiness.

Internet of Things can facilitate the interaction of smart homes by collecting information and uploading it to a specific platform for analysis and feedback. Taking a set of smart home health care system as an example, it can integrate medical equipment such as blood pressure monitor, body fat scale and blood glucose meter into one. After the human body indicators are detected, the obtained physiological data such as blood pressure, blood sugar and body fat are forwarded through the gateway and stored in the health cloud platform database. The server software will display the data on the platform and re-feed back to the user through big data processing and analysis. Therefore, both users and medical institutions can log in to the cloud platform to observe and compare changes in the user's blood pressure, body fat and blood sugar in real time, and timely formulate improvement plans and treatment measures for different users' physical conditions. [5] The characteristics of intercommunication and integration increase the things we can do in the home environment. The simple physical examination that once had to go to the hospital often can now be replaced by the assistance of smart homes. In the 5G era, the convenient data interoperability of the cloud platform improves real-time and sharing, and the data exchange can quickly contact public medical resources when necessary, which will greatly save the time of pre-check and improve the efficiency of people's daily life.

In addition to hardware support and explicit convenience, smart home products can also take care of people's psychological needs. The combination of artificial intelligence and big data can provide timely feedback on people's psychological preferences and potential needs. Personalized recommendation is a psychologically oriented service method

for smart homes, and algorithms have played a huge role in the fields of audio and video. Whether it is a Bluetooth speaker equipped with a network with the function of "guess what you like", or a smart TV pushes the preference memory of the householder, the higher people's usage, the more accurate the directional recommendation of big data. It goes round and round to get people's psychological preferences satisfied in the smart home medium system. Coincidentally, taking the voice robot as an example, people can meet some social needs through simple dialogue with the robot. The robot has sufficient time and energy, and can realize simple intelligent companionship according to the user's living habits and personalized settings. The intelligent companion robot born from social needs even needs to have a friendly and pleasant visual experience. The shape, color and material design should be as fresh and soft as possible to reduce the inherent rigidity and indifference of high-tech products and make it easy for users to accept. [6] These cares for people's psychological needs in terms of design and technology application have greatly improved people's acceptance of technological products.

Although technology may also have negative effects, for example, after the extensive use of voice robots, people's social stickiness may be weakened, but no technology will stop its development due to its potential risks, and the construction of the ecological environment of smart homes will also become the trend. We might as well explore more actively how to improve the interactive construction of smart home for the elderly, so that it can better meet the needs of people of different age groups, and it is truly convenient for the people with its stronger service, so that people can dispel their doubts after benefiting from it, integrate technology into life and make life better.

### III. PROBLEMS AND DEFICIENCIES OF "SUITABILITY FOR THE ELDERLY" OF SMART HOME PRODUCTS

As a sub-category in the smart home environment, smart home products for the elderly market occupy an important position in the aging market. But is smart home really "appropriate for the elderly"? Smart homes on the market are often dominated by young people. They are the most tolerant and accepting of new things, and they are the fastest to learn how to use new technologies. Especially for the Z generation crowd, their birth and the development of the network information age stand on the same starting line, they are greatly influenced by Internet application products like smartphones, and they are also more curious about the constantly changing new products. Smart home products can easily open a breakthrough and gain market access among them. In contrast, the elderly have different physiological and psychological conditions, different degrees of acceptance of technology, and limited access to information. Not only are they difficult to access smart home products that suit the elderly, but even if they are exposed to them, it is easy for them to give up using the products due to price issues, physical sensation issues and other reasons.

Considering the group characteristics of the elderly, the basic characteristics of smart home products that's suitable for the elderly are: simple interaction mode, large character design,

multi-function realization, safe appearance design, moderate price and so on. This is related to the value orientation of the elderly. They no longer work, their incomes decline, and their spending power is weakened. At the same time, they often have the awareness of saving money for their children and grandchildren. The way too high prices of products will directly cause the losing of the market and can no longer continue to impress the potential consumer. This is also related to the physiological characteristics of the elderly. As the age increases, the difficulty of learning emerging content will also become higher. If it has multiple functions and is not easy to acquire, it's easy for the elderly to feel frustrated when trying out. And because the cost of learning is too high, they would ultimately give up learning.

Starting from the psychological status of the elderly, most of the elderly still hope to give full play to their social value after retirement, gain respect and recognition from others by participating in various social activities, and meet their own needs of belonging. Some elderly people will take the initiative to help the younger generation to take care of the children, and some elderly people will devote themselves to volunteering, so as to avoid being out of touch with the development of society. Therefore, the relevant smart home design should avoid excessively affecting the living habits of the elderly, focus on assistance, not excessively interfere with the normal activities of the elderly, and help the elderly to complete the life plan they choose. At the same time, the life course theory points out that the events experienced by the individual before and after affect each other, and the old life is the continuation of the entire growth process of the individual. The thinking and way of dealing with problems of the elderly will basically be consistent with their previous thinking and way of dealing with problems. [7] the application and understanding of smart products by the contemporary elderly is very limited in the past, it is normal for them to lack the use of logic and subconscious correct judgment when facing new smart home products. As a smart home product, it is necessary to improve its adaptability to the elderly, we must pay attention to the use logic of intelligent products, avoid setting buttons according to the commonly thinking way of young people, but consider more natural logic, and take human biological instincts into account, so as to increase the probability of adaptation for the elderly.

Starting from the physical condition of the elderly, there is a big difference between the elderly and some elderly people with dementia and disability in their demand for smart home products. For the elderly people, their barriers to interaction requirements are relatively small, and their expectations for smart home products will focus on making their lives more comfortable and convenient, such as being able to read small characters aloud by voice, and recording and reminding some important information at anytime. At this time, as a smart home that can make life better, parity and practicality have become two important driving points for it to open up the market. It doesn't need all-round life-assisting hardware, but only needs to provide soft assistance according to some of the user's defects, can improve the living standards of them. For some elderly people with dementia and disability, the hardware of smart home products will be more important. As the motor

function of the elderly declines and the metabolic capacity weakens, some medical and health needs and the functions of auxiliary prosthetics also need to be reflected in the smart home. At this time, smart home needs to be designed more in terms of safety and customization. Different elderly people have different ranges of disability and different life needs, so they need customized help. The price control and the mutual restriction of convenience level bring many challenges in product design. For some elderly people with dementia, their ability to cope with and deal with problems will decline even more. If they encounter problems during use, they are more likely to feel at a loss, and if they cannot use smart products correctly, they will not be able to enable smart homes. The product's assistance to the elderly will cause adverse consequences over and over again. Therefore, a more natural and interactive operation method in line with the human biological instinct will become an important smart home design condition for the elderly.

But no matter what kind of product it is, the principle of "being suitable for the elderly" should try to simplify the interaction mode as much as possible. Through the blessing of technology, the elderly can learn to use smart homes into a smart home that is more suitable for the elderly. The instinct to interact naturally becomes the instruction manual for "age-friendly" products.

In terms of "suitability for the elderly", there are many problems in the current smart home products on the market. Different brands specialize in different smart home directions, but to form the most ecological series of smart home products requires multiple linkages. But the operation command mode is very different, and the data connection between competing products cannot be opened up, which has become a major problem. In order to meet the relatively high difficulty of learning and operating new products for the elderly, the whole house can only be achieved by using a full set of smart home products under the same brand, tolerating some defective product designs or waiting for products that have not yet entered the market to achieve the concept of "ecosphere". Only by using the power of technology as soon as possible to open up the cooperation and connection between different brands, to improve the convenience of product use and reduce the difficulty of learning and operation, can more elderly people develop the habit of using smart home products and create more demand for the market. In turn, it will promoting the design optimization of market products positively.

In terms of price, the sense of technology and new ideas are important targets for smart home products, but this also means that the product positioning of smart home products is always between necessities and luxury goods. That said, for the vast majority of the elderly with reduced spending power, the probability of active choice has dropped. Accelerating technological development and shifting brand positioning from mid-to-high end down to help more middle-aged and elderly people enjoy a higher-quality elderly life should be the development goals of related companies.

In terms of safety, smart home products combine the characteristics of "suitability for the elderly", which are mainly reflected in the sleek appearance and safety in material



selection. When the elderly use smart home products, they may accidentally damage the products due to improper operation. When the products are damaged, they should try to consider in advance and avoid potential secondary injuries, such as whether the glass display is designed with safety glass to prevent injury to the main body; whether the material is resistant to falling and not easily deformed to produce sharp corners and so on. The simple and convenient interaction design can also reduce the difficulty of using the elderly from the operation level, thereby increasing the actual use efficiency and safety performance of smart home products.

#### IV. BASED ON THE PERSPECTIVE OF "INTERACTION" TO IMPROVE THE "SUITABILITY FOR THE ELDERLY" OF SMART HOME PRODUCTS

Because the media literacy of the elderly is lower than that of the young, the "digital divide" has become an important obstacle for the elderly to choose smart home products. When facing the prompts issued by smart products, the elderly cannot immediately identify the difference between the advertisement and the data report of the product itself, and are more likely to be deceived. Some interfaces that induce downloads and are difficult to close are just laborious for young people, but for the elderly, they may be the culprit that makes them feel overwhelmed and resist smart products. From the perspective of "interaction", the producer needs to make profits, and the placement of advertisements cannot be completely eliminated, so the user or his/her children can pay an additional fee to obtain another more easily identifiable advertisement placement model or a monthly payment model. Completely buying out advertising promotion can help the elderly to better adapt to the interactive mode of smart home products and enjoy a new media environment suitable for the elderly.

After the interactive environment is opened, the convenience of human-computer interaction also needs to be considered. Taking a smart TV as an example, the buttons on the remote control are clustered together and the functions are written in a small way for the sake of appearance and suitable size. Although the TV screen is huge, in terms of practical use, such a product is not suitable for the elderly. Therefore, more products that pursue "suitability for the elderly" have begun to rely on "natural interaction" design. Natural user interfaces allow users to interact with products using their various natural sensory channels, and this interaction is naturally efficient and imprecise, so natural user interfaces are also understood as intuitive interactions in some cases. [8] Based on the perspective of natural interaction, the existing technologies have been able to realize a lot of multi-channel interactive product design, but due to the limited sensor function, it often requires a large amount of action to sense "multi-sensory interaction", so it is not really suitable for the elderly. To be more precise needs to start from technical means and product design, and increase the accuracy of the sensor under the premise of controllable cost and price. Taking eye-tracking technology as an example, if the elderly are accustomed to the reading habit of turning pages on paper, then when designing smart home products, some display screens can realize natural interaction through sensors. When it is detected that the reading

progress of the elderly has reached the content in the lower right corner, it can automatically jumps to the next part of the content, so that the elderly can read from the upper left corner again. Machine vision such as face recognition and expression recognition can be placed on intelligent health detection equipment, and each person corresponds to a set of body data, which can not only maintain the privacy of personal data, but also feedback the unexpected physical condition of the elderly to the relevant medical system at the first time. This kind of smart home, which subtly improves the convenience of the elderly's life, is really suitable for them.

Natural interaction enables the elderly to have the ability to process information naturally without deliberate learning, which will enhance the initiative of the elderly to use smart home products. Most of the elderly in this era lack the requirements and imagination for using smart products. They were born before the age of intelligence, but live in the moment of data explosion. They are more passively accepting the development of science and technology, rather than actively proposing the possible development direction of science and technology. Therefore, the designer also needs to make a correct guess on the psychological needs of the elderly in the face of "intelligent interaction" through further understanding of cognitive psychology and behavioral psychology, so as to improve the product's suitability for the elderly.

Like the youth group, the elderly will also develop curiosity and thirst for knowledge when they first learn about new smart furniture products. In addition, due to herd mentality, in order to reflect that their "social values" still exist, to maintain social relations that keep pace with the times, and not to be out of touch with society, the elderly have the potential to actively explore smart home products. As mentioned above, as the age increases, the range of activities of the elderly will become more limited, the family environment will become their main activity space, and the application of household products is also a kind of rigid demand, from this perspective, it can be more practical to urge the elderly to accept such high-tech products.

At the same time, because the elderly are frequently interfered by the younger generation when using smart products--these younger generations are either out of kindness or being asked for help, and their stronger learning ability and more digital usage habits often allow them to explore faster than the elderly themselves. However, the universality of this behavior pattern will leave a stereotype that the elderly cannot use smart products by themselves, and will bring negative psychology to the elderly group, making them think of needing the help of the younger generation instead of trying to figure it out themselves when they encounter problems. But in fact, many elderly people are actually capable of self-adaptation and learning. They just need a breakthrough to get rid of this psychological barrier and take the initiative to try.

In the interactive design of smart home products, it is necessary to grasp the curiosity of the elderly, understand the social and psychological needs of the elderly, protect the self-esteem of the elderly, and follow the thinking mode of the elderly in order to improve "suitability for the elderly". The functions shouldn't be too complicated and it shouldn't cause excessive learning pressure. It should be in line with the

background characteristics of the current era, taking care of the average learning ability and flexibility of the elderly and let the technology fit the natural behavior of people.

#### V. INNOVATE THE "SUITABILITY FOR THE ELDERLY" FUNCTION OF SMART HOME PRODUCTS

According to the data in the "China Media Industry Development Report (2021)", the penetration rate of the Internet among the elderly is increasing year by year. As the penetration rate rises, the elderly will no longer be a marginalized group in the smart age, a new cultural group for the elderly is taking shape, and the elderly will gradually increase their acceptance of the smart age lifestyle. With the increasing recognition and acceptance of smart home products by the elderly, the perspectives of innovative smart home products are also more diverse and younger. Starting from the classification of smart home products, smart home products can be divided into lighting, music, video, temperature, energy saving, anti-theft, total control and other categories. Some of them are intelligently mobilized from a multi-sensory and personalized perspective, and some are intelligently guaranteed from a security perspective.

For smart home products with stronger suitability for the elderly, special attention should be paid to personalized settings to improve the quality of life of the elderly, and use the smart network system to assist the memory habits of the elderly, increase the comfort of life. In terms of safety, it is also necessary to provide the necessary protection mechanisms for the elderly to guard against accidents. The "suitability for the elderly" function of innovative smart home products is also mainly explained from the two aspects of personalization and security.

Personalization needs to be adjusted in time according to the changes and needs of the characters. For the elderly with different physical conditions, smart home products need to have the ability to integrate different functions and present multiple modes in permutations and combinations. Everyone will grow old, but everyone has the right to disobey the old. What smart home products can do to help the elderly is to help the elderly make up for their physical weakness and maintain the average quality of life of them. In terms of information acquisition, smart home products can supplement the function of reading aloud, and use the natural interactive questioning function to retrieve and feedback some knowledge points that the elderly do not understand, helping the elderly with vision loss to keep up with the trend of the times and read for them. From the perspective of lighting and ventilation and other people who generally lack intelligent awareness, the memory attributes of smart home products can be innovated. Based on regular time changes, different light effects and ventilation environments can be prepared for the elderly at different time periods. Open windows for ventilation at specific times during the day; automatically turn on lights in the evening; dim lights and close windows at night to promote the sleep quality of the elderly. Especially in uncertain weather, smart home products can also automatically collect and dry clothes, irrigate plants, etc. based on the feedback of networking and sensors. Smart home products with social functions will also become the

general trend. Elderly people who live alone without children or those who are not easy to go out due to physical reasons still have social needs. Smart AI can now realize simple conversations with people. If this feature could be widely used to empower smart home products, it will be able to meet the communication needs of the elderly, while according to some dialogues to determine whether the elderly have the tendency of mental illness, and the warning intelligence will be included in the health file of the elderly. Of course, any technology serves people. If the elderly want to exercise by doing some housework when they are in good physical condition, the smart home products can also be transformed into a reminder mode, such as informing the elderly about the climate change that day, the plant water content, major news, etc. In that way, it will truly meet the needs of the elderly group, rather than fully replace human work.

Security is even more important than personalization. It is reflected in the prevention of problems before they occur, and the last checkpoint for the safety of life and property of the elderly. For some elderly people with severe dementia and disability, if they can achieve the intelligent features of one-time setting and long-term storage of water temperature control, they can prevent scalds and colds. In addition, there are also smart door locks, portrait recognition and other safety devices that automatically match the work according to physiological characteristics, which can also protect the safety of the elderly. Including safe smart home products' design on helping the elderly with limited mobility, smart home products that assist walking and is convenient for the elderly to ride, should be equipped with the feature of infrared recognition of obstacles to prevent the elderly from turning over due to uneven ground or obstacles that the elderly do not see clearly in time. With the help of the deep learning technology of smart home products, smart home products should also be more convenient to use every day. For example, smart home products that assist the elderly to move should be able to identify locations where obstacles often appear, slow down in advance, or issue a prompt sound; and medical assistance. Medical aimed smart home products for the elderly should be able to give medication reminders and change notifications in a timely manner according to the user's medication status and fluctuations in physical condition, and should be able to realize the function of one-click help or automatic help when necessary. These interactive features hidden behind the technology will become the underlying logic of products that intelligently assist the elderly.

The above-mentioned innovative prospects for smart home products are based on helping the elderly reduce the memory burden and maintain their quality of life. The specific degree of realization still depends on the subjective will of the user to determine the degree of penetration of the machine into their life. The power of technology is to guide, not to replace. Only by allowing more elderly people to experience and recognize the assistance of technology to a better life can we promote the development of the technology industry in this direction, empower smart home products in the context of aging governance, and innovate better smart home products.

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