

Interaction Design of Products for the Elderly in Smart Home Under the Mode of Medical Care and Pension

Minggang Yang^(✉), He Huang, Haozhou Yuan, and Qichao Sun

School of Art, Design and Media,
East China University of Science and Technology,
M. BOX 286, No. 130, Meilong Road, Xuhui District, Shanghai 200237, China
{yangminggang, 1983222hh}@163.com, dfyhz@vip.qq.com,
871778027@qq.com

Abstract. The problem of aging population in the world is increasing. Elderly health, daily life and other aspects of the problem with modern information technology, intelligent service facilities or product do not match the contradiction is increasingly prominent. At the same time, sensory function and action ability of the elderly are in the continuous degradation. Their cognitive and learning level is limited, which leads to experiencing smart home hardily. Therefore, it is imperative to study and improve the interaction design of smart home products for the elderly. In this paper, the contradiction between the design of smart home products and the demands of the elderly in daily life is studied under the mode of medical care and pension, as well as case analysis of smart home products for the elderly. The purpose of the paper is to study the type and interaction design of smart home products for the aged. The main method is through the investigation and user analysis of smart home, finding the principles and characteristics of interaction design from the products. Research shows that intelligent products can be divided into three types under the mode of medical and pension: smart home appliances, smart home management system and call monitoring system. Through the mobile Internet, intelligent terminal and touch screen control, smart home can meet the needs of the elderly users seamless, which will be a trend in the design of smart home products.

Keywords: Mode of medical and pension · The elderly · Smart home products · Interactive design · User experience

1 Introduction

The global economy and industry are in the development as well as the rapidly changing modern life. People's material life is enriched more and more while a series of problems brought by aging are still uncovered. In the contemporary social life products and the information product innovation, the elders cannot easily enjoy the life changes brought by the reform of science and technology. The life class medical supplies close to the daily needs of the elderly are simplex to function, lack of designing factors and quality is poor. Such as the elderly hearing aids, cane and bath products. The purpose of assisting

the elderly life is not really realized. Meanwhile, the smart home products for elderly have entered the public view and are in the continuous research and development stage. However, it needs some time and inspection for these products to really enter the daily life of the elderly. The elderly physiological and cognitive learning level is unceasingly in the recession, their physical decline and memory is poor. Based on these problems, concern and care should be highlighted in the interactive smart home products experience.

In November, 2015 the government launched China medical support combined with new pension model, which is to promote the health and pension services combination. Take pension as the main aim and medical service as auxiliary to drive the transformation of the whole social pension system upgrade and to maximize the use of social resources, in order to better serve the health of the elderly life. The demand of the elderly smart home products under this policy will be growing. On one hand, application of the smart home products can offer the convenience of the elderly living environment, strengthen communication with outside world, at the same time, the smart home system service to the elderly can reduce the cost of human resources and alleviate the pressure on the family and social old-age pension. On the other hand, the safe and convenient smart home furnishing life could help old people to improve their independence and quality of life and enhance the recognition and their sense of happiness in old age psychological downturn. In addition to the technical, economic, ecological construction and improvement, smart home product development and popularization should be constructed between the smart home and the elderly, and the smart home system with interaction design is particularly important.

This paper explored the Smart Home Furnishing products elderly interaction design. The work of this paper and the main results are summarized as follows: 1. Define the concept and characteristics of smart home furnishing products interaction design for elderly under the mode of raising and medicine combination on the basis of literature review. 2. Research the existing elderly smart home products by case analysis method, and carry out user interviews and questionnaire survey through the analysis to obtain the factors affecting the interaction design of elderly smart home products, and summarize the principles of interaction design from description of three aspects: sensory identification, cognitive function and associated behavior. Finally, discuss the improvement strategies and suggestions of interaction design of smart home furnishing products for elderly.

2 Research Background

The “2015 the global retirement index” published by Natixis Global Asset Management (Contains the 20 performance indexes including retirees financial status, health, safety and comfort of life, world economic environment etc.) indicates that Switzerland is the world’s best national endowment. The 10 countries with the highest score of the pension, there are as many as 8 from Europe. Norway rank second, Australia rank third. The Fourth to tenth are Iceland, Holland, Sweden, Denmark, Austria, Germany and New Zealand. As to the Asian countries, South Korea ranked the highest as fourteenth.

In addition, Japan rank seventeenth, Singapore is thirtieth and the United States rank nineteenth.

At present, there are 4 main kinds of typical international pension service system, particularly represented by the United States, Japan, Sweden and Hong Kong, see sheet1. Foreign pension industry started early and developed rapidly, thus they have formed a relatively complete industrial chain and achieved a certain scale of the industry. The pension industry of the United States has become vitality and cannot be ignored is the aging society. It supports economic and social growth. The pension industry in Japan takes the aged care industry as the main line, covering a wide range from the welfare services to the value of life.

China National Bureau of statistics data show that by the end of 2014, Chinese people over the age of 60 has accounted for 15.5 % of the total population, reaching 212 million. It is predicted that by 2050, the elderly population in the world will reach 2 billion 20 million. The Chinese elderly population will reach 440 million, accounting for almost 1/4 of the world's elderly population. According to "China Aging Industry Development Report (2014)", during 2014 to 2050, the consumption potential of China's elderly population will grow from 4 trillion CNY to 106 trillion CNY accounting proportion of GDP will increase from 8 % to about 33 %. China will also become the country with the most potential in global aging industry. In general, China pension services are still in the early stages of development. Pension services and product supply shortage problems are serious. At present, the development of the urgent needs of the elderly life care, long-term care, spiritual comfort, culture and entertainment services are relatively slow. In December 2011, the Ministry of civil affairs of China promulgated the social old-age service system construction of "Twelfth Five Year" plan. It clearly put forward that by 2015, China will realize a social old-age service system with perfect system, perfect organization, moderate scale, good operation, excellent service, supervision in place and sustainable development. In July 2015, China's State Council promote the smart health care industry development and smart combination of medical care will be the future direction of development of health service system in actively promoting "Internet + action guidance".

With the popularization of the Internet technology, smart home furnishing products have entered the era of rapid development. The application of RFID technology, wireless sensor network, network cameras and other technology will change traditional old-age home in the future. Smart home such as smart medicine box, remote nursing system, smart food procurement system applications will also gradually mature in the future. The old man can complete a certain degree of self-care through their own activities, and their children can also observe the living conditions of the elderly through the remote monitoring. In general, with the increasing popularity of technology and progress, smart home system of the old in the home care, medical health monitoring, the elderly at risk prevention field elderly smart home plays an irreplaceable role in future pension field (Table 1).

Currently the Chinese market for the elderly design of intelligent home is not enough. Part of the smart home furnishing is independent of the individual like an information isolated island. There is no full interconnection, intercommunication and interoperation. It doesn't blend into the overall home design. The smart home for the elderly in the interaction design field did not fully realize mutual integration of person,

Table 1. Sheet 1 comparing of four typical pension service systems worldwide

Mode	Characteristics
The new liberalism service system (USA)	Introduce market mechanisms to reduce the responsibility of the government; take the civil service agencies as the center and emphasize the care and help among each other
Diversified service system (Japan)	The common participation of government, family, community, work units, non-governmental organizations, service units and main body diversification; stress the role of the family while the state investment in welfare is ignored
Uniform service system (Sweden)	The state makes the standards for all the national welfare service to provide unified services to all citizens through public welfare institutions, which leads to increased financial burden
The government based integrated service system (Hong Kong)	Emphasize the responsibility of the government and strengthen the community care

Origins: Juan [5]

matter and environment. Old people's increasing age will also have many problems. On one hand, aging of the physical function causes movement coordination and sensory ability weaker and weaker. Their prevalence of risk and number are in increase, and some of the diseases are difficult to cure. On the other hand, due to the age increases, psychological problems are more prominent. Elderly people are lack of awareness of the outside world, prone to loneliness and anxiety, not willing to accept and learn new things. Because of these physiological and psychological problems, there constitute a barrier for older people to use the smart Home Furnishing. According to the survey, more than 50 % of the problems the elderly encounter in daily life are potentially associated with product design. Only 53 % of them are well trained to use good products to meet their needs. From this aspect, the application of smart home can indeed bring a lot of convenience to old people in the future, but in which should pay attention to and study are the elderly user experience and interactive behavior. To overcome the elderly physiological and psychological obstacle, we must consider the common features of the elderly users group. Start from the interactive mode and apply the user experience design idea to the interaction design of smart home to truly enable older people to benefit.

3 Literature Review

Elderly people smart home has been constantly under test and development stage in the world. Mature products invested in market are not much. Some products are lack of system and are single in function. In the moral point of view, some monitoring equipment will be related to the elderly people's privacy. And at the same time, the

relevant research on interaction design documents is little. But with the physical network technology unceasing popularization, improving of the interaction design and user experience perfecting, the elderly intelligent Home Furnishing will usher a rapid development.

Research in the field of user experience in foreign countries in the elderly intelligent Home Furnishing interaction design are mainly focus on the testing of new technology, the elderly acceptance and privacy issues. For example, EM Tapia, SS Intille, K Larson (2004) introduces the application of sensor can realize the omnipresent at home. Those simple and small sensor facilities can give people life convenience. Karen I Courtney and George Demirisa (2008) studies elders' privacy situation and acceptance in the smart home using sensor and finds that older people are willing to accept the change of smart home life, they have a high degree of participation and the development of new technology can eliminate privacy problems to a certain extent. Parisa Rashidi (2013) introduced the "auxiliary environmental life" (ambient-assisted living) and the possible application of the AAL system. They think that can better serve the health of the elderly life through the system. Francois Portet and Michel vacher (2014) study in-depth of the intelligent home in the elderly based on speech recognition system and conclude that older people could communicate more conveniently by speech remote control and communication, and home smart degree can also be improved and bring more convenience to the lives of the elderly.

China's elderly smart home is still in the starting stage. Most of the literatures are just based on the theoretical discussion of applied feasibility. Research papers are less on health care and pension services based on technology and interaction design and user experience. Zhang Jin (2014) thinks that through reasonable functional classification, reality enhanced technical assistance and the system security enhance can enhance the smart home system affinity for the elderly and make high-tech effective better serve the elderly. Li Yangfeng, Chenglong (2015) think that smart pension is to combine the medical support pattern in the "Internet + background", a modernized medical support using modern computer technology, network technology and artificial intelligence. It encourages the use of cloud computing, data and third-party service forces and provide long-time follow-up, forecasting warning individuation service management to achieve elderly timely information sharing in order to ensure the safety and health of the elderly. Liu Shulao (2015) divides elderly smart home furnishing into interaction property and support attributes. Attribute interaction is divided into six categories: easy operation, intuitive and representative, context awareness, spatial interaction and social interaction. Support property contains blow: mathematical degree, barrier free convenience, sensory support, safety and security, self-control and function of promoting.

Above all, the foreign research of smart home is much advanced compared to domestic. At present foreign elderly smart home research is forwarding to diversified development point of view, mainly emphasizing on the implementation and practical application of new technologies. But theory and research related to interaction design on the user experience is not rich. There is still some room for improvement.

4 Research Methods

The main research methods of this paper are:

Multidisciplinary Research Method: The content frame of the research uses interdisciplinary knowledge system in interaction design construction of smart home furnishing products for the elderly. From intelligent home product technical means of combined with knowledge of the structure of the Internet of things, use the factors of psychology analysis of user demand levels. Applications need to try to accommodate users with higher levels of the hierarchy of needs. Analyze older users' interest points and viscosity category of smart home products. Then try to use psychology, aesthetics and design idea in the elderly people of smart home products interaction design.

Literature Research Method: This article translates and studies a collection of smart home product interaction design, the elderly related design and design aesthetics, psychology related books and materials. Methods and characteristics of research were combing and analysis for elderly people smart home product interaction design contents. At the same time, through comparative analysis of the literature, the article draws a conclusion to the user interface design strategy that we should be closely combined with the analysis of market environment and competitive factors. Choose the design approaches and methods more suitable for the elderly smart home product interaction.

Case Analysis Method: Compare and analyze the typical products in smart home furnishing, summarize and conclude features of different kinds of elderly intelligent home products application from the point of view of interaction design and user experience, summarize the elements that should be noted in the direction of the interaction of the elderly smart home system.

Model Research Method: Through the analysis of elderly users demand hierarchy induction in the field of intelligent home, study put forward the user cognition, emotion and behavior model. Through the user model construction and induction, put forward corresponding matching requirements to the smart home products elderly experience.

5 Results

5.1 Definition of the Concepts of Interactively Designed Smart Home Products for the Elderly

Broadly speaking, an intelligent home product that satisfies medical care and maintenance is a complete system that comprises of smart household electrical appliances, smart household management system and call supervisor system. A perfect solution to the smart household aimed at old people is supposed to have a combination of all the functions of the three aspects above. Its interactive design consists of two main aspects: the interactive design for the elderly and home products, and the smart home systemic design based on old users, which includes management system and call supervisor system.

The interactive design of elderly and home products refers to the human-computer interactive design which begins from perspectives including sensory organ, cognition and acts, and facilitates the elderly in using smart home products and gain active information or physical feedback from products so as to assist with the old people’s demand and provide them with good experience.

The interactive design of smart home system at the basis of old users, and which realizes mainly through sensors and RFID technology, can be seen as an interactive systemic design constructed upon users, acts, circumstances and products, with Smart home, children, community and hospitals as informative communication terminals to realize the convenient communication among all terminals as well as timely medical care and maintenance feedback.

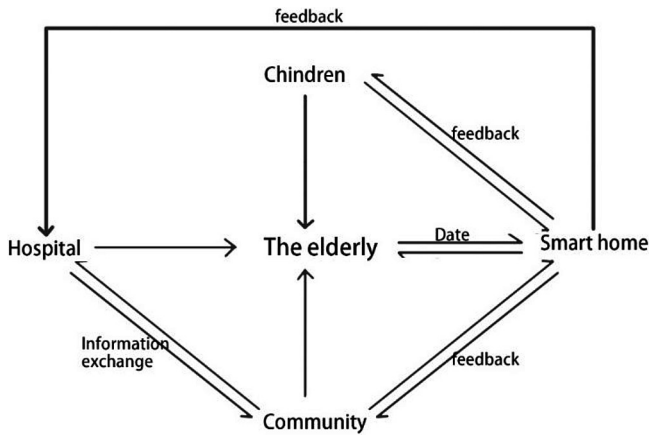


Fig. 1. Sketch map of smart home furnishing interaction system

It can be seen from the picture that smart home system for the elderly is pretty excellent, with the old users as center, and send their real-time conditions to their children, community center and hospital via the informative shift of smart home system. Children are informed of old people’s daily life and health through Smart home system, instant communication with the elderly is also doable. Community center takes charge of storing up old people’s health data and routine health care, and establishing uninterrupted informative communication with the hospital, feeding back physical change and medical information of the old people without delay. Hospitals can carry out timely cure for the elderly in emergency via Smart home system. The whole interactive system is a complete service close loop, actualizing informative and intelligent nurse for the elderly with the help of the Smart home system (Fig. 1).

Smart household system designed by the German team of engineers. It can send alarming information to old people’s kinsfolk when they fall. The Safe home smart household system is virtually a group of sensor boxes placed in every room in the house. It can perceive movements, voices and locations of the family members via optical and acoustical sensors. It would at first await and judge whether the person

stumbled down can get up by himself if perceive someone falls, and if not, then it will go to the second stage, during which the Safe home would firstly ask the person whether he needs to call. And if there's no response, it will immediately get through emergency service and inform other family members that the old people had fallen. Safe home system actualizes automatically domestic alarming for the elderly at home, offering an essential safety guarantee for them.

5.2 Influence Factors of Interactive Design of the Smart Home Products for the Elderly

According to the former surveys on smart home products, smart home products that serve the elderly are supposed to have three functions as medical aid and monitoring (physiological data transmission, simple medical treatment, etc.) life assists (sports exercise, diet, augmented sensory organ and so on.), security forecasting (forestall stumbling, emergency warnings, etc.). Along with the existing functions, smart home products require certain manipulation, moving ability and feedback of the elderly, thus basic interaction with smart home products can be carried out. For the disabled and semi-disabled old people, they would have to accept a passive aid from smart home products to a certain degree.



A UD doctoral student, conducts tests of the PDShoe at the Newark Senior Center in Delaware.

UD's PDShoe is an ordinary beach shoe equipped with force sensors and a vibration system.



Fig. 2. Robotic shoe helps patients with Parkinson's walk smooth and steady

Researchers in University of Delaware contrive a kind of shoe with vibrating insole, whose vibration frequency is controlled by a micro-computer, to help improve the walking disorder of patients with Parkinson, reduce rigidity of pace, improve walking speed while keep in balance. This kind of shoe is provided with three functions in simple medical treatment, acts assistance and forestalling stumbles (Fig. 2).

Elder users, compared to youngsters, have problems below that affect the interactive experience when use smart home products:

Physiological functions decline: For instance, cardiovascular decline, osteoporosis, decline on moving ability and easy to stumble, etc. According to reports from the WHO, 20 % to 30 % American elderly got slight or severe wounded after fall. Falls mostly cause traumatic injuries, hip fracture and head traumas. Part of the reasons that bring about the risk may be the aging of body, sensory organ and cognition and the environment’s failure to meet the needs of the aging of population.

Cognitive Decline: Like auditory and visual fade, serious memory fade, which also causes deficiency in learning and cognitive ability, so as to affect directly the experience in human—computer interaction, like the elderly people’s frequent misrecognition of functional buttons when use smart home products.

Mental Change: Since some old people live in solitude, and due to their physical and mental changes, they tend to feel lonely and nervous, repelling strange surroundings and are reluctant to receiving and learning new things, owning contradictory emotions toward high—tech products such as smart home products and so alike.

Chart 2 carries out qualitative analysis on different kinds of smart home products based on the smart home products at service of medical treatments for elderly and its classification, summarizing how deeply different kinds of smart home products are affected by the elderly people’s self—condition, which also indicates smart home products’ demand level on the elderly people’s self—condition. H, M and L represent high, medium and low impact level respectively (Table 2).

Table 2. Chart 2 Influence factors and relationships between smart home products and the elderly.

<i>Influence factors</i> <i>Smart home products</i>		Sensory organs			Body		Learning & Memorizing
		Auditory sense & tongue	Vision	Tactile sensation	Hands	Limbs	
Medical aid	Physiological sensors	L	L	H	M	M	L
	Domestic medical treatment	L	M	M	M	M	M
Life assistance	Sports exercise	M	M	M	H	H	H
	Diets	L	M	M	H	M	H
	Sensory intensifier	M	M	M	M	L	M
Security alarming	Independent auxiliary	L	M	M	H	H	M
	Walker	L	L	M	M	H	M
	Alarming system	L	L	L	L	L	L

(H: High M: Middle L: Low)

Analysis shows that present smart home products require relatively high of old people’s physical health and memory in most cases. And in the matter of sensory organ, vision and tactile sensations are at higher requirement while auditory sense and tongue less required on the elderly.

5.3 Construction Principle and Upgrade Strategy for the Interactive Design of Smart Home Products for the Elderly

Principles of design for the smart home products for the elderly proposed due to the poor physical condition in combination with the function of medical hygiene and pension services:

Principle of Accessibility of the Human-Computer Interaction: Accessibility consists of establishing accessible human-computer interactive interface, efficient and user-friendly feedback mechanism and reducing the elderly people's movement, cognitive, psychological and memory burden. Such as the elderly intelligent wearable device Tempo, which is equipped with a 9 axis MEMS sensor (including a 3 axis accelerometer, a 3 axis gyroscope and a 3 axis magnetometer), enabling it to track acts like strolling and lying down. Battery-driven pointer points to where the home or the center of the sensor is. The system can locate where acts take place, like in the bathroom, bedroom or kitchen. Tempo reduces the burden to the minimum for the elderly when use intelligent products, and is designed in a way aimed at integrating into daily life in interactive form, which realizes indiscriminating communication between man and products (Fig. 3).



Fig. 3. Pic 5.1 Smart equipment “Tempo”

Principle of Security: The principle of security comprises of two aspects. One is the safety of old people that lives alone when use smart home products. The design of indoor smart home products is supposed to have certain fault tolerance. Considering first about all kinds of possible conditions when old people use them when design products, lowering the danger coefficient to the minimum. The other one is data safety of smart home products. In the overall environment of smart home products interaction, individual privacy and residential information safety shall be put under protection in time, since their capability to resist the external interference is relatively weak.

Principle of Practicability: Part of the old people deem products with high-tech as white elephants, cutting redundant interactively designed functions, and remain those

succinct, central interactive design, establishing benign user experience with practicability as premise.

The interactive design of smart home products suggest that apart from satisfying basic functions and interactive communication among old people, further additional strategies are wanted on products and systems of smart home products to improve the experience of care and emotional solicitude toward old users.

Multi Sensory Interactive Design: Most of the elderly-served intelligent home products such as smart phones and domestic medical apparatuses are interactive products based mainly on tactile sensation and auxiliary with vision and auditory sense. Functional design in sensory organs should be augmented, like augmenting home furnishing experiences with audio-based orders, enabling the elderly to actualize interactions with the intelligent home products in least self-burden, and synchronizing the feedback from intelligent home products with the elderly sensory level. For example, measures like regulating intensity of light through acoustic control in the lighting system of the intelligent household can be adopted in accordance with varied regions or occasions.

Modularized and Standardized Design: Modularized interactive designs are in the light of different conditions of the elderly. The elderly have varied demand toward medical treatment and recuperation, thus modularized functional joint should be adopted to save resources and costs. Standardized designs are based upon the whole intelligent home products system. Close-related screen interaction enables the elderly to reduce their burden as they memorize and learn. At the same time, the intelligent home products have yet developed a unified standard in home-area network and technology layout, and lack of compatibility, putting some burden on the users.

Joyfully and Emotionally Interactive Designing: The elderly are psychologically fragile, lacking care and enjoyment of life. According to a survey, over 80 % of the elderly are pressed for care from their children, and don't get enough communication with the outside. For instance, traditional medical apparatuses are kind of cold, so warm color design in appearance can be carried out in related products, and meanwhile employ some approachable material design like acrylic, polycarbonate and rubber paint spray, improving affinity of the products, lessening the elders' indisposition towards technology products.

6 Conclusions and Discussions

To improve the interactively designed products for the elders under the mode of medical care and pension is to improve the interactive experience of the elderly in using the smart home products that are aimed at the elders' physical and mental features at the base of big data and technology advantages in information intelligence. The designer of the smart home products should design with a user-friendly, secure and practical interactive designing principle, along with experienced designing increments that are emotional and joyful, in addition to considering over the elderly interactive mode that is multi sensory and multi aspect, as well as designing methods which is

standardized and modularized. Meshing the elderly and products design, and pay heed to what they need, understand their senses so that man-machine distance narrowed, and interactive products of more distinctive and more humanized quality can be designed in support of technology.

All in all, products that are seamlessly matched to the demand of the elderly users through mobile Internet, intelligent terminals and touch-screen control will be the trend in which the smart home products design will follow.

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