Research on the Design of Barrier-free Intelligent Furniture for the Elderly

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Abstract: Population aging problem is becoming more and more prominent, which has become an important issue that cannot be ignored in today's society. The emergence and rapid development of intelligent furniture provide technical support for improving the life quality of the elderly. The elderly have the characteristics of low health level, weak sensory ability and declining memory. In view of the physiological and psychological characteristics of the elderly, this paper puts forward the design principles of barrier-free intelligent furniture for the elderly, and gives the design points of intelligent furniture for the elderly with the functions of intelligent monitoring, intelligent control and intelligent reminder to provide some references for the relevant researchers.

1. Concept of Barrier-free Intelligent Furniture

The development of human society has gone through different stages of development, such as handicraft, mechanization, automation and so on [1]. Intelligence is the inevitable trend of its development. Artificial intelligence is not only applied in the field of production such as mechanical processing, but also in the era of furniture. Intelligence has begun to play a role in people's lives. Intelligent buildings, intelligent furniture and intelligent appliances have been widely recognized and accepted. Furniture design is the extension of architectural design to the interior. Furniture is an important part of the interior. Furniture should also be intellectualized to adapt to the development of intelligent buildings. Intelligent furniture as a combination of high-tech and traditional industries will play a huge role in promoting the development of traditional furniture industry. Intelligent furniture is the integration of traditional furniture and modern electronic information technology, sensor technology and other high-tech technologies. The high-tech content of intelligent furniture makes it difficult for products to be imitated. Enterprises without scientific and technological strength will be thrilled. Even if they imitate, they can only imitate their appearance. The essence of high-tech cannot be imitated. Generally speaking, it is called intelligent furniture that integrates high and new technology into the development process of furniture design through system integration to realize the optimization and reconstruction of furniture type, material, structure, technology or function, so as to replace such furniture operated by human beings. In a narrow sense, this kind of furniture belongs to intelligent furniture by applying the technical principles of mechanical transmission, sensors, single-chip computer and embedded system to the furniture entity, so that it can be integrated into the intelligent furniture system and transformed into an intelligent single product. Therefore, intelligent furniture is based on modern fashion furniture, which integrates combination intelligence, electronic intelligence, mechanical intelligence, and material-related intelligence into furniture products skillfully. Intelligent furniture makes furniture intelligent, fashionable, multi-functional, more convenient and comfortable to use. It is the trend of furniture development in the future.

2. Features of the Elderly and the Needs for Barrier-free Intelligent Furniture

2.1. Features of the Elderly

Compared with ordinary people, the elderly has some common characteristics in cognitive ability, living habits and so on. The cognitive abilities of the elderly have the following characteristics: sensory abilities, such as vision, hearing and olfaction, are gradually declining, and the coordination

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and flexibility of the body are also declining accordingly; attention is not easy to concentrate and alertness is low. The ability to cope with abnormal situations is reduced; memory is declining, and learning ability is also greatly reduced. In addition, the living habits of the elderly are also different from those of the ordinary working people, such as long stay at home, regular work and rest time, and single life style. Because of the characteristics of physical quality and cognitive ability of the elderly, health and safety monitoring is particularly important in the daily life of the elderly. According to the theory of cognitive load, the working memory capacity of individuals is extremely limited, especially in the elderly with cognitive deficits. The memory of the elderly tends to decline with age, but the decline is not large. The general trend is that there is an obvious recession stage after forty years old, and then maintains a relatively stable level until a more obvious recession stage occurs after seven years old [2]. The main manifestations are as follows: the mechanical memory is obviously reduced, the speed of memory is obviously slowed down, the memory span is reduced, and the recall ability is significantly reduced. The basic goal of intelligent furniture is to provide people with a convenient, comfortable, safe and efficient living environment. Based on the characteristics of the elderly, the intelligent furniture for the elderly should be practical, focusing on the functional design [3].

2.2. Needs for Barrier-free Intelligent Furniture

The emergence of population aging makes people pay more attention to the home life of the elderly. The reasonable solution should start with exploring the needs of the elderly. According to Maslow's theory, the needs of the elderly can be divided into five levels: physiological needs, safety needs, social needs, respect needs and self-fulfillment needs. The needs of the elderly also apply to Maslow's theory. Physiological needs are the most basic elements of all needs, which are embodied in the needs of the elderly for water, air, food and warmth. This is the condition on which everyone lives. However, the elderly will have more emphasis on these basic needs, such as more attention to health care in diet, health and nature in the environment, more attention to warmth than young people, and so on. Safety needs are a desire to protect oneself from harm after people's physiological needs are met. For the elderly at home, their safety needs are more urgent than other groups, especially in the defense of physiological damage and the prevention of foreign invasion. The elderly all hope to be able not to get sick or less sick to achieve health and longevity. They also hope to get good care when they are sick. The living environment of the elderly requires easy movement and activities. There are no hidden dangers in the internal facilities, and they can effectively prevent foreign attacks, looting, theft and so on. In order to ensure compatibility and expansibility, the design of intelligent furniture system serving the elderly should also follow the relevant national and regional standardization. The reliability of the system itself and some important functions. The safety and fault-tolerance of the design are highly valued. Intelligent furniture should be easy for the elderly to learn and use [4].

3. Design Principles of Barrier-free Intelligent Furniture for the Elderly

Intelligent elderly furniture emphasizes more functions than traditional furniture. Intelligent furniture supplies should provide corresponding functions and support for different types of elderly people. Corresponding to the type of the elderly, intelligent furniture has the functions of daily life, life intermediary and medical assistance. In order to enable the elderly to live independently in their own homes, daily-life intelligent devices should provide appropriate intelligent furniture services to assist daily activities such as bathing, toilet and so on. Life-mediated intelligent devices should provide instrumental support for the elderly in daily life, such as drug management, food preparation and so on. Self-care elderly people may also need to strengthen their daily activities to adapt to changing environments. Medical-assisted intelligent devices should be able to provide information consultation and medical treatment in combination with the physiological and psychological support of the elderly. Different types of intelligent furniture can make the life of the elderly more convenient, can make walking more relaxed, can make the elderly easier to read or more convenient to communicate with people. In the process of product design, designers always adhere to the design concept of convenience and service for people, that is, the development and design of products are all

around people. In order to design intelligent furniture products that can meet the needs of the elderly and facilitate their operation, we should fully consider the reality of senior's perception and physiological function decline in the design, and consider the cognitive, use, experience and interaction of the elderly in the use process, so that the elderly can more easily interact with the intelligent products in the use process, so as to make the products easier. It can quickly respond to the needs of the elderly and support their various functional activities. In order to provide ideal interactive experience for elderly intelligent furniture products, it is necessary to evaluate the function.

4. Design Points of Barrier-free Intelligent Furniture for the Elderly

4.1. Intelligent Monitoring

Nowadays, the elderly are mostly in sub-health state. Monitoring their health status by embedded sensors, such as sleep monitoring, breathing monitoring, heart monitoring, etc., can enable the elderly to detect health problems and adjust them in time. The function of health monitoring is more practical for elderly patients who need long-term monitoring. Modern people live in a fast rhythm and are under great pressure. They often feel tired when they get home. Intelligent massage can relieve the tension of the body. This function can be combined with intelligent recognition function and health monitoring function, according to the preset occupations and lesions of different people and the health status monitored to develop different massage programs. Smart furniture can be equipped with sensory enhancers, emergency response systems and entertainment aids. Sensory enhancers analyze telephones with enlarged subtitles and automatic reminder drug dispensers. Emergency response system compares call promise machines with nursing systems in emergency response, direct connection and emergency access. Entertainment aids make the elderly enjoy interesting sports activities with sports and physical games facilities. Monitoring sensors are devices that make people feel better about themselves. Intelligent devices analyze the functions of hand exercisers and pain relief devices, such as effective treatment, pain relief and so on. Intelligent device pedometer is a device for monitoring sensors, which enables users to understand daily activities and physical functions in real time. Intelligent security can monitor the family environment in real time, avoid illegal intrusion, gas leakage, fire and other occurrences, as well as timely alarm in case of emergency, and start related electrical appliances into emergency linkage state, so as to achieve King Motion prevention. The remote monitoring system can record the activities of the elderly in key locations at home through special sensors. If any abnormal situation occurs, the information system of smart furniture will send an alarm message to the family immediately.

4.2. Intelligent Control

Intelligent sitting and sleeping furniture can be adjusted according to room temperature. When the room temperature is high, the temperature decreases, and when the room temperature is low, the temperature rises. This function can improve the comfort of furniture. The adjusting function design of bed intelligent furniture mainly aims at adjusting the height of the bed and the inclination angle of the bed. The bed height of the patients and the elderly is slightly higher, and the appropriate bed height makes it easier for them to get up and lie down. Many people like to read, play computer and watch TV in bed. At this time, we need to adjust the tilt angle of the back. The interior of storage furniture is a small climate environment, which changes with the change of external climate. In order to store goods better, the internal microclimate indicators can be adjusted according to the type, texture or chemical composition of the storage. The temperature and humidity of the air can be automatically processed after exceeding the preset value, and the temperature can be automatically raised or lowered, and the dehumidification can be automatically carried out. For the health of family members, storage intelligent furniture should also have the function of automatic sterilization and disinfection to prevent the breeding of bacteria and viruses from causing harm to family members. Intelligent lighting function should be used in the interior of intelligent furniture. It can automatically

control the opening and closing of lighting function like the interior lighting of refrigerators. Illumination can be automatically adjusted according to the degree of light and shade in the interior. Storage furniture with different functions adopt different irradiation directions according to different storage methods. Bookshelves and bookshelves should adopt inclined irradiation directions from outside to inside to downward so as to facilitate users to find books. Wardrobes should be illuminated from top to bottom to facilitate the elderly to observe the color and style of clothing.

4.3. Intelligent Reminder

According to the characteristics of the old people's working and sleeping rules, the intelligent reminder function can help the old people form healthy living habits according to the different working and sleeping seasons and different personal working and sleeping habits. The intelligent prompt function of the sofa can automatically wake up according to the time when the human body remains static to avoid catching cold. Help them to carry out their daily activities on time. Medical management device is a computer-controlled medicine box, which can send audio-visual signals to the elderly through the alarm system. If the old man does not take the medicine within a specified period of time, he will call his guardian at the first time. Unobstructed information interconnection, through voice calls and other fast ways to achieve instant calls, video calls, management of family information and contact with property management companies in the community. The main difficulty for the elderly to control smart home lies in the process of finding corresponding functions. The multi-level classification is not in line with the life experience of the elderly, and the ideal way is to follow the natural living conditions of the elderly. Reality augmentation technology provides the possibility for this design idea. Intelligent furniture control software is loaded into a mobile phone or tablet computer, and furniture is photographed with a back camera. Intelligent recognition technology identifies the controllable electrical appliances in the field of vision, and automatically pops up the corresponding control panel to operate smoothly. We can apply modern science and technology such as information technology to the design of intelligent wardrobe, and realize an intelligent wardrobe which can adjust the internal environment to help the elderly to keep clothes. In the development and design of intelligent wardrobe, we can use the theory of artificial intelligence and embedded system to embed the single chip computer and sensors in the intelligent wardrobe, so that the intelligent wardrobe has moisture-proof and sterilization. New functions, such as disinfection and clothing index reminder, can protect the health of the elderly and their families.

5. Case Study: Design of Intelligent Wardrobe for the Elderly

Intelligent wardrobe is an important storage space for the elderly. It is mainly used to place clothes and home textiles for the elderly. Usually the wardrobe is too high for the elderly to use. According to the body size of the elderly women, the suitable storage height ranges from 600mm to1350 mm. However, the suitable storage height ranges from 500 to 1100 mm for the elderly who use wheelchairs. Ordinary wardrobe height is about 2400 mm. In order to make full use of wardrobe space, it is recommended to use the lifting hanger. Generally, the width of wardrobe is about 600mm. It is not recommended that the wardrobe be too deep, which will make it inconvenient for the elderly to take things. The width of a group of wardrobes ranges from 900 mm to 1200 mm, and the width of the opening of a flat wardrobe should not exceed 500 mm. As far as possible, the cabinet can be opened with an angle greater than 90 degrees, and the larger open space can be more convenient for the elderly to use. The design of wardrobe storage space for the elderly should be more meticulous. Clear classification can make the storage of the elderly more reasonable to arrange. for the elderly, different drawers should be set up under the wardrobe. Flat storage mode is convenient for the elderly to store some scattered items in an orderly manner, and convenient for memory and access. At the same time, some open partitions should be designed in the wardrobe to make the space efficiency higher. As shown in Figure 1, it is recommended to install the induction lamps in the wardrobes because of the vision decline of the elderly. When the wardrobe is opened, the induction lamps light up to facilitate the elderly to find their own needs.

Figure 1. Intelligent wardrobe with induction lamp for the elderly

6. Conclusion

The global trend of ageing poses a huge challenge, and the development of intelligent technology can improve the quality of life of the elderly. The physical and psychological characteristics of adults are different from those of young people. In the future design of intelligent furniture, we need to consider the characteristics of the elderly and their barrier-free needs. Designers should develop a variety of intelligent furniture that can interact with the elderly and be used easily by the elderly to improve the life quality of the elderly.

References

[1] Li Shan. Intelligent Furniture Speech Recognition Accuracy Optimization Simulation [J]. Computer Simulation, 2018, 35(11): 281-284.

[2] Guo Yeyingzi, Yi Xiqiong, Chen Haomiao. Research on Intelligent Furniture and Its Design Method [J]. Furniture, 2016, 37(1): 70-73.

[3] Liu Shulao, Cheng Yijing. Study on The Interactive Design of Smart Home Appliances for The Elderly [J]. Furniture & Interior Design, 2015(6): 28-30.

[4] Wu Zhihui, Zhang Xueying, Xu Wei, et al. Research Progress and Development Trend of Intelligent Furniture [J]. China Forest Products Industry, 2017(5): 5-8+13.