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Research on the Design of Age-Appropriate Bathroom Products

Zixuan Li, Ruidi Jiang

College of Arts and Information Engineering, Dalian Polytechnic University, Dalian, China

Abstract

With the growth of individual age, physical functions gradually deteriorate. Issues such as limited mobility, decreased eyesight, and impaired hearing have become common problems among the elderly. These physiological changes make daily activities-especially those in the bathroom-more difficult and dangerous for the elderly. Statistics show that bathrooms are among the places where falls occur most frequently, and the elderly face a higher risk of accidents here. As bathrooms are also frequently used by the elderly, safety has become the most crucial factor to consider. When using traditional bathroom facilities, safety hazards like slipping and instability while standing are likely to happen. Through research and analysis, this study identifies the shortcomings of existing products on the market, summarizes and proposes more suitable improvement plans, thereby providing an innovative direction for the subsequent design of bathroom products for the elderly.

Keywords

Elderly Bathroom Products; Age-appropriate Design; Safety Assurance; Adjustable Auxiliary Equipment.

1. Introduction

As the global aging population intensifies and the number of elderly people continues to increase, the elderly face more and more safety risks in their home bathroom environments. Therefore, it is necessary to design home bathroom products specifically for the daily lives of the elderly. This paper aims to explore the design background, objectives, and innovation points of home bathroom products for the elderly, and analyze the feasibility and necessity of their design. The study finds that due to the decline in mobility and balance ability, the elderly are prone to safety problems such as slipping and instability when using traditional bathroom facilities.

2. Analysis of the Current Design Status of Bathroom Products for the Elderly

The research on age-appropriate bathrooms in China is affected by various factors such as economy, technology, architectural conditions, and population living conditions. To a certain extent, the formulation of policies can reflect the research progress of age-appropriate bathrooms in China and lay a foundation for academic research. Scholars Zhang Hua and Li Linman analyzed the elderly's needs for bathroom products from the perspective of emotional design, combined with Maslow's hierarchy of needs, and summarized the emotional design direction of barrier-free bathroom products for the elderly [1]. Scholar Yang Hao conducted research on age-appropriate in-vehicle interaction design strategies for the behavior of elderly drivers, carried out experiments, and proposed an evaluation system for age-appropriate interaction methods [2]. Wang Yue put forward relevant principles for age-appropriate product design based on the cognitive, behavioral, and emotional characteristics of the elderly [3].

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2.1. Safety

A large number of users believe that the anti-slip design is insufficient. The anti-slip measures for the floor, bathtub, and shower area are inadequate, which easily leads to the elderly slipping and getting injured. The position of handrails is inappropriate or their design is unstable, failing to provide effective support. Emergency call buttons are difficult to reach or complicated to operate, affecting timely help-seeking in emergency situations.

2.2. Convenience

Some users also point out that the height of toilets and shower seats is fixed, which cannot adapt to the elderly of different heights and needs. The operation of adjusting water temperature with faucets is complicated, and the elderly are prone to misoperation, resulting in scalding or uncomfortable water temperature. Auxiliary equipment such as shower chairs and bathtub chairs are too large or inconvenient in design, affecting the elderly's use.

2.3. Intelligence

In addition, some users mention that with the rapid development of science and technology, most intelligent products have the characteristics of numerous functions, complex usage steps, and difficult-to-understand operations [4]. The operation interfaces of equipment such as intelligent constant-temperature faucets and intelligent monitoring systems are complex, making it difficult for the elderly to use them proficiently. Intelligent monitoring systems rely on the network, and failures are likely to occur when the network is unstable, affecting normal use.

3. User Analysis for the Design of Bathroom Products for the Elderly

3.1. Physiological Status of the Elderly

Decline in muscle strength and bone density: With the increase of age, the muscle strength and bone density of the elderly gradually decrease, leading to the weakening of their body stability and support ability. The specific manifestations include muscle atrophy and osteoporosis. The elderly are prone to limited mobility and instability when standing due to insufficient muscle strength. At the same time, the decline in bone density increases the risk of fractures, especially when falling. When bathroom products are equipped with solid support facilities such as handrails and seats, they can help the elderly maintain balance and safety, and reduce the risk of falls and fractures.

Reduced joint flexibility and flexibility: The joint flexibility and flexibility of the elderly generally decrease, often accompanied by arthritis symptoms of varying degrees. This makes it difficult and painful for them to bend over, squat down and other movements. Designing height-adjustable bathing chairs, toilets, washbasins and other equipment can reduce the need for the elderly to bend over or squat down, and reduce the burden on joints.

3.2. Psychological Status of the Elderly

With the growth of age, the elderly's demand for environmental security increases significantly. The degradation of physical functions and the worry about accidents such as falls make them more cautious in daily activities. By designing stable and reliable auxiliary facilities such as anti-slip floor mats, handrails and adjustable seats, the sense of security of the elderly can be enhanced. The elderly usually hope to maintain independence as much as possible and avoid relying too much on others to protect their self-esteem and autonomy. However, physical limitations make them need help in some daily activities, which may make them feel frustrated and lost. Designing bathroom products that are easy to operate and in line with ergonomics enables the elderly to complete basic activities such as bathing and going to the toilet by themselves, and reduces their dependence on others.

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4. Research on the Design of Bathroom Products for the Elderly

4.1. Research and Analysis on the Types of Bathroom Products Market for the Elderly

With the intensification of population aging, the market of bathroom products for the elderly has gradually become an important segmented market, as shown in Figure 1. The main product types can be divided into three categories: safety assurance, easy operation and intelligent assistance. Safety assurance products include anti-slip facilities and safety handrails, which have the largest demand. Easy-to-operate products, such as height-adjustable equipment and auxiliary bathing equipment, help the elderly carry out bathroom activities more comfortably. Intelligent auxiliary products, such as constant-temperature faucets and intelligent monitoring systems, are gradually favored, showing the expectation of the elderly and their families to improve the safety and convenience of life through intelligent technology.

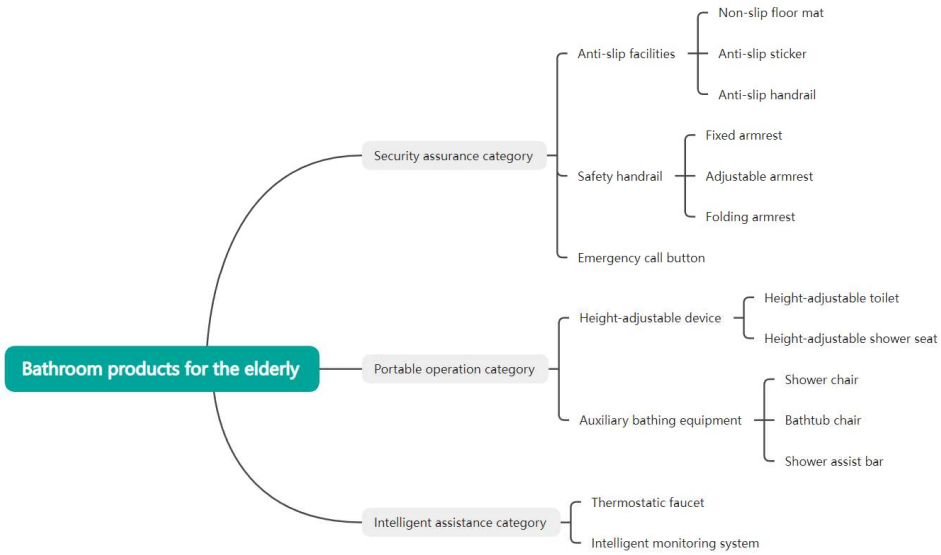


Figure 1. Types of Bathroom Products Market for the Elderly

Note: The figure includes anti-slip facilities (anti-slip floor mats, anti-slip stickers, anti-slip coatings), safety assurance products (safety handrails: fixed handrails, adjustable handrails, foldable handrails, emergency call buttons), elderly bathroom products, easy-to-operate products (height-adjustable equipment: height-adjustable toilets, height-adjustable shower seats; auxiliary bathing equipment: shower chairs, bathtub chairs, bathing auxiliary poles), and intelligent auxiliary products (constant-temperature faucets, intelligent monitoring systems).

4.2. Research on Existing Technologies of Bathroom Products for the Elderly

With the intensification of the global aging population trend, the market demand for elderly bathroom products is increasing. In order to improve the quality of life of the elderly and reduce accidents in the bathroom, relevant products are constantly innovated and improved in technology. The following are the main existing technologies of bathroom products for the elderly:

A. Anti-slip coating: Applied on the ground and product surfaces, it achieves anti-slip effect by increasing surface roughness, and is suitable for families and public places.

B. Process monitoring and alarm technology: Using smartphone Apps or networked devices, family members can real-time monitor the bathroom safety of the elderly and receive alarm notifications in case of emergencies.

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C. Electronic constant temperature technology: Using sensors and microprocessors, it real-time monitors and adjusts water temperature, providing more accurate and stable constant temperature effect.

5. Design Ideas for Age-Appropriate Bathroom Products

5.1. Principles of Age-Appropriate Bathroom Design

This research mainly targets the elderly aged 60 and above, especially the elderly living alone. The design concept is based on safety: comprehensive safety assurance is provided through the design of anti-slip floor mats, anti-slip stickers, anti-slip coatings and stable handrails, and an emergency call system is equipped to ensure quick help-seeking in emergency situations. A smooth design language is adopted in the appearance design [5]. In terms of convenience, height and angle adjustable equipment such as toilets and shower chairs, simplified operation, voice control, intelligent sensing and other technologies are used to provide convenient operation methods. In terms of comfort, ergonomically designed toilet seats, shower chairs and handrails, facilities such as heated seat rings and constant-temperature faucets improve the comfort during use, and soft lighting and colors create a warm bathroom environment. In terms of intelligence, an intelligent control system is adopted to realize automatic adjustment and remote monitoring of equipment, and integrate multiple functions such as automatic flushing, heating, drying and deodorization to improve the overall user experience. The real-time monitoring and feedback system ensures that the equipment operates well and reminds maintenance in time. Artificial intelligence technology mainly refers to strengthening manual methods to combine computer technology with product design [6].

5.2. Product Man-Machine Relationship and Size Design

In the design of barrier-free bathroom products for the elderly, the accurate consideration of man-machine relationship and size is crucial. Safety ergonomics is an important branch of safety science and environmental engineering [7]. The product adopts an ergonomic design, and the width of the shower area is set to 1000 mm, providing sufficient rotation and movement space for the elderly using wheelchairs. The installation height of the handrail is 850 mm, which is convenient for the elderly to grasp easily and provide stable support. The seat height is 450 mm, and the backrest inclination angle is 15 degrees. These size and angle settings are designed to provide the best comfort and support, and reduce fatigue during bathing. The overall space layout fully considers the activity range and usage habits of the elderly to ensure the smooth flow from the entrance to each functional area.

5.3. Product Shape Design

In the shape design of these three products, the classic design elements of products on the market are adopted, and some unique detail treatments are integrated, so that these products maintain practicality and affinity while being more modern and fashionable. The shape of the intelligent toilet is round and full, which meets the elderly's demand for a sense of security and comfort. The design of the movable handrail is integrated with the overall shape, providing practical functions without being obtrusive. The handrail design of the shower system is simple, with smooth and stable lines, giving the elderly a visual feeling of stability and reliability. The height and angle of the handrail have been carefully considered to ensure that it can provide the best support effect in various usage postures. The shape of the auxiliary toilet focuses more on the comfort and convenience of actual use. The overall shape is smooth and without edges and corners, which greatly reduces the risk of the elderly being hit.

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5.4. Color Design

In the barrier-free bathroom products designed for the elderly, silver is selected as the main color, based on its modern and technological sense in visual perception, as well as its ability to convey a sense of stability and reliability. The high reflectivity of silver helps to improve the brightness of the space, provides a clearer view for the elderly with possible decreased eyesight, and reduces the risk of accidents. At the same time, the reflective property of silver reduces shadows and improves the recognizability of the ground and environment. In terms of material selection, the silver surface is easy to clean and maintain, which meets the elderly's needs for durability and easy maintenance. In addition, as a neutral color, silver can match with a variety of colors, adapting to the personal preferences and home styles of different users. Generally speaking, silver is not only favored for its beauty and modern sense, but also selected as the main color of this product because of its positive impact on the elderly group at the visual and psychological levels, aiming to provide a safe, comfortable and beautiful bathroom environment.

5.5. Product Structure and Technology Design

The barrier-free bathroom products have been carefully designed in terms of structure and technology application to ensure functionality, safety and comfort. The product design strictly follows the principles of ergonomics, and all control components and operation interfaces are set in positions easily accessible to the elderly. The surface adopts anti-slip materials to reduce the risk of slipping, and at the same time provides a spacious space to facilitate the use of walking aids or assistance from caregivers. In terms of technology, the product integrates an intelligent temperature control system to automatically adjust the water temperature, prevent scalding and ensure a comfortable experience. In addition, adjustable support rods and handrails adapt to the physical conditions of different elderly people, and advanced waterproof and moisture-proof technologies ensure the durability and stability of the product.

5.6. Product Material and Process Design

The age-appropriate barrier-free bathroom products have undergone careful selection and design in terms of materials and processes to ensure the durability, safety and comfort of the products. The main structural materials are high-quality stainless steel and ABS plastic. These materials not only have excellent corrosion resistance and wear resistance, but also are easy to clean and maintain. The combination of the sturdiness and durability of stainless steel and the light weight and easy processing characteristics of ABS plastic ensures the safety of the product and facilitates transportation. In terms of surface treatment, advanced electroplating technology is used to plate a uniform and smooth silver coating on the stainless steel surface, which enhances the aesthetics and corrosion resistance. The ABS plastic parts are carefully polished to ensure a comfortable touch and smooth surface. In terms of connection technology, the product uses precision welding technology and high-strength fasteners to ensure the firm connection between components and the stability of the overall structure. All metal parts have undergone strict anti-rust treatment to extend their service life. In addition, food-grade silicone materials are used for seals and gaskets, which are non-toxic and odorless, and have good elasticity and sealing performance, ensuring the sealing and waterproofness of the product.

5.7. Product Function Design

This series of products aims to provide a convenient, safe and comfortable user experience through a series of function designs. The product is equipped with a multi-functional shower system, including various shower modes such as raindrop type, massage type and spray type, to meet the bathing preferences of different users. Auxiliary handrails are installed at key positions on the side of the shower system to help the elderly stand or move more stably during bathing. The movable handrail of the multi-functional seat allows the elderly to have better rest

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conditions during bathing and provides more convenient toilet conditions, reducing the physical harm and fall risk caused by the elderly squatting on the squatting toilet for a long time. The movable lifting toilet handrail is easy for the elderly to understand and operate, and provides a just right support point for the elderly to go to the toilet or rest in the bathroom.

6. Innovation Points of Home Bathroom Products for the Elderly

6.1. Movable Handrail for Intelligent Toilet

The movable handrail adopts a flexible design, which can be fixed or moved in different positions according to the needs of the elderly, providing personalized support. The handrail can slide, rotate or fold, which is convenient for the elderly to use in different situations, such as different support needs when sitting down, standing up and turning around. This level of flexibility greatly improves the convenience and comfort of use. The movable handrail of the intelligent toilet has a built-in safety sensor, which can real-time monitor the movements and postures of the elderly. When the intelligent toilet detects slipping or abnormal movements, the handrail will automatically lock and issue an alarm to notify family members or caregivers to provide help in time. In addition, the surface of the handrail adopts anti-slip materials to increase friction and further ensure the safety of use.

6.2. Shower System Design

The shower system adopts an intelligent design, and its supporting handrail is equipped with intelligent sensing technology, which can automatically detect the movements and postures of the elderly. Barrier-free handrails are installed around the shower to facilitate the elderly to stand and hold, and at the same time increase the safety guarantee [8]. The intelligent sensing technology ensures that the handrail provides support immediately when needed, improving the convenience and safety of use.

6.3. Auxiliary Toilet Design

The design of the toilet conforms to the principles of ergonomics. The shape and material of the seat ring have been optimized to provide comfortable support and a good sitting feeling. The handrail design takes into account the grasping habits and strength of the elderly, and its position and height are easy to use, ensuring that the elderly can obtain stable support when sitting down and standing up.

7. Design Practice of Home Bathroom for the Elderly

The product effect display is shown in Figure 2, Figure 3 and Figure 4.



Figure 2. Rendering of Age-Appropriate Home Bathroom Products

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Figure 3. Rendering of Age-Appropriate Home Bathroom Products



Figure 4. Rendering of Age-Appropriate Home Bathroom Products

8. Conclusion

This study focuses on home bathroom products for the elderly, aiming to address the social problems caused by the increasingly serious population aging and solve the multiple difficulties faced by the elderly in daily life. With the growth of age, the mobility and balance ability of the elderly gradually decrease, and they are prone to problems such as slipping, instability and difficulty in operation in the traditional bathroom environment. These problems threaten their safety and limit their independent life. In response to these problems, this project has specially designed bathroom products for the elderly. Through a series of innovative designs, the safety, convenience and comfort of the user group have been significantly improved. By introducing safety assurance facilities such as anti-slip floor mats, anti-slip stickers, anti-slip coatings and stable handrails, slip accidents are effectively prevented, and the safety of the elderly in the bathroom environment is ensured. At the same time, due to the decline in muscle strength and joint flexibility, the elderly often need help from others when using conventional bathroom equipment. The design of the movable handrail of the intelligent toilet and the handrail of the shower system, through intelligent sensing technology and automatic adjustment devices, enables the elderly to get the necessary support and help when sitting down, standing up and during the shower process. At the same time, the operation steps are simplified, and the ability of independent use is improved. The elderly bathroom products designed and studied in this project respond to the social demand for improving the quality of life of the elderly and provide an effective solution to cope with the challenge of population aging.

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