

Digitally Enabled Aging-Responsive Design of Interior Spaces in Chongqing's Healthcare-Integrated Senior Living Institutions

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Abstract: With the aggravation of population aging, healthcare-integrated senior living facilities are also increasingly popular. As a region with a high degree of aging, Chongqing, how its senior care institutions combine smart technology with senior care services, empower the senior care industry with science and technology, and create a new model of smart medical care is of great significance for achieving healthy and happy aging of the elderly. This paper takes Chongqing medical and nursing integration senior living institutions as the research object, analyses the status quo and demand of its indoor space aging and intelligent design, and explores how digital technology empowers its aging design from the three aspects of spatial interaction, spatial guidance system, and barrier-free design, to improve the quality of life of the elderly and the service efficiency of senior living institutions, and help the intelligent development of Chongqing's senior living industry.

Keywords: Digital technology; Medical and nursing integration; Senior care institutions; Aging-friendly design; Chongqing

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1. Introduction

With the aggravation of the problem of population aging in China, the problem of elderly care has become the focus of social attention. The state has issued a series of measures to promote the improvement of the quality of senior care services. The "Several Measures on Further Promoting the Consumption of Senior Care Services and Enhancing the Quality of Life of the Elderly" issued in October 2024 proposes to innovate the "wisdom +" senior care scenarios, encourages the construction of intelligent senior care homes, and configures intelligent equipment for life care, rehabilitation care, health management, and so on ^[1]. In December of the same year, the Opinions

of the State Council of the Central Committee of the Communist Party of China on Deepening the Reform and Development of Elderly Services emphasized the optimization of the supply pattern of elderly services based on the home, community-based, institutional professional support, and the combination of medical care and nourishment, and the promotion of the expansion of the capacity and improvement of the quality of elderly services ^[2]. By the end of 2024, the proportion of Chongqing's elderly population aged 60 and above had reached 21.67%, and the proportion of the elderly population aged 65 and above was 17.75%, with the degree of aging at a high level. Chongqing has actively responded to the national policy and made some progress in the construction of the elderly service system, but it still faces a large amount of pressure and challenges. This paper mainly discusses the integration method of smart technology and the indoor space of medical and nursing integration of elderly institutions in terms of interaction, guidance, and accessibility design, aiming to create an indoor spatial environment that meets the physical and mental needs of the elderly, to improve the quality of life of the elderly and the service efficiency of Chongqing's senior care institutions, and to help the intelligent development of Chongqing's senior care industry.

2. Medical and nursing integration of elderly care institutions

Medical and nursing integration is the combination of medical and health services and senior care services, for the elderly at home, community, and institutional care, based on daily life care, to provide the medical and health services they need ^[3]. A healthcare-integrated senior living facility is a senior living facility that combines healthcare and senior living services to provide the elderly with a variety of services such as living and living, culture and entertainment, rehabilitation training, and healthcare and integrates the diverse functions of healthcare, rehabilitation, wellness, and senior living. It can meet the diversified health and old-age life needs of the elderly, and provide a warm, comfortable, safe, and convenient old-age environment for the elderly, thus improving the quality of life of the elderly, and realizing a sense of nourishment, medical care, and enjoyment for the elderly.

3. Demand analysis of aging-friendly design under digital empowerment

The key service objects of medical and nursing integration are the disabled (including dementia), chronically ill, elderly, disabled, and other elderly people, mainly providing services focusing on health education, preventive health care, disease diagnosis and treatment, rehabilitation care, hospice care, taking into account the services of daily life care ^[3]. Therefore, most of the elderly groups targeted by medical and nursing integration elderly care institutions have specific requirements in terms of physical function and emotional needs.

3.1. Physical needs and aging-friendly design

Physical function: due to the gradual decline of physical function, the elderly have weakened mobility and decreased balance, resulting in a higher risk of falling, and falls are more likely to lead to serious consequences such as fractures ^[4]. Therefore, barrier-free design is particularly important in spatial design, such as setting up barrier-free access, widening the space scale, and increasing handrails and other barrier-free facilities; the floor adopts non-slip materials to reduce the risk of falling; in addition, the introduction of intelligent facilities, such as intelligent detection equipment and emergency call systems, can further enhance the safety and convenience of the space.

Sensory ability: Elderly people's eyesight generally declines, their sensitivity to colors decreases, and their

ability to adapt to light is weakened; their hearing and tactile sensitivity also decreases. Therefore, in terms of the spatial guidance system, more saturated colors should be chosen to enhance the recognition of the signs; at the same time, the design of intelligent guidance systems, such as voice prompts and intelligent dialogues, should be increased to satisfy the dual needs of the elderly in terms of vision and hearing and to enhance their navigation experience in the space.

3.2. Psychological needs and aging-friendly design

Safety needs: The elderly are more likely to have a sense of insecurity due to the decline of their physical functions. Therefore, the introduction of intelligent facilities such as emergency call systems and intelligent monitoring in spatial design can provide timely services when the elderly need help, thus enhancing their sense of psychological security.

Emotional and social needs: The elderly are prone to loneliness due to the narrowing of their social circle, and their needs for emotional companionship and social interaction have increased accordingly. Therefore, the planning of interaction space should be emphasized in spatial design, and more open communication areas, recreational facilities, and public activity spaces should be set up for the communication, recreational needs, and social needs of the elderly, to enrich their spiritual life. At the same time, robotic companionship or remote interaction with loved ones using intelligent technology can be adopted to abate the loneliness of the elderly.

3.3. Aging-friendly design that eliminates the digital divide

With the rapid development of digital technologies such as artificial intelligence, big data analysis, and machine learning, the lifestyles of the elderly are experiencing an unprecedented transformation, and the first challenge brought about by this change is the cognitive limitations of the digital model of smart aging^[5]. Elderly people often have problems such as operating difficulties due to the sensory, cognitive, behavioral, and psychological barriers they face, and the loss of vision and hearing leading to fear of new technologies. Therefore, there is a need to help older people use intelligent spatial facilities more effectively through various forms of large fonts, high contrast, and voice interaction.

4. Research on the current situation of the application of wisdom in the indoor space of Chongqing's medical and nursing integration senior living institutions

With the development of intelligent technology, technology-assisted aging design of senior care facility space has become a necessary development trend. Through the visit and research of Chongqing Medical University Affiliated First Hospital Qingkang Elderly Nursing Centre and Chongqing New One City Longhu Chunshan Wanshu Yi Nian Apartment and other senior living institutions, it is found that their intelligent application scenes are mainly concentrated in the basic stage of health monitoring, emergency call, intelligent positioning system, intelligent access control, etc., and there is still a lot of room to be improved in the areas of accessibility design, spatial guiding design, spatial interaction design, and so on.

4.1. The intelligent application of barrier-free design is insufficient

The barrier-free design originated in the 1930s, aiming to eliminate physical barriers in the built environment so that all people can use various facilities and services equally and freely^[6]. It emphasizes attention to the special needs of the elderly and helps them to better participate in spatial activities through technical measures in spatial

design. Some senior living structures in Chongqing have made some progress in the intelligent application of barrier-free design, but there are still the following deficiencies. First, the application scope of intelligent barrier-free facilities is insufficient. For example, the Qingkang Elderly Nursing Centre of the First Affiliated Hospital of Chongqing Medical University has introduced wireless call and positioning systems, remote visitation systems, smart wristwatches, and other equipment to monitor the safety of the elderly in real time and provide convenient services. However, only a small number of smart devices are installed in key areas such as bathrooms and corridors, failing to form a systematic solution. Second, the transport space lacks an aging-friendly design, and barrier-free facilities are insufficient. For example, Chongqing New One City Longhu Chunshan Wanshu Yi Nian Apartment is located in the main city with convenient traffic and rich medical resources, but the internal space of the institution is crowded, and the traffic layout of the high-rise building is mainly vertical, which restricts the elderly's traveling and basically only allows them to move around in a limited space. Thirdly, due to the lack of technical adaptability and low digital literacy of the elderly's smart device application ability, some of the intelligent accessibility equipment is not used efficiently and fails to give full play to its function.

4.2. Insufficient spatial intelligent guide design

The design of the guidance system, also known as the design of the guidance system, the design of the guidance system, or the design of the signage, is the design of the interface of spatial information conveyance that helps people to distinguish spatial attributes, to find the target path, and to manage the purpose of behaviors in the space ^[7]. The intelligent spatial guide design of Chongqing's medical and nursing care institutions has had initial development, especially some newly built or renovated nursing care institutions, which have introduced intelligent guide systems, such as electronic displays and voice prompts, to provide navigation and information prompts for the elderly. However, most of the institutional guide design still stays at the stage of traditional signs, and there are still problems such as insufficiently clear signs, too small fonts, insufficient color contrast, insufficient barrier-free information prompts, and insufficient application of intelligent guides.

4.3. Insufficient spatial intelligent interaction design

The digital revolution has given birth to a virtual network with a high degree of interactivity and two-way communication characteristics, and this emerging field has gradually become another important platform for the socialization of citizens. It has reshaped interpersonal connections and continues to influence traditional social structures and people's lifestyles ^[8]. The interactivity and participation of the elderly in the space are promoted through digital technology. The category of intelligent application of spatial interaction design in Chongqing medical and nursing care institutions is more limited, and the application is still relatively single, mainly focusing on the medical and health care field, while there is insufficient application in the daily life of the elderly, social interaction and other aspects. For example, the activity space is not interactive enough, lacks diversified social places, and the utilization rate of some public spaces in non-activity time is low, failing to give full play to their social and leisure functions and making it difficult to meet the rehabilitation needs of the elderly.

5. Digital-enabled indoor space aging design proposal for healthcare and nursing care institutions in Chongqing

As a mountainous city with complex terrain, changing climate, and rich regional cultural resources, Chongqing, combined with the needs of the characteristics of the population in the healthcare and nursing care institutions,

discusses the digital empowerment of the aging design from the three aspects of accessibility design, spatial guidance design, and spatial interaction design.

5.1. Intelligent barrier-free design

The accessibility design of indoor space in Chongqing's elderly care institutions should be closely integrated with the characteristics of the local terrain with big undulations and humid and foggy climate, and improve the convenience and safety of the elderly with the help of digital technology. Specific measures include the following. First, optimizing the layout of indoor space and simplifying the design of spatial flow lines. Avoid complex paths and too many twists and turns in spatial design to reduce the walking burden of the elderly, and form a simple and clear spatial guide to help the elderly quickly find their destinations. Second, in terms of three-dimensional traffic and barrier-free access design, build a multi-level barrier-free traffic flow. Drawing on Chongqing's unique three-dimensional traffic system, the design of multi-level barrier-free traffic flow lines, the use of vertical lifts, barrier-free ramps and rain and wind corridors and other facilities, linking indoor spaces of different elevations, to resolve the obstacles brought about by the difference in height. Thirdly, intelligent assistive facilities are introduced. With the help of smart handrails, emergency call buttons, and smart sensors, the activity status of the elderly is monitored in real time to ensure that timely help is given to the elderly when necessary. Fourth, the design of intelligent environmental regulation. Through intelligent sensors and controllers, automatically adjust the indoor temperature, humidity, light, etc., to adapt to the climate change in Chongqing. Fifth, the configuration of barrier-free facilities. Barrier-free toilets, barrier-free showers, automatic sensor doors, intelligent toilets, etc. are set up to further enhance the convenience of life for the elderly. Sixth, set up intelligent health testing. Set up intelligent health detection equipment, such as smart mattresses and health monitoring terminals, in the living space and public activity areas to monitor the vital signs of the elderly in real time and upload the relevant data to the terminals of healthcare personnel, to detect abnormalities in a timely manner. Seventh, the introduction of smart home systems such as intelligent lighting, intelligent curtains, intelligent home appliances, etc., so that the elderly can easily operate through voice control. For example, through voice command lighting brightness, control curtains or air conditioning, and other switches. Eighth, emotional interaction support. Introducing intelligent video and other calling devices to help the elderly maintain close communication with family and friends. For example, through remote tactile interaction technology, family members in different places can also pass hugs and communicate emotionally to meet the emotional needs of the elderly and achieve barrier-free emotional communication.

5.2. Intellectualized spatial guide design

Chongqing's intelligent spatial guide design gives full consideration to the visual and cognitive characteristics of the elderly, and considers the problem of recognition of the elderly with different physiological conditions; at the same time, it integrates the regional culture to innovate, develops intelligent pension products and services with cultural characteristics, and integrates traditional cultural elements into the product design and the content of the digital platform^[9]. Specific design strategies are as follows. First, high contrast and eye-catching logo design. The guide signs should be saturated with colors, high contrast, and eye-catching so that it is easy for the elderly to identify quickly. Second, multimodal guidance system. Combined with language prompts and an intelligent dialogue system, it helps the elderly to identify the direction or functional area more conveniently and improves the convenience of navigation. Third, personalized intelligent navigation. Using intelligent navigation devices

such as smart bracelets or mobile phones to provide personalized navigation services for the elderly in real time. Fourth, configure intelligent navigation devices. Setting up in public areas, such as electronic maps, intelligent guide screens, and robotic guidance, to help the elderly quickly locate and plan their routes. Fifth, integrate regional culture. Digging deep into the cultural resources of the project location, applying cultural symbols, colors, materials, and other elements to the image design of the guidance system, increasing the sense of affinity and belonging of the elderly, and enhancing the experience of the elderly while also reflecting Chongqing's unique mountainous city style and humanistic care.

5.3. Intelligent spatial interaction design

The indoor space design of medical and nursing integration elderly institutions should not only focus on aesthetics and function, but also strengthen spatial interactivity and communication through intelligent design. The design suggestions are as follows. First, expand public space. Add more public spaces to meet the needs of the elderly for interaction and communication. For example, design multifunctional parlors, elderly gathering areas, rehabilitation gardens, and other activity areas to promote communication and interaction among the elderly. Secondly, set up intelligent interactive devices, such as interactive paving, interactive seats, and other vignette facilities. Third, apply augmented reality (AR) technology. Use AR technology to enrich the social and entertainment experience of the elderly, such as expanding their life horizons through virtual scene interaction or cultural display. Fourth, inherit regional cultural characteristics. Combine with Chongqing's Bayu culture, design cultural display areas and activity spaces with local characteristics, and enhance the artistic taste of the elderly institutions through the introduction of artwork and warm color matching, to satisfy the aesthetic needs of the elderly and enhance their sense of cultural identity.

6. Conclusion

Chongqing's unique natural resources and human resources provide unique cultural characteristics and spatial flavor to the medical and nursing integration of the elderly institutions, and at the same time, it also provides a better space for the elderly environment. Combining digital technology with regional cultural resources, through intelligent barrier-free design, spatial guide design, and spatial interaction design, it will effectively enhance the aging level of the senior care institutions, meet the diversified needs of the elderly, and provide strong support for them to achieve high-quality life in their twilight years.

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