Research on the Adaptability of Interior Design Professionals in Architecture to Community Elderly Care Needs in the Context of Smart Cities

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Abstract: As smart city construction progresses, the community's demand for elderly care services is escalating; yet, existing facilities struggle to cater to the diverse needs of seniors. This article delves into the adaptability and innovative approaches for architectural design within the smart city framework, drawing upon a comprehensive analysis of the background and current landscape of smart city development and elderly community development. It critically examines the shortcomings in the design of senior housing within communities, underscores the significance of smart space design, interdisciplinary curriculum development, and participatory design initiatives, and offers a comprehensive interpretation of the strategies to implement these design concepts. Furthermore, it explores the influence of smart cities on the design of environments for aging in communities and investigates how architectural interior design can effectively support the unique needs of these environments.

1. Smart city development and the status and challenges of ageing populations

The concept of smart city originated from the idea of "Smart Earth" put forward by IBM in 2008 [1] .Currently, the smart city strategy is widely implemented in countries, regions and cities around the world and has become the leading direction and core strategy for city building in most countries globally[2].With the acceleration of globalization, cities are facing problems such as resource shortage and environmental pollution, and the construction of smart cities has become an effective means to meet these challenges. After years of development with transformation and upgrading, the smart city construction market in China is constantly growing. According to relevant statistical data, the market scale of China's smart city construction in the five-year period 2017-2021 is in a state of stable growth. Among them, the market scale of China's smart city construction in 2021 was as high as 21.08 trillion yuan, and the market scale of China's smart city construction in 2022 reached a staggering 25 trillion yuan, an increase of 18.6% year-on-year [3] .China has achieved significant advancements in the development of smart cities, yet further endeavors are imperative to seamlessly integrate the service requirements of the elderly population.

Since the turn of the century, China has transitioned into an aging society, witnessing a substantial and rapid expansion of its elderly population, with the growth rate escalating annually. By the conclusion of 2023, the number of individuals aged 65 and above in China is projected to surpass 217 million, constituting 15.4% of the total population, firmly establishing the country within the realm of an aged society[4].

On the flip side, China's substantial elderly population confronts numerous challenges, including inadequate care services and minimal social engagement among seniors. Presently, the development of community amenities catering to the elderly is trailing behind, necessitating an enhancement in both the elderly's self-reliance consciousness and society's recognition of elderly care needs, which significantly hinders societal progress. Nonetheless, from an economic vantage point, the elderly demographic forms a substantial consumer base, whose pull effect on economic development cannot be overlooked. Amidst this demographic shift towards an ageing population, the elderly market reveals immense growth potential. It is predicted that by 2024, the market size of China's elderly population will reach RMB 12 trillion, leaving room for the development of such industries [5].

China is confronted with the escalating challenge of an aging population, where the swift

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augmentation in the elderly populace imposes a formidable strain on social services tailored for them. Presently, the conventional methods of elderly care, including home-based and institutional arrangements, are revealing evident shortcomings in addressing the multifaceted requirements of seniors. Consequently, there arises an imperative necessity to delve into and forge a novel, community-centric elderly care paradigm that is aligned with the demands of the contemporary era.

2. Needs analysis

China's elderly care system encompasses three primary aging modes: at home, in the community, and in institutions. Notably, home care stands as the predominant form, accounting for an impressive 90% of all aging arrangements, highlighting its widespread acceptance and preference among the elderly population. In stark contrast, municipal care is chosen by roughly 70% of seniors, whereas institutional care trails behind, making up merely 30% of their choices. This overall preference for aging in familiar surroundings can be largely attributed to concerns about the quality, affordability, and the uncertainty surrounding the standard of care offered in institutional settings.

According to the latest official figures from the Ministry of Civil Affairs, over 360,000 community-based elderly care services have been established across the country, marking a substantial scale of operations. Nevertheless, upon conducting field research, it has been revealed that these community-based elderly care organizations predominantly grapple with financial constraints, with inadequate profitability impeding their sustainable growth. Funding shortages and infrastructural deficiencies have emerged as significant barriers to the advancement of elderly care services in China.

Upon closer scrutiny, certain elderly care institutions and community facilities reveal shortcomings in their planning and design. While these establishments fundamentally cater to infrastructure construction requirements, they lack distinctive highlights and intricate detailing. Consequently, there arises an immediate necessity for China's community-based elderly care organizations to fortify their infrastructure and elevate service standards, ensuring sustained and robust development. Additionally, during the design and planning stages, they must prioritize the genuine needs and lived experiences of the elderly, striving to deliver more accessible and cozy elderly care services.

The essence of the community-based care model lies in fostering the integration of seniors into society and enhancing their quality of life substantially via the offering of tangible services and the enrichment of social endeavors. This approach not only alleviates the familial burden of caring for the elderly, but also fully harnesses community resources, thereby fostering a more joyful and fulfilling twilight years for the seniors.

In the process of actively dealing with the aging of the population and seeking to improve the well-being of the elderly, information technology has been transformed into a fundamental force in the innovation strategy of elderly care [6] .The intelligent innovation of home care has been recognised by the government and society at the theoretical level and has begun to be explored in local practice [7]. At the policy level, the state has issued the "Guiding Opinions on Actively Promoting the "Internet+" Action", the "Action Plan for the Development of Smart and Healthy Ageing Industry (2017-2020)" and the "Medium and Long-term Plan for the Development of "taking technological innovation as a way to actively respond to population ageing. Technological innovation as the first driver and stategic support to actively address population ageing[8]" At the local level, during the five-year period from 2017-2021, a total of 634 pilot projects of smart health applications for ageing were set up across the country, with home care as a key scenario for pilot demonstration being launched in the layout. Several policy trials such as internet + home care and smart home care have taken root to varying degrees in 31 provinces, municipalities and autonomous regions across the country. Technology-mediated 'embedded' utilities have emerged, and convenient and accurate smart elderly care products and facilities have gradually been commercialised and brought into the homes of the elderly. At the same time, the state has made great efforts to promote the construction of new infrastructure, and "digitalisation" and the "Internet of Everything" have outlined a beautiful development scenario for the future of home-based elderly care, which has

accelerated the innovation process of home-based elderly care.

With the swift ascendancy of 'smart cities' and the burgeoning 'digital economy', a succession of revolutionary technological concepts has arisen in rapid succession. From the widespread adoption of the internet to the ascendancy of the Internet of Things, each technological breakthrough consistently pushes the limits of human understanding and cognition.These revolutionary technological innovations are leading to the gradual integration of smart cities and smart spaces into the lives of the general public, becoming an indispensable part of our daily lives.Since 2013,China's national high-tech industrial evelopment zone, the Innovation Driven Development Strategy Enhancement Action implementation Programme, has been implemented, effectively driving the vigorous development of related fields in China [9].

However, the current state of smart space development is yet to attain perfection. Despite the technological advancements embodied in some products, the absence of comprehensive market research has led to practical shortcomings in their application. These products, though technologically ahead, are often marred by operational complexities that fail to cater effectively to the actual demands of users.

3. Path analysis

The design of senior living communities necessitates strict adherence to the fundamental principles of barrier-free, age-appropriate, and humanized design, thereby fostering a secure and cozy living environment. Additionally, it is crucial to seamlessly integrate intelligent design elements, leveraging sensors, network communication, and other innovative technologies to enhance the automation and intelligence of these spaces. This strategic approach significantly elevates the level of intelligence in senior housing, providing residents with unparalleled convenience and comfort.

Designing smart spaces necessitates a profound comprehension of the multifaceted requirements of senior citizens, encompassing activity necessities (leisure, recreation, and learning opportunities), health considerations (environmental factors and accessible facilities), and safety prerequisites (pertaining to housing and transportation). It is imperative to ensure that the design solutions precisely cater to the genuine needs of this demographic while adhering to the five fundamental design principles.

Given the persistent and increasing demand for municipal elderly care services, it is immediately necessary to undertake a comprehensive overhaul of the curricula of university architectural interior design programs. The objective of this overhaul is to cultivate professionals who are proficient in meeting the evolving requirements of the market. As a foundational and crucial step, it is imperative to reinforce the establishment of interdisciplinary courses that integrate seamlessly the disciplines of architectural design, gerontological psychology, sociology, and information technology, among others. This integration will equip students with a profound understanding of the needs and psychological intricacies of the elderly, thereby empowering them to create living spaces that are more empathetic and considerate towards this demographic.

Secondly, the curriculum content should be seamlessly integrated with both theoretical and practical components, providing students with ample opportunities for hands-on experience through school-business collaborations, authentic project engagement, and fieldwork research. This entails, for example, partnering with local elderly care facilities on space design and renovation endeavors, which not only sharpens students' practical abilities but also contributes tangible design solutions to the society. Additionally, the integration of virtual reality (VR) and augmented reality (AR) technologies enables students to practice design in a simulated environment, enabling them to intuitively comprehend the positive influence their designs have on enhancing the quality of life for the elderly.

Furthermore, the course evaluation system requires heightened flexibility and diversification. Apart from the conventional exams and assignments, it ought to encompass evaluations of design projects and assessments of teamwork abilities, thereby holistically assessing the overall quality and innovativeness of students. This methodology ensures that the cultivation of elite design talents is in

sync with the requirements of contemporary society, as opposed to merely satisfying the needs of retirees.

Lastly, it is imperative for universities and colleges to intensify their communication and collaboration efforts with governmental bodies, industrial organizations, and societal groups. They must promptly grasp the nuances of political shifts and industry trends. Furthermore, they should adapt their curricula with agility, ensuring a seamless integration between the educational content and the evolving market demands. Through these concerted efforts in comprehensive curriculum reform, the field of architecture and interior design within higher education institutions will strengthen the talent pool, thereby providing a solid foundation for the development of elderly care within the context of smart cities.

4. Design and Development of Intelligent Community Elderly Care Service Center

A well-conceived community elderly center necessitates the concerted efforts of community elderly institutions, governmental bodies, local communities, and families. This collaborative approach addresses the multifaceted needs of the elderly, encompassing physiological, psychological, and behavioral aspects, through the efficient utilization of intelligent systems. The center ought to offer a comprehensive array of services, which encompass life care, medical assistance, spiritual support, emergency relief, educational opportunities, and recreational activities [10]. The design and implementation of intelligent public spaces will be centered on two key aspects: the intelligence of the equipment employed and the suitability of the environment for elderly users. This paper endeavors to propose specific applications of intelligent public space design within the prevailing Chinese elderly care paradigm, with a focus on safety, convenience, and comfort, thereby enhancing the utilization of space and the efficiency of services at municipal elderly care centers.

4.1 Safe design

The safety design of intelligent public spaces pertains to enhancing the security of these spaces through intelligent methods, specifically aimed at safeguarding the wellbeing of elderly individuals. The key initiatives encompass:①Monitoring Design: Leveraging an intelligent monitoring system to achieve comprehensive surveillance of public spaces, thereby safeguarding the safety of the elderly.②Intelligent Alarm Design: Implementing access control management to track the entry and exit of elderly individuals and maintain records. Furthermore, during nighttime hours, door and window sensors are activated to monitor for any abnormal intrusion attempts, promptly alerting the social management platform or triggering an alarm. This intelligent alarm system ensures timely detection and response to security concerns within public spaces.③Daily Health Monitoring: Utilizing infrared temperature measurement to monitor elderly individuals' body temperature and generating online temperature monitoring charts for easy access at any time. Additionally, we analyze data from intelligent mattresses and equipment to track the elderly's sleep patterns, generate sleep data, and seamlessly synchronize this daily health monitoring with a comprehensive management platform.④Emergency Care Design: Strategically placing emergency care buttons beside beds and in bathrooms to swiftly provide emergency services to the elderly, enhancing the timeliness of initial treatment. Simultaneously, Yuli vibration sensors are employed to monitor the elderly's posture and time spent out of bed, enabling the detection of potential hazards such as falls or prolonged inactivity, thereby reinforcing their safety.

4.2 Design for convenience

Convenience design of intelligent public spaces refers to improving the convenience of public spaces through intelligent means so that the elderly can easily perform various activities in public spaces. Specific measures include: ①Navigation design: Through intelligent navigation systems, provide navigation services for the elderly in public spaces to help them quickly find their destinations. ②Cognitive assistance design: remind the elderly to take medication, locate the

location of the elderly. ③Barrier-free design: sort out the needs of elderly-friendly spaces according to the barrier-free design standard and realise the dynamic line of ageing public space. Barrier-free facilities are provided and VR equipment is installed in community activity rooms with the function of integrating recreation and nursing to facilitate various activities for the elderly. ④ Smart home design: divided into daily smart home and physiological monitoring equipment. Through smart home systems such as smart door locks and smart curtains, smart home services are provided to the elderly to facilitate their daily life; data is collected through smart bracelets, blood pressure monitors, pulse oximeters and other devices to record electronic medical records to facilitate the monitoring of the physical condition of the elderly.

4.3 Design for comfort

The comfort design of the intelligent public space refers to the realisation of the older space through intelligent environmental transformation to improve the comfort of the public space. Specific measures include: ①Temperature control: Through the intelligent temperature control system, the temperature of the public space is automatically adjusted to maintain a comfortable temperature. ②Lighting for the elderly: The vision of the elderly from the light area to the dark area, it takes a long time to adapt to the use of intelligent lighting systems, to achieve automatic adjustment of the lighting in the public space, to maintain the proper light intensity and colour temperature. ③Colours are suitable for the elderly: Older people's colour perception deteriorates, colour sensitivity decreases and research shows that yellow and red compared to purple and blue are easy for older people to identify. Colour contrast can be used in the design of the room management system to help seniors identify themselves better and increase their independence and safety. ④ Air purification: Monitoring gas leakage and other hazards, and equipped with fresh air system and air filtration system to achieve air purification in public spaces and keep the air fresh. ⑤Emotional and safety companionship: Intelligent robots as pet companions to increase daily interaction, provide spiritual support and reduce the loneliness of the elderly; at the same time, intelligent home assistants are added to evaluate to enable and assess the daily activities of the elderly and help the elderly in their old age.

5. Conclusion

In the ongoing and profound construction of smart cities, the requirement for municipal elderly care services has emerged as a prominent concern, presenting novel challenges and opportunities for the architectural interior design sector. Set against the landscape of smart city development, this research examines the current shortcomings of elderly care facilities and highlights the crucial importance of smart space design, interdisciplinary curriculum enhancement, and community-centered design in enhancing the living conditions for seniors within residential communities. The conclusions drawn from this study emphasize the necessity for universities offering architectural interior design programs to embark on curriculum reforms, thereby fostering professionals who are adept at addressing the evolving requirements of municipal elderly care within the framework of smart cities.

By leveraging state-of-the-art technologies, intelligent space design substantially elevates the quality of life for senior citizens within the framework of community-based aging services. This is achieved by reinforcing safety, convenience, and comfort. Additionally, the execution of interdisciplinary curricula fosters the integration of knowledge from various disciplines, equipping students with a holistic educational foundation. This foundation enables them to profoundly comprehend the necessities of older adults and subsequently create living environments that impeccably cater to their specific requirements. Moreover, community participatory design underscores the paramount importance of involving elderly individuals and their families in the design process. This ensures that the devised solutions accurately align with actual needs, thereby augmenting their satisfaction and enhancing their overall quality of life.

The design of community elderly centers should incorporate smart technologies, such as sensors,

the Internet of Things, and big data analytics, to facilitate seamless real-time health monitoring of senior citizens and expedite emergency response mechanisms. Universities are strongly exhorted to establish partnerships with healthcare, scientific, technological, and social service organizations to collaboratively develop intelligent products and services tailored to the elderly, thereby elevating the quality and efficiency of municipal elderly care services. During the planning and operation of these facilities, it is of utmost importance to actively seek the input and recommendations of elderly individuals and their families to ensure that the content and format of services align with their genuine requirements. Furthermore, architectural design programs in higher education institutions should intensify their collaborations with industry, fostering students' innovative and practical skills through hands-on training and project collaborations, thereby nurturing talent for community-based elderly care. Ultimately, the government should enact more conducive policies to encourage cross-sectoral collaboration in the development and administration of community elderly care facilities, while providing essential financial and technical support.

Future research endeavors should delve more deeply into examining the effectiveness of smart space design across a wide range of community-based aged care settings, while meticulously assessing the impact of interdisciplinary curriculum advancements on enhancing students' design proficiency. Additionally, it is crucial to explore both the feasibility and the inherent challenges associated with community participatory design in real-world applications. Furthermore, a comprehensive, long-term study of the smart community-based aged care service model is essential, with the aim of evaluating its long-term sustainability and societal implications.

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