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Research on the Strategy for Age-Friendly Transformation of Living Environments from the Perspective of Smart Cities

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Abstract: With the intensifying global aging trend, creating a safe, convenient, and comfortable living environment for the elderly has become an important issue in the construction of smart cities. This paper, based on the perspective of smart cities, explores strategies for age-friendly transformation of living environments, including comprehensive planning, environmental renovation, technological application, and other aspects. By analyzing successful cases at home and abroad, a series of feasible transformation measures are proposed, aiming to provide references for age-friendly transformation in smart cities.

Keywords: Smart cities; living environment; age-friendly transformation

Introduction

With the continuous deepening of population aging, the housing environment needs of the elderly have become increasingly prominent. Smart cities, as a new direction in modern urban development, aim to enhance urban management and service intelligence through information technology. In this context, applying the concept of smart cities to age-friendly transformation of living environments holds significant practical significance and social value.

1. Overview of Smart Elderly Care and Age-Friendly Transformation of Living Environments

1.1 Concept and Development of Smart Elderly Care

Smart elderly care is a product of the deep integration of modern technology and elderly care services. It refers to creating an intelligent, personalized elderly care system for older adults by integrating cutting-edge technologies such as the Internet of Things, big data, cloud computing, and artificial intelligence. It goes beyond traditional care by utilizing technological means to comprehensively improve the elderly's quality of life, health management, and social interaction capabilities. Smart elderly care aims to monitor elderly individuals' physiological indicators in real-time, promptly detect health risks, and use big data analysis to provide customized health management plans. At the same time, through smart social platforms, it encourages interaction between elderly individuals, their families, friends, and communities, alleviating loneliness and enhancing psychological well-being[1].

1.2 Significance of Age-Friendly Transformation of Living Environments

Age-friendly transformation of living environments refers to scientifically and rationally adjusting and optimizing residential spaces and facilities based on the elderly's physiological characteristics, psychological needs, and living habits, to create a safer, more convenient, and comfortable living environment. This transformation process is of great significance, directly affecting the quality of life and well-being of the elderly. First, age-friendly transformation can effectively reduce accidental injuries caused by safety hazards in the living environment, such as the installation of handrails, anti-slip treatments, emergency call systems, etc., improving the safety of the living space. Second, by adjusting furniture layout, optimizing lighting, and designing for accessibility, it allows elderly individuals to complete daily activities more easily, enhancing convenience. Moreover, age-friendly transformation also focuses on creating a warm and comfortable atmosphere, helping to reduce loneliness and anxiety, and improving psychological well-being. Therefore, age-friendly transformation is not only a necessary measure to address the challenges of an aging society but also an important manifestation of society's care and respect for the elderly.

2. Strategies for Age-Friendly Transformation of Living Environments from the Perspective of Smart Cities

2.1 Comprehensive Planning and Detailed Implementation

2.1.1 In-Depth Research on the Diverse Needs of the Elderly

Under the framework of smart cities, the first step in age-friendly transformation is to accurately grasp the real needs of the elderly. This requires diversified research methods, such as designing detailed surveys covering elderly people's daily activities, health management, social interactions, etc.; organizing face-to-face interviews to listen directly to the concerns and challenges of the elderly; and constructing a comprehensive portrait of elderly needs based on feedback from family members and community staff. Special attention should be paid to the elderly's acceptance, preferences, and obstacles in using technological products, ensuring that the transformation plan aligns with practical needs and improves elderly involvement and satisfaction.

2.1.2 Comprehensive Evaluation of the Existing Environment and Optimization Suggestions

The evaluation of elderly living environments should be meticulous, covering not only the physical environment but also psychological perceptions and social support systems. Specifically, the evaluation includes: (1) Physical environment evaluation: Using professional tools to test the anti-slip properties of floor materials, the stability of furniture layouts, the adequacy and softness of lighting systems, and whether indoor temperature and humidity are suitable to avoid extreme conditions that could affect the elderly's health. (2) Safety facility inspection: Focus on checking the configuration and effectiveness of safety features such as smoke detectors, emergency call buttons, non-slip mats, and handrails, ensuring that the elderly can receive timely assistance in emergencies[2]. (3) Psychological and social factors: Assess whether the living space is conducive to the elderly maintaining mental well-being, such as sufficient natural light, plant decoration, and accessibility to community activities to reduce loneliness.

2.1.3 Scientific Selection and Integration of Smart Facilities

In selecting smart facilities, it is essential to choose products that align with elderly users' habits and significantly improve their quality of life based on preliminary research results. For example: (1) Smart door locks and access control systems: Use convenient unlocking methods like facial recognition or fingerprint identification to reduce memory burdens for elderly individuals while ensuring home security. (2) Smart environmental monitoring: Deploy temperature and humidity sensors and air quality monitors to automatically adjust the indoor environment, creating a comfortable living space. (3) Health monitoring and assistive devices: Provide wearable devices to monitor physiological indicators like heart rate and blood pressure, smart mattresses to track sleep quality, and integrate big data analysis to offer personalized health recommendations. (4) Smart entertainment and social platforms: Develop easy-to-use smart TVs, voice assistants, and social platforms designed for the elderly to promote communication with family and friends and enrich their social lives.

2.2 Age-Friendly Transformation of Indoor and Outdoor Environments

2.2.1 Refined Transformation of Indoor Environments

For indoor environments, age-friendly transformation should focus on every detail to ensure the convenience and safety of elderly residents. Specific measures include optimizing space layout, setting up spacious shoe-changing areas and sturdy furniture, equipping sensor-based lighting, and reducing obstacles in daily activities. Choose low, rounded corner furniture to reduce the risk of bumps, and install adjustable-height tables and lift-up cabinets to meet different seating and storage needs. Additionally, install emergency call buttons at the head of the bed and place frequently used medications and flashlights within easy reach. Non-slip tiles should be laid on the floor, handrails installed on walls, and anti-slip treatments and seating should be added to the shower area to simplify operations and ensure safety.

2.2.2 Accessibility Design for Outdoor Environments

Outdoor age-friendly transformation is equally important and should integrate accessibility design principles. Increase the width of doorways and corridors, install handrails on both sides, and ensure that wheelchairs can pass smoothly. For multi-story buildings, elevators or lifting platforms should be installed to eliminate vertical movement barriers. In public areas such as stairways and hallways, set up sloped ramps and non-slip tiles to enhance elderly mobility safety. Additionally, increase lighting and use high-contrast color markings, and install audio and visual prompts to help elderly individuals with vision and hearing impairments better perceive the environment.

2.3 Age-Friendly Transformation of Urban Public Spaces

2.3.1 Age-Friendly Design of Urban Squares

Urban squares, as common public spaces for elderly people, play a key role in age-friendly transformation. Sufficient rest benches and shading facilities should be provided to ensure a comfortable resting environment. The square floor should be made of non-slip materials, and clear directional signage should be placed to help elderly individuals easily navigate the area. Moreover, public toilets should be equipped with accessible features such as low-level washbasins and toilets to meet the special needs of elderly individuals.

2.3.2 Age-Friendly Transformation of Urban Parks

Urban parks are essential places for elderly people's outdoor activities and social interactions. In parks, moderate-width walkways with handrails and non-slip tiles should be installed to ensure safe walking. Age-appropriate fitness equipment and leisure facilities, such as low chairs and chess tables, should be provided to encourage light physical activity and social interaction. Additionally, adequate lighting should be installed, and emergency call systems should be set up to address unexpected situations.

2.4 Technology Empowerment and Smart Application

2.4.1 Deep Integration of Smart Systems and Personalized Services

The integration of smart systems is a critical support for smart elderly care. By developing or selecting highly integrated smart home systems, the management of indoor environments, such as lighting, temperature control, and security, can be intelligently controlled remotely. At the same time, smart wristbands, smart mattresses, and other devices can monitor elderly health indicators in real time, uploading data to the cloud to provide family members and caregivers with timely health information. Furthermore, integrating smoke detectors, water leakage sensors, and other safety monitoring devices builds a comprehensive safety network.

2.4.2 Building a "One-Click" Comprehensive Service Platform

A "one-click" service platform should be built to integrate diversified services such as medical consultation, home services, meal delivery, and social entertainment to meet the comprehensive needs of the elderly. Through the platform, elderly individuals can easily book doctor appointments, access health information, and receive medication reminders. Additionally, the platform provides daily cleaning, laundry, and personalized meal services, as well as online learning resources and elderly university courses, enriching their spiritual lives and promoting social interaction.

3. Case Analysis: "Barrier-Free Community" in Tokyo, Japan

As a city with a high degree of aging, Tokyo offers

valuable experience in age-friendly transformation. Tokyo's "Barrier-Free Community" initiative addresses both the physical and social accessibility of environments (Figure 1). Physically, the community features wider doorways, handrails, elevators, and other modifications to improve accessibility. Socially, it emphasizes accessible public transportation, multi-language services, and enhanced interpersonal communication within the community. Additionally, Tokyo has established a comprehensive elderly care service system that includes day-care centers, short-term care facilities, and in-home services, catering to the diverse needs of the elderly[3].

The main features of this project are as follows: (1) Comprehensiveness: Tokyo's barrier-free community initiative emphasizes a holistic and systematic approach, enhancing the quality of life for the elderly from all dimensions—hardware to software, material to mental aspects. (2) Technology Integration: Tokyo utilizes modern information technology in its age-friendly transformations. Smart wearable devices, emergency call systems, and environmental monitoring sensors enable real-time monitoring and alerts regarding elderly health conditions, improving the precision and efficiency of elderly care services. (3) Human-Centered Approach: Tokyo's barrier-free community initiative not only addresses the physiological needs of the elderly but also focuses on their psychological needs. By fostering interpersonal communication within the community and providing multi-language services, it creates a warm, inclusive environment.

4. Challenges and Countermeasures in Age-Friendly Renovation of Living Environments from a Smart City Perspective

4.1 Challenges

4.1.1 Technical Difficulties and Maintenance Costs

The effective application and ongoing maintenance of smart technology are primary challenges. On one hand, age-friendly renovations require advanced technologies such as IoT, big data, and AI, demanding a high level of technical knowledge and expertise for integration and deployment[4]. On the other hand, the maintenance, system upgrades, and troubleshooting of smart devices require a dedicated technical support team, which increases long-term operational costs.

4.1.2 Funding Difficulties

Age-friendly renovations involve structural adjustments, the purchase of smart devices, and the installation of accessible facilities, each requiring significant financial investment. For most families, this poses a considerable economic burden. Furthermore, funding channels for renovation projects are limited, lacking stable sources, making widespread implementation challenging.

4.1.3 Cultural Differences and Acceptance

Elderly people from different regions and cultural backgrounds show varied acceptance levels toward smart technology. Some elderly individuals may resist smart devices due to a lack of digital skills or fear of new technologies, hindering the full benefits of smart transformations. Additionally, economic disparities between regions affect the adoption and application of smart technologies.

4.2 Countermeasures

4.2.1 Strengthen Technical Research & Developing and Standardization

Encourage research institutions and companies to increase investment in smart elderly care technology, developing more elderly-friendly smart products and systems, such as voice recognition assistants and simplified interfaces. Establish unified standards for smart, age-friendly renovations to regulate technology application processes and service quality, ensuring the professionalism and effectiveness of renovation efforts.

4.2.2 Diversified Funding and Policy Support

Seek government financial subsidies and tax incentives to support age-friendly renovation projects, reducing the burden on families and individuals. Explore public-private partnership (PPP) models to attract social capital to age-friendly renovation projects, achieving efficient fund allocation through market-based operations. Set up special public welfare funds that accept donations to provide renovation assistance for economically disadvantaged elderly individuals.

4.2.3 Public Awareness and Community Involvement

Provide digital skills training for the elderly to enhance their understanding and use of smart technology, reducing technology-related fears. Offer smart services tailored to the lifestyle and preferences of the elderly, incorporating local cultural characteristics to increase

technology acceptance. Leverage the community's role in age-friendly renovation as a bridge to inspire more elderly people to participate by showcasing and promoting successful cases, fostering a positive social atmosphere.

Conclusion

Age-friendly renovations in smart cities are crucial in addressing the challenges of an aging population. Through comprehensive planning, technological empowerment, human-centered approaches, and community participation, a safe, convenient, and comfortable living environment for the elderly can be created. Moving forward, efforts should continue to focus on technical research and development, policy support, and public awareness to drive further progress in age-friendly renovation. Additionally, human-centered care and community involvement are essential to fostering a warm, harmonious community environment, allowing the elderly to truly benefit from smart city development.

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