Creativity and Innovation
2025, VOL. 9, NO. 4, 16-21
DOI: 10.47297/wspciWSP2516-252703.20250904

Design of a Community Spatial Service App for the Elderly Driven by Age-Friendly Design Theory

Lu Deng

Hunan Normal University, Changsha, Hunan, 410000, China

ABSTRACT
This study responds to the urgent need of elderly populations for community spatial services in the context of an aging society. Tracing the evolution of age-friendly design theory—from universal design to inclusive design—it provides an in-depth analysis of the physiological, psychological, and social behavioral characteristics of older adults. Based on this, a four-dimensional design framework is proposed, encompassing physical adaptability, cognitive friendliness, emotional inclusiveness, and safety and trust. The research further integrates practical design strategies for elderly community service apps. The outcomes provide theoretical support and practical models for smart elderly care applications, aiming to bridge the digital divide and promote the construction of age-friendly communities.

KEYWORDS
Age-friendly design; Elderly communities; Spatial services; App design; Inclusive design; Smart elderly care

1 Introduction

1.1 Research background

The global demographic structure is undergoing a profound transformation, with aging becoming a defining feature of 21st-century human society. According to the United Nations' World Population Prospects 2023 report, the global population aged 60 and above is expected to increase from 1 billion in 2023 to nearly 2.1 billion by 2050, rising from 13% to 22% of the total population. China is experiencing an even faster aging process. As of the end of 2023, the country had 297 million people aged 60 and above, accounting for 21.1% of the population, including over 44 million who are disabled or semi-disabled, and more than 50% classified as "empty-nesters." In this context, traditional community spatial service models are insufficient to meet the diversified and personalized needs of the elderly. Smart elderly care is emerging as a key solution to these challenges[1].

Meanwhile, the rapid development of mobile internet technology offers opportunities for intelligent transformation of community services. However, the "digital divide" facing the elderly is becoming increasingly apparent. According to the Ministry of Industry and Information Technology, despite efforts to promote age-friendly transformation of internet applications, few apps truly meet the needs of older users. Existing community service apps are generally designed with younger users in mind, resulting in complex interfaces, cumbersome operations, and a lack of emotional care. This leads to low willingness among elderly users to engage with such apps and high learning costs. Therefore, conducting research on elderly-oriented community service apps based on inclusive design principles holds significant practical value.

1.2 Research objectives and significance

This study aims to achieve three core objectives: examining the evolution of age-friendly design theory from universal to inclusive design and constructing a theoretical framework aligned with the needs of elderly populations, conducting empirical research to deeply explore the functional requirements, interaction pain points, and emotional needs within elderly community service scenarios, and proposing app design strategies that balance both functionality and emotional resonance while validating these strategies through practice. Theoretically, this research contributes to the application of inclusive design in the field of digital products for the elderly and refines the methodological system of age-friendly design[2]. Practically, the findings provide actionable design guidelines for elderly care service providers, community managers, and app developers to facilitate the creation of community service apps that genuinely address the needs of older adults, further promoting the development of smart elderly care ecosystems and the construction of age-friendly societies.

2 Literature review

2.1 Evolution of age-friendly design theory: from universal design to inclusive design

The development of age-friendly design theory is closely tied to the increasing awareness of the needs of special populations. The theoretical roots of this concept can be traced back to the 1980s, when American architect Ronald Mace

proposed the idea of "Universal Design." This theory emphasizes that design should meet the needs of users of all ages and abilities without requiring special adaptations. The seven principles of universal design—equitable use, flexibility in use, simple and intuitive use, perceptible information, tolerance for error, low physical effort, and appropriate size and space for approach and use—provide a general framework for product and environmental design and lay a theoretical foundation for elderly inclusion in society[3].

With the rise of inclusive values, the concept of "Inclusive Design" gained prominence in the early 21st century. Inclusive design goes beyond the functional focus of universal design by emphasizing a deeper understanding of user diversity and integrating the voices of marginalized groups into the design process. The UK Design Council defines inclusive design as a solution that involves three dimensions: "observing differences, understanding needs, and creating value." This theory promotes a shift in age-friendly design from merely eliminating barriers to actively addressing the emotional, social, and cultural needs of elderly users.

2.2 Current research on elderly community spatial services

2.2.1 International developments

Under the influence of inclusive design, international research on elderly community spatial services has shown a trend of integrating technology with humanistic care. In Japan, the "regional-based" elderly care model has inspired the development of the "Health Care Navi" app, which integrates community medical care, shopping, and social resources into a one-click service interface. The app uses large icons and voice navigation to enhance accessibility, with elderly users accounting for 73% of its user base. In Nordic countries, a proactive aging approach is evident. For instance [4], Norway's "Age-Friendly City Map" combines GIS technology and AR navigation to mark age-friendly facilities and offer personalized services such as real-time weather updates and activity reminders, thereby enhancing elderly users' ability to independently explore their surroundings. In the U.S., the AARP developed a "Livability Index" tool that visualizes data to help elderly individuals assess community age-friendliness across ten dimensions, including housing, healthcare, and transportation. This reflects the core inclusive design principle of "observing differences and understanding needs."

2.2.2 Domestic research landscape

In China, research on elderly community spatial services has achieved some progress, but there remains substantial room for applying inclusive design concepts in depth. In the smart elderly care platform space, enterprise-led initiatives have yielded notable results. JD Technology Group, as an industry leader, has implemented pilot projects across multiple regions. For instance, the smart elderly care service platform in Hexi District, Tianjin, integrates data on elderly residents from four major dimensions and 21 indicators, such as family and health status. This data connects departments like public security and social insurance, supports privatized deployment, and enables dynamic updates to elderly care data. JD's "Xiao'ang" smart calling system automatically contacts 5,000 elderly individuals living alone daily, completing health checks within three hours. Additionally, JD has co-developed the "Jingcai Homeland" operating system with Xi'an Aerospace Base, leveraging IoT platforms to integrate in-home and outdoor smart systems and provide one-stop services like remote monitoring and housekeeping assistance[5].

In academia, the Institute of Health Informatics at Nanjing University (2023) expanded the traditional RFM model using real smart elderly care platform purchasing data. By adding L, R, F, M, S, and SR indicators, they used K-means++ clustering to create user profiles and employed the Boruta algorithm and LightGBM for feature selection and model training, thereby offering data-driven strategies for platform optimization.

However, real-world applications continue to face challenges. Platforms such as Beijing's "96156" community hotline and Shanghai's "One-Click Elderly Services" often suffer from fragmented functionality and interfaces poorly adapted to elderly cognitive traits. Some apps feature overly complex workflows that exceed older adults' information processing capacities, resulting in unsatisfactory user experiences and highlighting a lack of inclusiveness and age-friendliness in current service design.

3 Analysis of existing elderly app design pain points and deficiencies

3.1 Mismatch between functional design and user needs

According to Maslow's hierarchy of needs, there is a significant mismatch between the functional design of elderly apps and actual user demand. Many current applications focus excessively on breadth—simply integrating diverse services like medical care and social entertainment—while failing to deeply develop high-frequency, essential use cases in elderly users' daily lives. In health management, for example, apps often introduce complex professional medical data interpretation modules, disregarding the fundamental needs of older adults for basic alerts and emergency guidance related to common illnesses like hypertension and diabetes. This leads to information overload and prevents users from

quickly extracting key insights. In the area of social functionality, developers often ignore elderly users' preference for familiar social circles and emotional exchanges, instead copying features from younger users' platforms such as short video creation or complex gaming mechanics. As a result, these functions are poorly aligned with the elderly's expectations and usability, violating the core user-centered design (UCD) principle.

3.2 Poor adaptation of interaction design to elderly cognitive characteristics

Interaction design in many elderly apps does not adequately consider the physiological and cognitive characteristics of aging users. Based on research in ergonomics and cognitive psychology, common interface problems include dense layout, small text and icon sizes, and low contrast color schemes, which hinder readability and accessibility. In terms of interaction processes, overly complex hierarchical structures and hidden features significantly increase users' cognitive load and learning costs. For example, registration and login processes often require multiple unnecessary personal details, CAPTCHA verification, and facial recognition, which contradict elderly users' need for simplicity and ease of use. Such designs hinder effective user engagement and violate usability design standards.

3.3 Structural deficiencies in information security and privacy protection

From an information security risk perspective, older adults—due to lower digital literacy and awareness—are at higher risk of online security incidents. Some elderly-targeted apps exhibit serious flaws in data management, collecting sensitive personal information such as biometric data and financial accounts without explicit user consent or through vague agreements, thus violating China's Personal Information Protection Law. In addition, insufficient technical safeguards in data storage and transmission pose risks of data breaches. Worse still, certain malicious apps disguise themselves as elderly care services to exploit users' trust and obtain critical data like ID numbers or bank passwords for telecom fraud. These issues reveal major gaps in the current elderly app ecosystem regarding authentication mechanisms and risk prevention systems.

4 Case study: design of an elderly community spatial service App

4.1 Design background

Against the backdrop of deepening population aging in China, urban communities have become key spaces for elderly individuals to live, socialize, and manage their health. However, current community service models often suffer from slow response, fragmented content, and a lack of personalized support, making it difficult to meet the multifaceted needs of older adults. Despite national efforts to promote age-friendly digital transformations, most elderly service apps still follow youth-oriented design paradigms—complex interfaces, cumbersome operations, and an absence of emotional care—further deepening the digital divide[6].

To address these issues, an integrated online-offline solution is needed to enhance service accessibility and user experience through intelligent means. This led to the conceptualization of the "Xingfu Jia" (Happy Home) app—a community-integrated elderly life service platform centered on smart meal assistance, designed to activate and enhance the community service ecosystem.

The project focuses on real needs of community-dwelling elderly residents such as event participation, neighborly interaction, and daily life support. It adopts a design philosophy based on "inclusive design + community scenario integration." In contrast with existing platforms like Wuhan's *Elderly Care Chain* (which emphasizes supply logistics) or Shanghai Putuo's *Elderly e-Meal* (which provides basic ordering), this app aims to be a comprehensive and intelligent platform that truly aligns with elderly user needs. Especially in the high-frequency scenario of meal services, the app integrates smart, inclusive, and emotionally responsive features to elevate the community experience from "functional usability" to "emotional engagement," fostering an efficient and human-centered smart elderly care ecosystem.

4.2 User needs analysis

To comprehensively capture the multifaceted needs of the elderly within smart community settings, field research was carried out from April to May 2025 across multiple communities in Changsha's Tianxin and Furong districts, concentrating on the meal service scenario. The study involved 67 elderly residents aged 65 and above with basic smartphone proficiency, from whom valid questionnaires were collected. Furthermore, 12 semi-structured interviews were conducted and the meal ordering and delivery processes at community cafeterias were observed continuously for five days. In terms of physical adaptability, most users preferred simple and efficient workflows like a three-step meal ordering process; voice input, large-icon navigation, and feedback animations (e.g., "warm bowl and chopsticks" effects) effectively reduced anxiety and increased confidence. However, regarding cognitive-friendliness, many participants found the interface logic confusing and information entry points fragmented, strongly desiring the integration and easy access to core features such as event registration, health services, and emergency contacts. Smart recommendation systems

suggesting delivery on rainy days, for example, not only simplified decision-making but also provided subtle emotional support.

For emotional inclusiveness, users wanted more than shared meals and table-matching; there was significant demand for intergenerational interaction features allowing children to remotely order "filial meals" for parents, and volunteer point-exchange systems were seen as a way to foster a stronger sense of participation, emotional warmth, and belonging. Safety and trust were top priorities for the elderly, who emphasized service traceability including food ingredient sourcing details[7], real-time delivery route tracking, and alert mechanisms like notifying a contact if a meal was not picked up in time, all of which were crucial for building platform trust and enhancing overall security. In essence, this project reimagines meal service as an emotional center, integrating health monitoring, emergency response, and community engagement into a holistic, emotionally attuned smart service model. By generating personalized meal recommendations based on health records, facilitating intergenerational voice messages, and offering birthday meal bonuses, it aims to strengthen family ties, with the overarching ambition of transcending traditional food ordering and supply chain paradigms to transform smart community living into a vision where "a single bowl of food nurtures an entire community."

Figure 1 Field study photographs

Figure 2 Survey questionnaire results

5 Design strategy

5.1 Functional design: demand anchoring and ecological service construction based on community scenarios

The needs of elderly users in community settings are diverse and highly specific, spanning life assistance, social engagement, and health maintenance. The functional design of the "Xingfu Jia" app is rooted in on-site research and targets typical pain points in age-friendly community scenarios.

In the life service module, a "demand–supply" precision matching mechanism is established. It integrates local elderly meal providers and in-home care service vendors, using Geographic Information Systems (GIS) to visualize service coverage areas. With the help of Location-Based Services (LBS), elderly users can quickly filter service providers by distance and available times. The operation process is simplified into three steps: "select service type – confirm time – submit order," effectively lowering operational complexity.

The social interaction module focuses on the social needs of elderly users, offering sub-modules such as event registration, interest-based communities, and neighbor mutual assistance. Event registration is linked to offline events hosted by community committees or senior colleges, supporting one-click sign-up, capacity warnings, and reminders. Interest-based communities are categorized by topics like calligraphy or gardening; users can create, join, and post content to stimulate community vitality. The mutual assistance feature encourages younger elderly residents to assist older individuals, forming a peer support network within the community[8].

The health management module supports the collection, analysis, and intervention of health data, synchronizing with smart devices (e.g., smart wristbands, body composition scales) to address elderly users' core needs in daily community life.

5.2 Visual design: dual-channel optimization model based on elderly visual cognition theory

Due to age-related physiological changes, the elderly population exhibits distinct traits in visual recognition and color perception. The visual design of the "Xingfu Jia" app follows principles derived from visual psychology and cognition.

In terms of color scheme, the primary tone adopts a warm yellow palette (e.g., RGB: 255,223,128), offering both strong visibility and emotional warmth. This is paired with a high-contrast cool color (e. g., RGB: 51, 153, 255) as an accent, effectively distinguishing interface layers. Verified through color psychology experiments, this combination performs

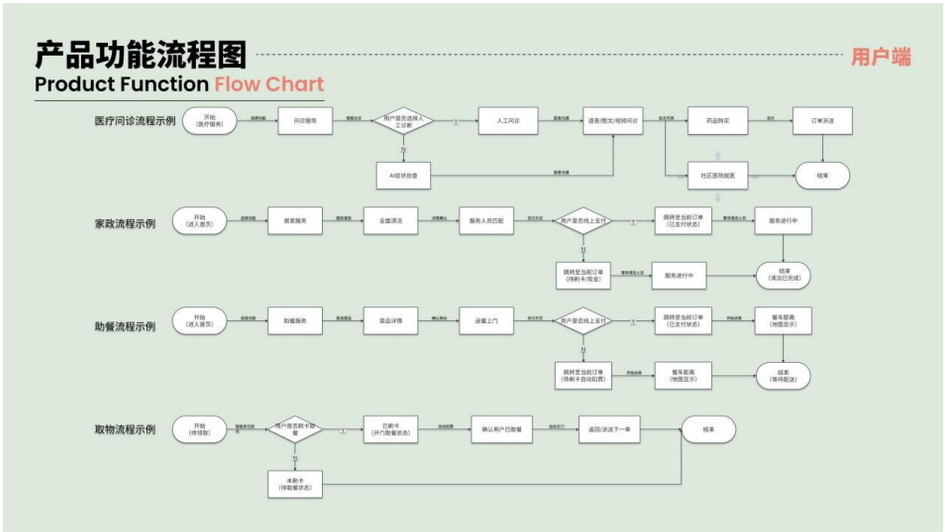

Figure 3 Functional flowchart of the app

better in tests on elderly users' visual fatigue and information recognition accuracy than conventional schemes, improving both readability and comfort.

The layout design adopts the principle of "minimalism," with an information architecture of "one screen, one function." Use of white space enhances breathing room and avoids visual clutter, resulting in better alignment with elderly cognitive characteristics.

Figure 4 Interface design samples of the app

5.3 Interaction design: low cognitive load-oriented age-friendly interaction paradigm

Elderly users typically experience low operational fluency and high learning costs with digital products. The interaction design of the "Xingfu Jia" app adheres to the principles of "low threshold, strong feedback, and user differentiation."

Process simplification is centered on "reducing redundancy and improving efficiency." For example, the conventional multi-step reservation process is optimized into a model of "scenario-based guidance + intelligent default values." The system automatically identifies commonly used addresses and service preferences, pre-filling form data so users need only confirm the core information to complete a task.

For differentiated needs between elderly users and community service providers, the elderly-facing side emphasizes convenience and fault-tolerance by including features like "undo operation" and "return to homepage." The community staff side focuses on "efficiency and information synchronization," streamlining work order processing and push notifications for real-time service changes. This end-to-end interaction optimization improves both elderly user experience and service responsiveness.

5.4 Brand extension: online-offline integrated ecosystem for community-based elderly services

The brand identity of the "Xingfu Jia" app incorporates age-friendly service concepts. Its LOGO uses "a house + caring hand gesture" as core symbols, designed with rounded lines and warm colors to convey the brand's values of "community protection and family warmth."

The visual identity system extends to community smart hardware (e.g., smart kiosks, autonomous delivery vehicles), maintaining visual and interaction consistency with the app to build a unified online–offline brand recognition system. Smart kiosks, installed in community activity centers and senior care stations, integrate features like service inquiry,

emergency calling, and health monitoring. The user interface reuses the app's visual and interaction logic to minimize cross-device learning curves.

The appearance of autonomous delivery vehicles incorporates branded visuals. Their deployment in real community scenarios reinforces elderly users' familiarity with the smart service platform. Meanwhile, the app collaborates with community committees and elderly care organizations to launch co-branded campaigns—such as the "Xingfu Jia Community Culture Festival." The app serves as the online portal for event registration and interaction, while offline events deepen emotional engagement with the brand. This expands the boundaries of the elderly service ecosystem and enhances brand recognition and user affinity in age-friendly community settings, driving a transition from "product use" to "ecosystem experience."

Figure 5 Design illustration of the autonomous delivery vehicle

6 Conclusion and outlook

The "Xingfu Jia" app presents a systematic design strategy based on community-centered elderly care scenarios, offering an innovative response to the dual challenges of population aging and smart community construction. Through precise functional alignment, age-adapted visual interaction optimization, and multi-dimensional brand ecosystem expansion, the app significantly lowers the digital threshold for older adults. By prioritizing user experience as the driving force, the app serves as a replicable model for addressing the digital integration challenges faced by the elderly.

In an era of accelerating aging and pervasive digital technology, this strategy not only provides new directions for upgrading smart community elderly care services, but also injects fresh momentum into the field of age-friendly product design. It supports the goal of enabling older populations to equally enjoy the benefits of the digital age.

Looking ahead, as the needs of elderly users evolve, new technologies emerge, and community ecosystems continue to develop, the optimization of smart community elderly services will face both new challenges and opportunities. Future research must continue to focus on the personalized and diverse needs of elderly users, integrating advanced technologies such as artificial intelligence and the Internet of Things to deepen age-friendly design practices. Furthermore, interdisciplinary and cross-sector collaborative innovation should be strengthened to elevate elderly services from being merely usable to being truly usable and lovable. This will help foster a more emotionally resonant and sustainable smart community ecosystem, and contribute design intelligence and practical solutions to better cope with aging and improve social governance.

References

[1] Sun, Yanyang. Research on Age-Friendly Design of Elderly Apartments Based on Maslow's Hierarchy of Needs [J]. Design, 2018(21):158–160.

[2] Dou, Jinhua & Qi, Ruoxuan. Design Strategy of Voice User Interface for Age-Friendly Smart Home Products Based on Situational Analysis [J]. Packaging Engineering, 2021, 42(16):202–210.

[3] Wang, Zhenxiang. Research on Age-Friendly Design of Household Products Based on Elderly Behavior Characteristics [D]. East China Normal University, 2019.

[4] Tang, Yi. Research and Recommendations on the Physical and Psychological Needs of the Elderly under Population Aging—Based on the ERG Theory Model [J]. Journal of Nanjing University of the Arts (Art and Design Edition), 2020(03):157–164.

[5] Cao, Wenjun. Research on Age-Friendly Design of Outdoor Spaces in Urban Communities Based on Environmental Behavior Studies [D]. Xi'an University of Technology, 2020.

[6] Wang, Yue. Research on Interface Interaction Design Based on Elderly Cognitive Characteristics [D]. Nanjing University of Science and Technology, 2018.

[7] He, Weishan. Research on Age-Friendly Interface Design for Online Learning Apps Based on Kano Model [D]. South China University of Technology, 2020.

[8] Chen, Yiyan. Research on Age-Friendly Design of Shopping Websites Based on Visual Cognitive Theory [D]. South China University of Technology, 2018.