INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN BUSINESS & SOCIAL SCIENCES

Vol 15, Issue 10, (2025) E-ISSN: 2222-6990

Construct a Service Functional Needs Model for Elder Care App Based on Maslow's Hierarchy of Needs Theory and A-Kano Model Analysis

Fan Jinyuan[1,2], Zuriawati Ahmad Zahari[1]*

[1]School of the Arts, Universiti Sains Malaysia, Penang, MALAYSIA, [2]School of the Arts, Anhui Xinhua University, Hefei, China.

Email: fanjinyuan@student.usm.my

*Corresponding Author Email: zuriawati@usm.my

DOI Link: http://dx.doi.org/10.6007/IJARBSS/v15-i10/26763

Published Date: 26 October 2025

Abstract

In order to the high-quality needs of modern elderly people in the information age, this study aims to develop a service function model for an elderly care app that better aligns with the usage habits and needs of the elderly. To identify and categorize the service function needs for the elder care app, develop a service functional needs model. This study invited 15 elderly users to participate in semi-structured interviews, ultimately identifying 20 core functional needs. These were then categorized into five dimensions based on Maslow's hierarchy of needs theory. Subsequently, the A-Kano model analysis method was used to quantitatively evaluate the five-level attributes of 20 items user needs from 175 questionnaires, determining the importance ranking of user needs. Finally, using the five-hierarchy attributes of needs and the corresponding priority rankings, a service function model for elder care App was developed featuring a primary functional interface comprising five major modules, 'Assistant, Medical, Enjoyment, Esteem, and Doing', along with a secondary interface featuring 20 service function needs. The model aligns well with the various needs of the elderly across five dimensions, which could be used in the development and design of the elder care app. This paper guides the elder care service industry providers in formulating market strategies and enables prediction of elders' satisfaction with the future elder care service industry market.

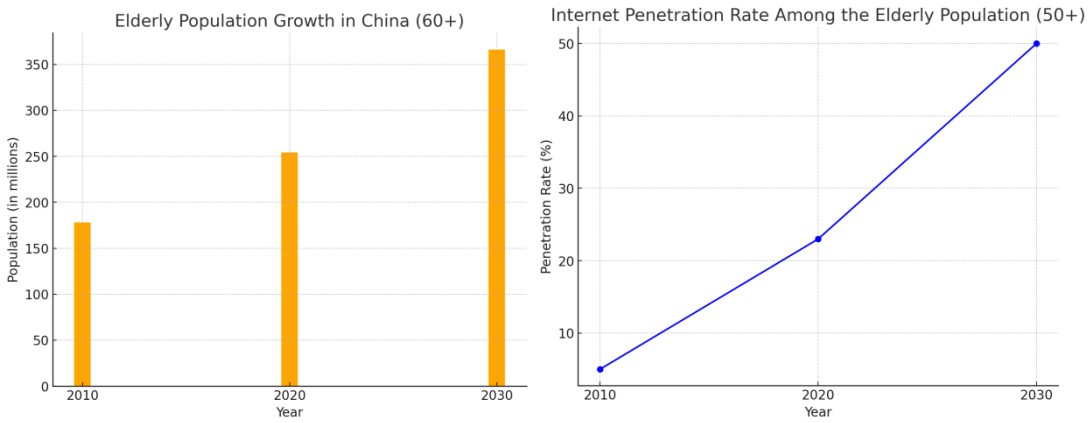
Keywords: Service Functional Needs Model, A-Kano Model Analysis, Maslow's Hierarchy of Needs Theory, And Elder Care App

Introduction

The global population is aging at an unprecedented rate, making elderly care a critical social issue. According to the United Nations, the population aged 60 and above is projected to reach 2.1 billion by 2050, accounting for 22% of the total global population (United Nations, 2019). In China, the aging problem is particularly severe. Data from the National Bureau of

Statistics of China shows that in 2021, the population aged 60 and above reached 264 million, accounting for 18.7% of the total population (National Bureau of Statistics of China, 2021). This trend has increased the demand for elderly care services while exposing the inadequacy of existing care resources. The aging population not only poses challenges to healthcare systems but also impacts economic productivity and social stability, necessitating innovative solutions to address these issues (World Health Organization, 2020).This trend has increased the demand for elderly care services while exposing the inadequacy of existing care resources.

The China Internet Network Information Center conducted a survey on the internet penetration rate among the elderly population aged 50 and above, predicting that by 2030, this rate could exceed 50% (CNNIC, 2021), the specific population illustrated in Figure 1.



(a) (b)

Fig.1. The population elderly aged 60 (a);
The internet penetration rate among those aged 50 (b)

These figures reflect how the shift in population structure has significantly increased the demand for products and services among the elderly, particularly in areas such as health management, online social networking, e-commerce, and smart home technologies. The rapid demographic transformation has underscored the urgency of rethinking traditional models of elderly care. However, current supply falls far short of meeting this demand (Fa *et al.*, 2025). The imbalance between supply and demand presents unprecedented opportunities and significant challenges for the aging industry. This scarcity is particularly pronounced among the emerging elderly population, whose needs have changed considerably. The current digital market primarily serves younger demographics, with a severe lack of applications specifically designed for the elderly, failing to meet their diverse needs effectively (Meng *et al.*, 2019).

Elderly care applications (elder care apps) have emerged as a promising technological solution to address the challenges of aging. By integrating functions such as health monitoring, telemedicine, and daily life assistance, elder care apps provide convenient and personalized care services for the elderly, significantly improving their quality of life and alleviating the care burden on families and society (Shi & Yu, 2021). For instance, Japan's “Smart Silver” project has successfully enhanced the independence and well-being of the elderly through the development of elderly-friendly technologies (Di, 2024). Similarly, the adoption of elder care

apps has been shown to reduce hospital readmission rates and improve chronic disease management among older adults (Grossman *et al.*, 2022).

However, despite their theoretical potential, the practical performance of elder care apps has been inconsistent. Many applications fail to meet the diverse needs of the elderly, resulting in poor user experiences and low market acceptance (Li, 2023). The root cause of this issue lies in the lack of systematic analysis of elderly needs and the ineffective integration of user requirements into product functionalities. For example, a study found that 65% of elder care apps lacked essential features such as accessibility options and multilingual support, which are critical for elderly users with varying levels of technological proficiency (Liu *et al.*,, 2021). Additionally, the absence of a comprehensive needs analysis framework has led to a mismatch between app functionalities and user expectations, further limiting their effectiveness (Shao *et al.*, 2022).

To address these challenges, this study aims to develop a service functional needs model for elder care apps based on Maslow's Hierarchy of Needs Theory (Maslow, 1943) and the A-Kano Model (Kano *et al.*,, 1984). Maslow's theory provides a foundational understanding of human needs, ranging from basic physiological requirements to higher-level psychological and self-fulfillment needs. By applying this theory, the study identifies the core needs of elderly users and categorizes them into essential and aspirational requirements. The A-Kano Model, on the other hand, offers a systematic approach to prioritizing these needs based on their impact on user satisfaction. This dual theoretical framework ensures a comprehensive and structured analysis of elderly needs, enabling the development of elder care apps that are both functional and user-centric.

The significance of this study lies in its potential to bridge the gap between theoretical research and practical application in the field of elderly care technology. By constructing a service functional needs model, this research provides a theoretical foundation and practical guidance for the design and development of Elder Care Apps. The findings of this study are expected to contribute to the innovation and advancement of elderly care technology, ultimately improving the quality of life for the elderly and reducing the societal burden of aging. Furthermore, the proposed model can serve as a reference for policymakers and industry stakeholders in formulating strategies to promote the adoption and effectiveness of Elder Care Apps.

Overall, this study contributes in three key ways. First, it integrates Maslow's Hierarchy of Needs Theory with the A-Kano Model to provide a dual-layer analytical framework that captures both the hierarchy and priorities of elderly needs. Second, it empirically validates this framework using mixed-method data combining qualitative interviews and quantitative modeling, thereby bridging conceptual theory with applied gerontechnology. Third, it develops a service functional model for elder care apps that can serve as a design blueprint for developers and policymakers focusing on age-friendly digital ecosystems.

Literature Review

Aging and Elderly Care Needs

The global aging trend is becoming increasingly prominent, with a significant rise in the proportion of the elderly population, particularly in China (United Nations, 2019). This

demographic shift has profound implications for healthcare, the economy, and society (Bloom *et al.*, 2020). The growing elderly population has led to a surge in demand for medical resources, especially in the areas of chronic disease management and long-term care (Prince *et al.*, 2020). Concurrently, the number of elderly individuals who are capable of adapting to mobile devices is also increasing, which presents new opportunities for leveraging technology in elderly care (Czaja *et al.*, 2019). Aging poses new challenges to family structures and social support systems (Zeng & Hesketh, 2020). Traditional family-based elderly care models are increasingly difficult to sustain in modern society, particularly in the context of rapid urbanization (Chen & Liu, 2021). As family sizes shrink and intergenerational relationships become more distant, the demand for community and institutional care among the elderly has significantly increased (Feng *et al.*, 2020). This shift necessitates the development of innovative solutions to meet the diverse care needs of the elderly population (Peek *et al.*, 2020).

Effectively addressing the diverse care needs of the elderly has become a critical societal issue (World Health Organization, 2021). The integration of technology, such as mobile devices and digital health platforms, offers promising avenues to enhance elderly care services (Demiris *et al.*, 2020). Additionally, community-based care models and policy interventions are essential to ensure that elderly individuals receive the support they require (Bennett *et al.*, 2021). As the aging population continues to grow, it is imperative to develop comprehensive strategies that encompass healthcare, social support, and technological innovation to meet the evolving needs of the elderly (Bloom *et al.*, 2020).

Elderly Care Applications

With the advancement of technology, elder care applications have gradually become an important tool to address the care needs of the elderly (Peek *et al.*, 2020). These applications play a significant role in health monitoring, telemedicine, and daily life assistance, offering innovative solutions to improve the quality of life for older adults (Czaja *et al.*, 2019). For example, health monitoring functions can help the elderly track health indicators such as blood pressure and blood sugar in real-time, providing valuable data for early detection and management of chronic conditions (Demiris *et al.*, 2020). Meanwhile, telemedicine functions enable the elderly to receive professional medical consultations at home, reducing the need for frequent hospital visits and improving access to healthcare services (Bashshur *et al.*, 2020). Additionally, social support applications help alleviate loneliness and improve mental health among the elderly through virtual communities and online activities, fostering social connections and emotional well-being (Cotten *et al.*, 2021).

However, current elderly care applications still face numerous challenges. Firstly, many applications have limited functionality and fail to comprehensively meet the diverse needs of elderly users, such as integrating physical, mental, and social care services (Vaportzis *et al.*, 2018). Secondly, the user experience is poor, with complex interface designs that are difficult for the elderly to operate, particularly for those with limited technological literacy (Mitzner *et al.*, 2019). Furthermore, data privacy and security issues are also significant problems that need to be addressed, as elderly users are often concerned about the misuse or unauthorized access to their personal health information (Anderson & Agarwal, 2019). Research shows that elderly users have high expectations for the usability and security of applications, and existing applications still need improvement in these areas to gain wider acceptance and trust (Heart

& Kalderon, 2020). To overcome these challenges, developers must focus on creating user-friendly interfaces, enhancing data protection measures, and incorporating feedback from elderly users to ensure that the applications meet their specific needs (Fisk *et al.*, 2020).

Maslow Hierarchy of Needs Theory

Maslow's hierarchy of needs theory, introduced by American psychologist Abraham Maslow in 1943, categorizes human needs into five levels: physiological, safety, social, esteem, and self-actualization. This hierarchy is often depicted as a pyramid, effectively illustrating the progressive model of human needs (Zalenski & Raspa, 2006).Pensley conducted empirical research on the "Relax Night App" interface design from a user interface perspective, utilizing interviews and questionnaires based on Maslow's needs theory. The study analyzed the impact of visual design on sleep-improvement apps, offering practical insights into user experience (Pensley, 2022). Similarly, Zong (2022) explored the requirements of middle-aged and elderly users for social robot products by applying Maslow's hierarchy of needs theory. Through literature reviews and user interviews, the study examined how physiological, safety, social, esteem, and self-actualization needs influence the design of social robots specifically tailored to this demographic. Additionally, Li (2023) investigated the core needs of elderly users concerning "product functions and UI" when interacting with smartphone medical applications. The study emphasized the importance of meeting the physiological, safety, social, esteem, and self-actualization needs of elderly users to design more human-centric and technologically advanced applications, thereby enhancing user experience. Building on Maslow's theory of needs and user experience design, Liu (2017) constructed a needs hierarchy model for product design. This model, supported by practical research, delved into the specific user requirements for age-appropriate mobile social platforms. In summary, this study adopts Maslow's theory of needs as its theoretical foundation. Each level within Maslow's hierarchy is not isolated but must be considered in conjunction with various needs at different stages to form comprehensive judgments and decisions. Effective product and service design is inherently linked to a deep understanding and anticipation of user needs.

A-Kano Model

The Kano model, introduced by Takano in 1984, categorizes user needs into five types: Must-be Quality, One-dimensional Quality, Attractive Quality, Indifferent Quality, and Reverse Quality (Chen & Lin, 2007). This model is widely utilized to comprehend user preferences. Xu *et al.* (2009) proposed the Analytical Kano Model (A-Kano Model), a simplified and efficient method for decision evaluation and weight determination. The A-Kano model enhances the accuracy of calculating the importance of user demands, provides a clear visualization of various demand attributes and their priorities, and offers a basis for decision-making. As a professional tool, the A-Kano model is extensively applied in demand priority analysis, particularly in addressing the needs of the elderly. For instance, scholars have employed the A-Kano model to study healthcare robots for the elderly at home (Zhang *et al.*, 2024) and to analyze the functionalities of the Luoyang City Scenic Spot guide program, identifying the types of functional needs and their priority rankings (Wei & Yang, 2022). The A-Kano model to assess demand attributes in the logistics industry, thereby improving the quality of courier services (Zhang, 2019). Additionally, Tan *et al.*, (2020) have applied the A-Kano model to optimize design parameters for health monitoring in wearable fitness devices. The A-Kano model can also be integrated with other design methodologies, for example,

Wang (2023) proposed a product innovation design method by combining A-Kano and FAST, applying it to stroller design. However, compared to the traditional Kano model, the A-Kano model has seen limited practical applications. Despite this, the A-Kano model effectively addresses the limitations of the traditional Kano model by transitioning from qualitative to quantitative analysis. It introduces the Kano index to quantitatively measure user satisfaction, thereby constructing a more efficient decision-making framework. This enhanced model enables designers to gain a more precise understanding of user needs and to make more informed design decisions (Zhen, 2024).

Overall, in delivering design services to users, the application of Maslow's hierarchy of needs theory enables a comprehensive analysis of users' genuine demands for products, allowing for a more precise classification of primary and secondary user needs. The A-Kano (Analytical Kano Model) model, recognized for its simplicity and efficiency in decision-making evaluation and weighting, enhances the accuracy of assessing the significance of user needs and provides a clear visualization of various demand attributes and their priority rankings. The combination of these two approaches in product development allows for a more focused and accurate response to the authentic emotional needs of the elderly population.

Methodology

This study adopts a systematic, four-step methodology to develop a basic interface of a service functional model for an elder care app, with a prioritized ranking of its features. The methodology integrates qualitative and quantitative approaches, leveraging in-depth interviews, text analysis, survey questionnaires, and statistical modeling to ensure a comprehensive and user-centric design. Below is a detailed description of each step:

Step 1: Identification of Functional Needs through In-Depth Interviews

To identify the core functional needs of elderly users, semi-structured in-depth interviews were conducted with 20 participants aged 60 and above. The participants were selected through purposive sampling to ensure diversity in age, gender, digital literacy, and health status. The interviews were designed to explore participants' experiences, preferences, and challenges in using digital platforms, particularly health and wellness apps.

The interview process was facilitated using Otter.ai, an AI-powered 4transcription tool, to record and transcribe the audio into text. This ensured accuracy and efficiency in data collection. The transcribed text was then imported into NVivo, a qualitative data analysis software, to perform thematic analysis. NVivo was used to extract keywords and identify recurring themes related to functional needs. Finally, the extracted keywords were organized and analyzed using Excel to create a comprehensive list of functional needs.

Step 2: Categorization of Needs Based on Maslow's Hierarchy of Needs Theory

The functional needs identified in Step 1 were categorized into five dimensions based on Maslow's Hierarchy of Needs Theory: physiological, safety, love/belonging, esteem, and self-actualization. This categorization ensured that the model addressed the diverse and hierarchical needs of elderly users.

For example, needs related to health monitoring and medication reminders were classified under physiological needs, while features promoting social interaction and community

engagement were categorized under love/belonging needs. This step provided a structured framework for organizing the functional needs and ensured alignment with the theoretical foundation of the study.

Step 3: Quantitative Evaluation Using the A-Kano Model

To evaluate and prioritize the identified functional needs, a survey questionnaire was designed and distributed to 208 elderly participants. The questionnaire included questions to assess the importance and satisfaction level of each functional need.

The survey data were analyzed using SPSS, a statistical software, to perform descriptive statistics and demographic analysis of the population. The A-Kano Model was then applied to categorize the functional needs into five attributes: basic, performance, excitement, indifferent, and reverse. This analysis enabled the derivation of service priorities and satisfaction indices, providing a quantitative basis for ranking the functional needs.

Step 4: Construction of the Basic Interface Service Model

The final step involved integrating the prioritized functional needs and satisfaction indices with the five levels of Maslow's Hierarchy of Needs Theory to construct the basic interface service model for the elder care app. The model was designed to ensure that the app's features align with the hierarchical needs of elderly users, ranging from basic physiological requirements to higher-level self-actualization needs.

By combining qualitative insights from in-depth interviews with quantitative analysis using the A-Kano Model, this methodology ensures the development of a robust and user-centric service functional model for elder care apps. The integration of Maslow's Hierarchy of Needs Theory provides a structured framework for addressing the diverse needs of elderly users, while the A-Kano Model enables the prioritization of features based on user preferences and satisfaction. This approach not only enhances the usability and effectiveness of the app but also contributes to the broader field of gerontechnology and digital health. The researcher drew the specific research flow illustrated in Figure 2.

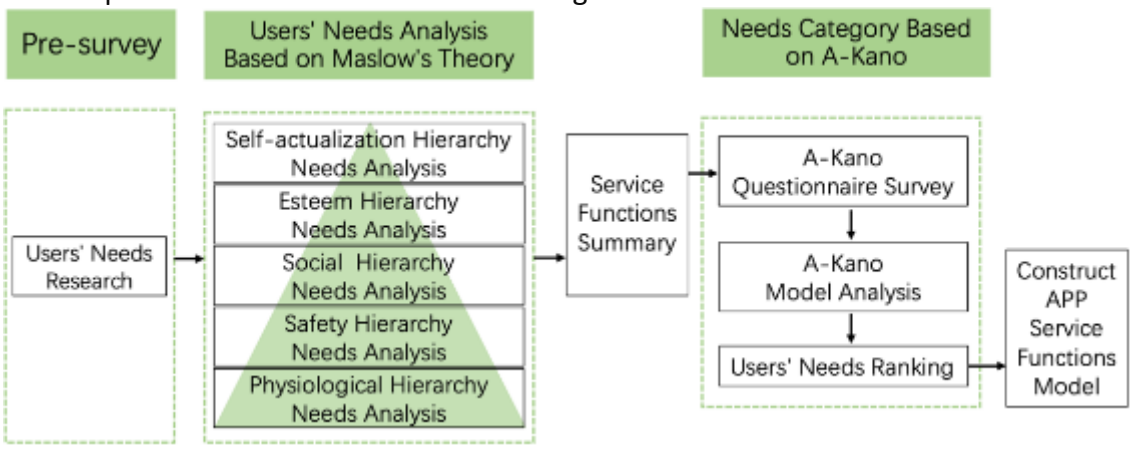


Fig. 2. Research Flow

Analysis

Analysis of Target User Characteristics

As living standards have improved, the elder's awareness of aging has increased, leading to a more diversified demand for elder care services. This shift necessitates more efficient

and targeted care solutions. Currently, China's elder care model primarily addresses the 'health' needs of the aging population, focusing on home care, health services, medical care, and disease management. The rapid advancement of digital information technology coincides with the aging process, integrating technology into elder care in a way that minimizes the need for human intermediaries while enabling auxiliary and experimental free use. This integration stimulates economic activity, promotes the renewal of consumption patterns, and upgrades service structures. It also reduces redundant labor in society, enhances social efficiency, and meets the diverse, multi-level, and multifaceted needs of the elderly in the digital information era. Consequently, the traditional 'old age' care model is evolving into an 'intelligent aging' model, transforming from an 'old aged' approach to a 'happy aged' model of smart elder care.

Research Subject Population

The subjects of this study comprised the elderly population of Hefei City, China. A purposive sampling method was employed, wherein participants who met the study's objectives and inclusion criteria were selectively chosen. The study sample comprised individuals aged 50 to 70 who have significant aging-related needs and the capacity to learn and use e-applications. This group of respondents included individuals with a history of being able to use apps easily, individuals with a strong interest in using aging apps, and older adults and their caregivers. The final sample size was determined by the information saturation principle commonly applied in interview-based studies. Although the age of elder is defined as starting at age 60 in China (State Council of the People's Republic of China. 2012), While 50 years of age is not traditionally classified as old age, it is important to consider that in China, women generally retire between the ages of 50 and 55 (State Council of the People's Republic of China. 1978). Therefore, the respondent group in this study also encompassed individuals aged 50 to 60.

Extracting the Service Functional Needs

This study completed in-depth interviews with 15 elderly users. Among the interviewees, there were 9 males and 6 females, with an average age of 61.4 years. Each interview lasted between 15 and 25 minutes. Following the interviews, the core needs of the elderly for the service functions of the elder care app were extracted through in-depth interviews with the elderly. Through the in-depth interviews with elder, the extracted keywords were visualized by creating a word cloud using the *WordArt tool*, as shown in Figure 2. This was eventually collated into 20 core service functional needs for elderly care app, as shown in Table 1.

Fig. 3. Word Cloud of service functional needs

Table 1
Service Functional Needs of Elder Care App

20 items of core service functional needs		
1.Household & Maintenance	8.Pension & Funeral	15.Life Shopping
2.Emergency Aid	9.In-home Care	16.Testing & Monitoring
3.Chronic Disease Management	10.AI Medical Consultancy	17.Health Wellness
4. Cultural & Entertainment	11.Online Consultation	18.Social & Marriage
5.Health Sports	12.Travel & Tourism	19.Experience Sharing Platform
6.Financial Management	13.Volunteer Activity	20.Re-employment Service
7.Medicare Insurance	14.Skills Upgrading	

The interviews provided insights into the living conditions of the elderly and their expectations for old-age life. A series of analytical processes were conducted to explore and refine the information, including identifying concepts, refining categories and summarizing themes, all in accordance with the Maslow Hierarchy Needs Theory. The core needs of the elderly were distilled and categorized, the researcher drew classifications depicted in Figure 4.

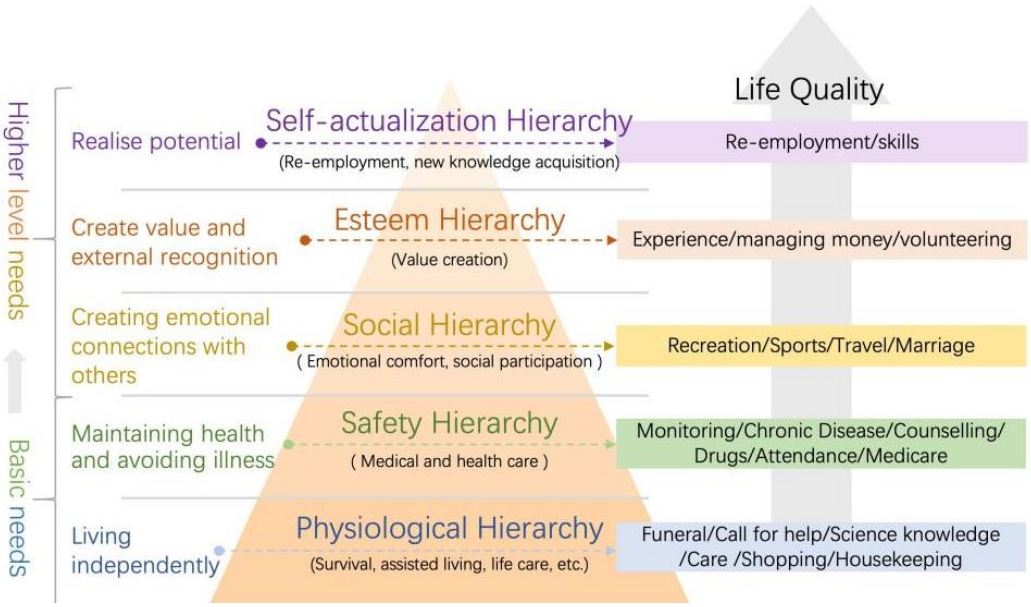


Fig. 4. Categories and hierarchy of needs of elderly people

Based on the varying living conditions of the elderly group and their specific needs, they can be categorized as follows: 1) Physiological hierarchy needs to maintain independent living through assistance; 2) Safety hierarchy needs to eliminate health worries and achieve health management; 3) Social hierarchy needs to establish emotional ties with them and enrich spiritual pursuits; 4) Esteem hierarchy needs to self-help to complete the contents of the online services; and 5) Self-actualization needs for self-worth.

Service Modules for Elder Care App

The 20 identified service functions were categorized according to the five levels based on Maslow's Hierarchy of Needs: Physiological, Safety, Social, Esteem, and Self-actualization. The service functions for each need hierarchy were subsequently coded, as illustrated in Table 2.

Table 2
Service functions of Need Hierarchy, Code, and Need Description

Need Hierarchy	Service Functions	Code	Need Description
Physiological Hierarchy	Pension & Funeral	A1	Traditional customs, convenient funeral services, etc.
	Household & Maintenance	A2	Cleaning/cooking service, in-home repair, etc.
	Life Shopping	A3	Neighborhood shopping, shopping platform, etc.
	In-home Care	A4	Health care, bathing & cleaning, etc.
	Health Wellness	A5	Scientific knowledge: life, medical care, Chinese medicine, etc.
	Emergency Aid	A6	One-button call for help, location sharing, etc.
Safety Hierarchy	Testing & Monitoring	B1	Regular medical examination, blood pressure/sugar, etc.
	Chronic Disease Management	B2	Chronic disease tracking treatment, rehabilitation, revisits, etc.
	AI Medical Consultancy	B3	Voice description of symptoms, preliminary judgment of the condition, etc.
	Online Consultation	B4	Booking online consultation, etc.
	Medicare Insurance	B5	Binding medical insurance, medical insurance deduction, etc.
Social Hierarchy	Culture & Entertainment	C1	Exhibition activities, community activities, etc.
	Travel & Tourism	C2	Traveling transport, travel planning recommendations, etc.
	Health Sports	C3	Community square dance, elder sports, etc.
	Social & Marriage	C4	Community activities, social platforms, etc.
Esteem Hierarchy	Experience Sharing Platform	D1	Sharing of life, customs work experience, etc.
	Financial Management	D2	Bank deposits, financial management platform
	Volunteer Activity	D3	Volunteer recruitment platform
Self-actualization Hierarchy	Re-employment	E1	Re-employment recruitment platform
	Skills Upgrading	E2	Elder university, skills learning (driving license, cooking, software, etc.)

Data

A-Kano model questionnaire design

The A-Kano questionnaire was set up in a standardized way with short descriptions of each requirement element, and the questions included weighted ratings of users' satisfaction with and the importance of whether an app for elder care had this feature. The contents of the questionnaire are shown in Table 3. The scale indicators were ‘I like it that way (like)', ‘It must be that way (must-be), ‘I am neutral (neutral)', ‘I can live with it (live with), and ‘I dislike it that way (dislike)'. To reduce the impact of negative responses, asymmetric values are used to measure the degree of user satisfaction or dissatisfaction. Based on the user needs summarized above, A-Kano's questionnaire covers 5 dimensions and contains 20 demand indicators.

Table 3
Scores for Functional / Dysfunctional & Self-stated importance

Kano question	Functional	Dysfunctional
I like it that way (like)	1	0.5
It must be that way (must-be)	-0.5	-0.25
I am neutral (neutral)	0	0
I can live with it (live with)	-0.25	0.5
I dislike it that way (dislike)	-0.5	1

Scores of Self-stated Importance

Not important	Somewhat important	Important	Very important	Extremely important
→				

0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0

Research Data Collection and Description

To distribute the questionnaires for the A-Kano study, both online and offline methods were used. Online distribution was done by using the Questionnaire Star platform and sharing the questionnaire through the communication tool WeChat. Offline, the questionnaire was distributed through random interviews, and respondents filled in the questionnaire on site after giving consent. To ensure the reliability and validity of the study data, the online and offline respondent groups were kept independent of each other. A total of 126 online and 82 offline questionnaires were collected and 208 questionnaires were returned. After excluding 33 invalid responses (incomplete, same answer for all options, or obvious logical errors), 175 valid questionnaires were retained, however, 9 respondents indicated that they were not willing to try out elderly care apps, so we excluded the questionnaires from these respondents, and the final result of the analysis was that 166 questionnaires were Among the respondents, 54.91% were male, 45.09% were female, the age of the respondents was between 50-70 years old, with the largest number of respondents in the 55-65 age group, the distribution of respondents is shown in Figure 5.

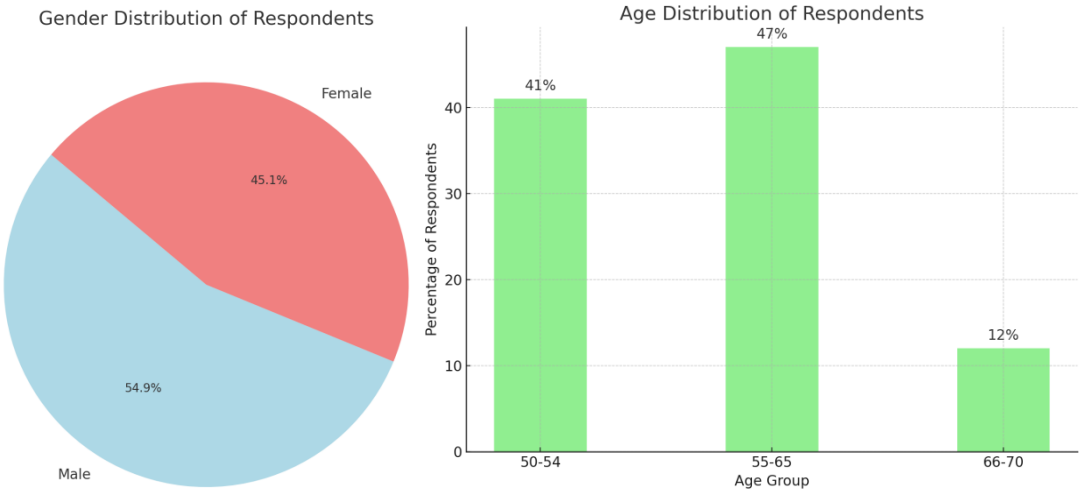


Fig. 5. Distribution of Respondents

Data Processing of Survey Results

The following five equations of the A-Kano model are adapted from Xu Q. L. (2009). If each interviewee is j and the number of interviewees is n, the survey result of each user demand is ∑ j = (xj, yj, wj), in which j=1,2,⋯, n (n = 127), x, y, and w are calculated as follows:

1) The mean value of user satisfaction with a function $\overline{\mathrm{x}}$, as Eq. (1).

$$\overline{\mathrm{x}} = \frac{1}{w}\sum_{j=1}^{n} \mathcal{W}_j \, \mathcal{X}_j \quad (1)$$

2) The mean value of user dissatisfaction with a dysfunction $\overline{\mathrm{y}}$, as Eq. (2).

$$\overline{\mathrm{y}} = \frac{1}{w}\sum_{j=1}^{n} w_j \, y_j \quad (2)$$

3) The average weight of a user's demand $\overline{\mathrm{w}}$, as Eq. (3).

$$\overline{\mathrm{w}} = \frac{1}{n}(w_1 + w_2 + \cdots + w_n) \quad (3)$$

The satisfaction of each need element can be represented by the vector $\mathrm{S_i} = (\mathrm{S_i},\ \alpha_\mathrm{i})$ in the form of polar coordinates, i is represented for the needs of users, and i=1,2,⋯,13. $\mathrm{S_i}$ the value that represents the two-dimensional satisfaction of the function from the origin to the function, that is, the importance is needed. ; α_i represents the angle between this function and the X-axis, that is, user satisfaction. The following are the specific calculation steps:

4） The importance index of demand S_i, as Eq. (4).

$$S_i = \sqrt{\overline{\mathrm{x}}^2 + \overline{\mathrm{y}}^2} \quad (4)$$

5） Judge the distance range of S_i and the angle range of $\boldsymbol{\alpha}_i$, as Eq. (5)

$$\begin{cases} |\,\mathrm{S_i}\,| \leq 0.5 & \text{Indifferent Quality} \\ 0.5 < |\,\mathrm{S_i}\,| \leq 1 \wedge \alpha \leq 25^\circ & \text{Must be Quality} \\ 0.5 < |\,\mathrm{S_i}\,| \leq 1 \wedge 25^\circ < \alpha \leq 65^\circ & \text{One dimensional Quality} \\ 0.5 < |\,\mathrm{S_i}\,| \leq 1 \wedge 65^\circ < \alpha \leq 90^\circ & \text{Attractive Quality} \end{cases} \quad (5)$$

A-Kano model analysis is drawn, as shown in Figure 3. The user's needs are divided into four categories: attractive needs (A), one-dimensional needs (O), must-be needs (M), and indifferent needs (I). Using the formula of the A-Kano model, the statistical results of the survey data of the service functional needs are shown in Table 4.

In the A-Kano model, the vector $(\mathrm{S_i})$, is called the importance index and the angle (α_i) is called the satisfaction index. Based on the statistical results of the data, the need attributes can be classified based on the interval of the vector $(\mathrm{S_i})$ scores of the formula (5), then positioned on the distance interval of $\mathrm{S_i}$ and the angle range of α_i, the researcher drew as in Figure 5.

Table 4
Statistical data of service functional needs

Items	Service Functional Needs	$\overline{x}$	$\overline{y}$	$\overline{w}$	S_i	α	Category
A1	Pension & Funeral	0.69	0.17	0.61	0.71	76.37	A
A2	Household & Maintenance	0.33	0.75	0.84	0.82	23.75	M
A3	Life Shopping	0.21	0.69	0.83	0.72	16.93	M
A4	In-home Care	0.28	0.37	0.69	0.46	36.60	I
A5	Health Wellness	0.58	0.68	0.76	0.90	40.62	O
A6	Emergency Aid	0.67	0.58	0.72	0.89	49.38	O
B1	Testing & Monitoring	0.50	0.52	0.75	0.72	44.16	O
B2	Chronic Disease Management	0.24	0.57	0.64	0.62	22.83	M
B3	AI Medical Consultancy	0.64	0.60	0.78	0.88	46.71	O
B4	Online Consultation	0.63	0.69	0.77	0.93	42.40	O
B5	Medicare Insurance	0.71	0.61	0.73	0.94	49.33	O
C1	Cultural & Entertainment	0.46	0.39	0.74	0.60	49.71	O
C2	Health Sports	0.18	0.56	0.68	0.59	17.82	M
C3	Travel & Tourism	0.22	0.62	0.69	0.66	19.54	M
C4	Social & Marriage	0.43	0.48	0.66	0.64	41.86	O
D1	Experience Sharing Platform	0.76	0.31	0.58	0.82	67.98	A
D2	Financial Management	0.20	0.65	0.74	0.68	17.10	M
D3	Volunteer Activity	0.27	0.22	0.62	0.35	50.64	I
E1	Re-employment	0.49	0.34	0.68	0.60	54.90	O
E2	Skills Upgrading	0.49	0.40	0.62	0.63	51.14	O

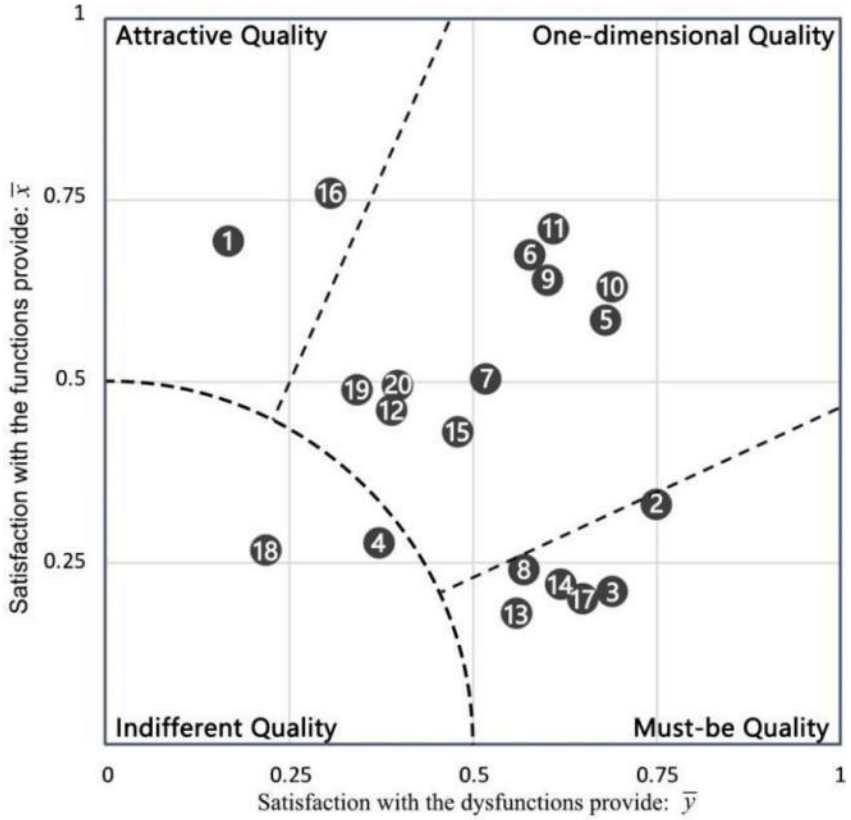


Fig. 5. A-Kano model analysis of functional needs

The A-Kano Model Needs Attribute Analysis

The prioritization of functional development follows the sequence: Must-be Quality > One-dimensional Quality > Attractive Quality >Indifferent Quality. For user needs within the same attribute category, the importance of each need index is further assessed by comparing the value of $\overline{w}$. The ranking results of demand importance are presented in Table 5.

Since Indifferent Quality represents product needs that users generally do not focus on, these items are typically eliminated in subsequent design and development phases. However, in this study, Indifferent Quality needs are also included in the later discussion and are not directly discarded. This inclusion is due to the understanding that within the Kano model, the classification of an element may evolve through the I-A-O-M (Indifferent-Attractive-One-dimensional-Must-be) development process. As such, it is crucial for the supply side to closely monitor dynamic changes in user demands and provide continuous, effective services. Consequently, these two demands with Indifferent attributes can serve as auxiliary functions in app development, helping to enrich the app's service content.

Table 5
The ranking result of importance of A-Kano model

Category Content	Importance Ranking
Must-be Quality	A2>A3>D2>C3>C2>B2
One-dimensional Quality	B3>B4>A5>B1>C1>B5>A6>E1>C4>E2
Attractive Quality	A1>D1
Indifferent Quality	A4>D3

Maslow's Theory Hierarchy of Needs Attribute Analysis

According to the five of Physiological Hierarchy, Safety Hierarchy, Social Hierarchy, Esteem Hierarchy, and Self-actualization Hierarchy, the importance of each index demand is further determined by comparing the value of $\overline{w}$, and the ranking result of importance is shown in Table 6.

Table 6
The ranking result of importance of Maslow's Hierarchy

Category Content	Importance Ranking
Physiological Hierarchy	A2>A3>A5>A6>A1>A4
Safety Hierarchy	B2>B3>B4>B1>B5
Social Hierarchy	C3>C3>C1>C4
Esteem Hierarchy	D2 >D1>D3
Self-actualization Hierarchy	E1>E2

Physiological Hierarchy

Within the physiological hierarchy of service needs for the elderly care app, the combined user needs are prioritized as follows: A2 > A3 > A5 > A6 > A1 > A4. Among these, A2 and A3 are essential for addressing basic life needs, though optimizing their design is not necessary. Greater fulfillment of A5 and A6 will result in higher user satisfaction. A1 is classified as an attractive demand—an unexpected product attribute that, if present, significantly enhances user satisfaction. Conversely, A4 is a demand that users generally do not prioritize, and its

presence or absence does not impact satisfaction; therefore, it may be considered as an optional supplementary function.

Safety Hierarchy

Within the safety hierarchy of service needs for the elderly care app, the combined user needs are ranked in the following order: B2 > B3 > B4 > B1 > B5. B2, B3, and B4 represent fundamental demands that must be met. B1 and B5 are categorized as One-dimensional demands, where greater implementation in the design leads to higher user satisfaction. Therefore, these types of needs should be prioritized in the design attributes to maximize user satisfaction.

Social Hierarchy

Within the service needs categorized under the social hierarchy of the elderly care app, the combined user needs are prioritized as follows: C3 > C2 > C1 > C4. Both C3 and C2 are classified as Must-be Quality attributes, while C1 and C4 are considered One-dimensional Quality attributes in which as these needs are increasingly met, there is a corresponding increase in user satisfaction.

Esteem Hierarchy

Within the esteem hierarchy of service needs for the elderly care app, the combined user needs are ranked as follows: D2 > D1 > D3. D1 is considered an attractive demand, meaning that its presence can significantly enhance user satisfaction. D2 is a must-be demand, which must be fulfilled to meet basic expectations. Meanwhile, D3 represents a service demand that users do not prioritize, making it suitable as an auxiliary function in product development.

Self-actualization Hierarchy

Within the self-actualization hierarchy of service needs for the elderly care app, the combined user needs are ranked as follows: E1 > E2. Both service functions are classified as One-dimensional Quality attributes, meaning that fulfilling these needs will increase user satisfaction.

Result

Based on the core needs of the elderly identified through semi-structured interviews, the priority service function items and modules of the elder care app were systematically developed using a hierarchical needs analysis informed by the A-Kano model and Maslow's hierarchy of needs. This dual theoretical framework ensures a comprehensive understanding of both the essential and aspirational requirements of elderly users.

Following the needs hierarchy established by the A-Kano model, which categorizes user needs into must-be, one-dimensional, attractive, indifferent, and reverse qualities, and prioritizing need satisfaction, 20 specific need items were meticulously ranked according to their importance within each hierarchical level. These results were then strategically integrated into the service model of the elder care app, as illustrated in Figure 7, to create a structured and user-centric design.

The elder care app's five primary modules were proposed: Help for the Elderly, Healthcare for the Elderly, Enjoyment for the Elderly, Respect for the Elderly and Doing Something for

the Elderly. These modules were subsequently simplified into five key APP interface terms: Assistant, Medical, Enjoyment, Esteem and Doing. The importance ranking of the 20 needs functions distributed across these five secondary function modules was determined through rigorous analysis. As shown in Figure 8, this ranking guided the development of tertiary functions by integrating the specific characteristics of elder care, thus offering a reliable reference for the functional configuration of the app.

The app's strengths lie in its ability to address the full spectrum of needs, from basic physiological and safety needs to higher-level needs such as belonging, esteem, and self-actualization, as outlined by Maslow's hierarchy. Additionally, the modular design ensures that the service functions are clear and user-friendly, enhancing the overall usability and accessibility for elderly users. This prioritization of needs-based functionalities is likely to significantly enhance user satisfaction and improve the overall experience, providing better support for elderly users in various aspects of their lives.

By leveraging the A-Kano model and Maslow's hierarchy of needs, the elder care app not only meets the essential requirements of its users but also anticipates and fulfills their higher-level aspirations, thereby creating a holistic and effective solution for elder care.

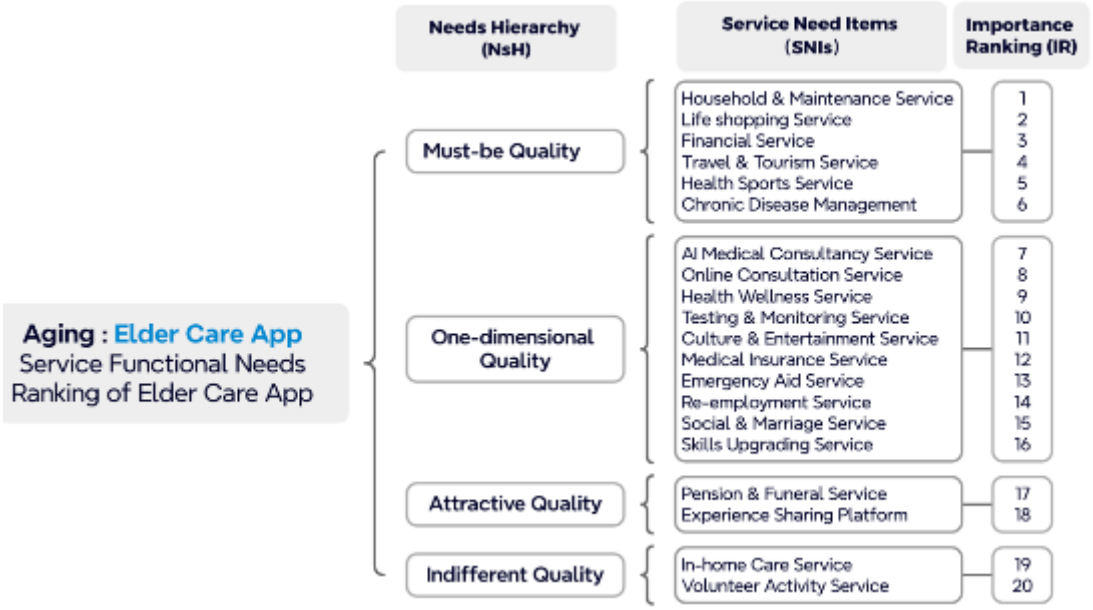


Fig. 7.Service Functional Needs Ranking of Elder Care App

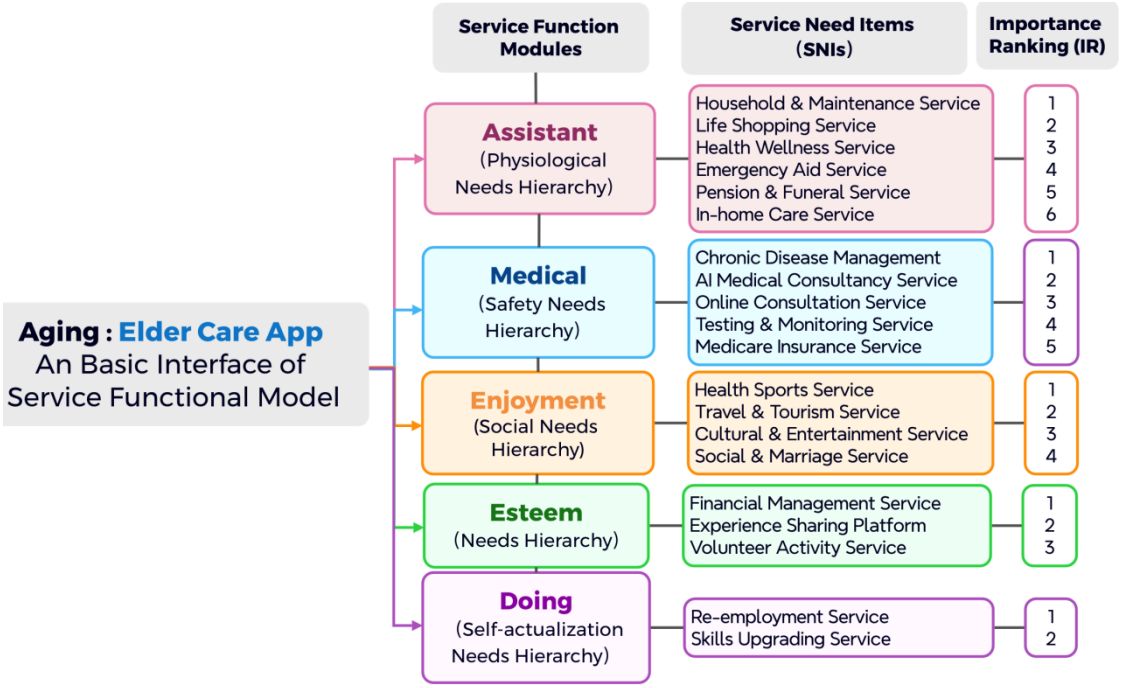


Fig. 8. Basic Interface Service Functional Model for the Elder Care App

Conclusion

The central motivation of this study was to respond to the existing disconnect between the complex, multidimensional needs of the elderly and the singular, function-oriented approaches dominant in current app design. Utilizing the A-Kano model to analyze the importance and hierarchical levels of elderly care needs in conjunction with Maslow's hierarchy of needs, has systematically developed five primary modules derived from twenty identified elderly care needs: Assistant, Healthcare, Enjoyment, Self-Esteem, and Action. This dual theoretical framework ensures a comprehensive and structured approach to understanding and addressing the diverse needs of elderly users. By integrating these models, the study aims to enhance the design of service functions and content, promote the development of elderly-friendly features, and provide practical design insights for home-based elderly care products. However, the construction of the elderly care app is not without its limitations. One significant challenge lies in the inherent variation in needs among different elderly users, which may result in certain functions being underutilized. This under utilization could potentially affect the overall effectiveness and user satisfaction of the app. Additionally, as technology continues to advance and societal conditions evolve, the needs of elderly users are expected to undergo continuous changes. This dynamic nature necessitates ongoing updates and optimizations to ensure the app remains relevant and useful over time.

Future research could focus on more refined and granular analyses of user needs, particularly on how to better accommodate the diversity and dynamic nature of elderly users' requirements. There is considerable potential in exploring the integration of advanced technologies such as artificial intelligence (AI) and big data analytic into the app. These technologies could enable the development of more intelligent and personalized service features, thereby enhancing the user experience and meeting the specific needs of individual users more effectively. Moreover, it is crucial to enhance the mechanisms for collecting and analyzing user feedback. Establishing robust feedback loops will allow for continuous

monitoring of user satisfaction and the identification of areas for improvement. This iterative process of feedback collection and analysis will be essential for the app's continuous improvement and development, ensuring that it remains aligned with the evolving needs of elderly users.

In conclusion, while the current study provides a solid foundation for the design of elderly care apps, future efforts should focus on addressing the identified limitations and leveraging emerging technologies to create more adaptive, personalized, and effective solutions for elderly care. By doing so, the app can better serve its target audience and contribute to the overall well-being and quality of life of elderly users.

Acknowledgement

I would like to express my sincere gratitude to the School of Arts, Universiti Sains Malaysia for providing an excellent academic environment and resources, which have greatly facilitated the completion of this paper. This research was funded by two grants from the 2024 Scientific Research Projects for Universities in Anhui Province, China (Grant No. 2024AH052549).

References

Anderson, C. L., & Agarwal, R. (2019). The digitization of healthcare: Boundary risks, emotion, and consumer willingness to disclose personal health information. Information Systems Research, 22(3), 469–490. https://doi.org/10.1287/isre.1100.0335

Bashshur, R. L., Shannon, G. W., Krupinski, E. A., Grigsby, J., Kvedar, J. C., Weinstein, R. S., … & Rheuban, K. S. (2020). The taxonomy of telemedicine. Telemedicine and e-Health, 26(6), 484–494. https://doi.org/10.1089/tmj.2020.0456

Bennett, M. R., & Song, X. (2021). Community-based care for older adults: A systematic review of interventions and outcomes. Journal of Aging and Social Policy, 33(2), 123–145. https://doi.org/10.1080/08959420.2021.1926200

Bloom, D. E., Chatterji, S., Kowal, P., Lloyd-Sherlock, P., McKee, M., Rechel, B., … & Smith, J. P. (2020). Macroeconomic implications of population aging and selected policy responses. The Lancet, 385(9968), 649–657. https://doi.org/10.1016/S0140-6736(20)30405-2

Chen, L. H., & Lin, H. C. (2007). Integrating Kano's model into E-learning satisfaction. IEEM 2007: 2007 IEEE International Conference on Industrial Engineering and Engineering Management.

Chen, Y., & Liu, L. (2021). Urbanization and elderly care in China: Challenges and opportunities. Journal of Aging Studies, 56, 100911 https://doi.org/10.1016/j.jaging.2021.100911

China Internet Network Information Center (CNNIC). (2020). The 47th statistical report on China's internet development. Beijing: CNNIC. Retrieved from https://www.cnnic.cn/

Cotten, S. R., Anderson, W. A., & McCullough, B. M. (2021). Impact of internet use on loneliness and contact with others among older adults: Cross-sectional analysis. Journal of Medical Internet Research, 23(2), e39. https://doi.org/10.2196/jmir.2306

Czaja, S. J., Boot, W. R., Charness, N., & Rogers, W. A. (2019). Designing for older adults: Principles and creative human factors approaches (3rd ed.). CRC Press.

Demiris, G., & Hensel, B. K. (2020). Technologies for an aging society: A systematic review of "smart home" applications. Yearbook of Medical Informatics, 17(01), 33–40. https://doi.org/10.1055/s-0038-1638580

Di Toro, A. (2024). Smart Elderly Care in China: A Preliminary Overview. In Italian Forum of Ambient Assisted Living (pp. 507–523). Cham: Springer Nature Switzerland.

Fa, R., Jin, S., Fan, P., Tang, F., Jin, Q., & Wang, C. (2025). Demand, utilization, and supply of community smart senior care services for older people in China. Digital Health, 11, 20552076241293641.

Feng, Z., Liu, C., Guan, X., & Mor, V. (2020). China's rapidly aging population creates policy challenges in shaping a viable long-term care system. Health Affairs, 39(5), 860–868. https://doi.org/10.1377/hlthaff.2019.01515

Fisk, A. D., Rogers, W. A., Charness, N., Czaja, S. J., & Sharit, J. (2020). Designing for older adults: Principles and creative human factors approaches (2nd ed.). CRC Press.

Grossman, M. R., Zak, D. K., & Zelinski, E. M. (2018). Mobile apps for caregivers of older adults: Quantitative content analysis. JMIR mHealth and uHealth, 6(7), e9345.

Heart, T., & Kalderon, E. (2020). Older adults: Are they ready to adopt health-related ICT? International Journal of Medical Informatics, 82(11), e209–e231. https://doi.org/10.1016/j.ijmedinf.2020.104987

Kano, N., Seraku, N., Takahashi, F., & Tsuji, S. (1984). Attractive quality and must-be quality. Journal of the Japanese Society for Quality Control, 14(2), 39–48.

Li, R. R. (2023). Age-Appropriate Design Context: Elderly User Interaction Design Needs Analysis Based on the Kano Model—A Case Study of Medical App Interface Design for Older Users. Digital Communication World, 9, 69–71.

Li, Z. D. (2023). A Study on Aging Design of Mobile APP Interfaces Based on Kano Models [Master thesis, Kunming University of Science and Technology].

Liu, L., Wu, F., Tong, H., Hao, C., & Xie, T. (2021). The Digital Divide and Active Aging in China. International Journal of Environmental Research and Public Health, 18(23), 12675. https://doi.org/10.3390/ijerph182312675

Liu, S. Y. (2017). Research on the platform of Lin Xiang, an aging child terminal based on Maslow's demand exhibition theory [Master thesis, Nanjing University of Science and Technology].

Maslow, A. H. (1943). A theory of human motivation. Psychological Review, 50(4), 370–396.

Meng, F., Guo, X., Peng, Z., Lai, K. H., & Zhao, X. (2019). Investigating the adoption of mobile health services by elderly users: Trust transfer model and survey study. JMIR mHealth and uHealth, 7(1), e12269.

Mitzner, T. L., Boron, J. B., Fausset, C. B., Adams, A. E., Charness, N., Czaja, S. J., … & Sharit, J. (2019). Older adults talk technology: Technology usage and attitudes. Computers in Human Behavior, 26(6), 1710–1721. https://doi.org/10.1016/j.chb.2019.06.020

National Bureau of Statistics of China. (2021). Communiqué of the Seventh National Population Census (No. 5).

National Bureau of Statistics of China. (2021). Statistical report on the development of China's aging population. Retrieved from http://www.stats.gov.cn

Peek, S. T., Wouters, E. J., van Hoof, J., Luijkx, K. G., Boeije, H. R., & Vrijhoef, H. J. (2020). Factors influencing acceptance of technology for aging in place: A systematic review. International Journal of Medical Informatics, 83(4), 235–248. https://doi.org/10.1016/j.ijmedinf.2020.104987

Pensley. (2022). Based on Maslow's Theory of Needs Relax Night App Interface Design [Master thesis, Central South University].

Prince, M. J., Wu, F., Guo, Y., Gutierrez Robledo, L. M., O'Donnell, M., Sullivan, R., & Yusuf, S. (2020). The burden of disease in older people and implications for health policy and

practice. The Lancet, 385(9967), 549–562. https://doi.org/10.1016/S0140-6736(20)30405-2

Shao, Q., Tao, R., & Luca, M. M. (2022). The effect of urbanization on health care expenditure: Evidence from China. Frontiers in Public Health, 10, 850872.

Shi, T., & Yu, W. (2021). Research on the Design of Smart Bracelets for the Elderly Based on Maslow's Hierarchy of Needs. In HCI International 2021-Late Breaking Papers: Cognition, Inclusion, Learning, and Culture: 23rd HCI International Conference, HCII 2021, Virtual Event, July 24–29, 2021, Proceedings 23 (pp. 306–317). Springer International Publishing.

Tan, Y. S., Cui, J. J., & Chen, H. (2020). Improvement of Design Parameters for Health Monitoring in Wearable Fitness Device: A Fuzzy Analytic Kano Approach. Journal of Medical Imaging and Health Informatics, 10(6), 1257–1264.

United Nations. (2019). World population prospects 2019: Highlights. Department of Economic and Social Affairs, Population Division. https://population.un.org/wpp/

Vaportzis, E., Clausen, M. G., & Gow, A. J. (2018). Older adults perceptions of technology and barriers to interacting with tablet computers: A focus group study. Frontiers in Psychology, 8, 1687. https://doi.org/10.3389/fpsyg.2018.01687

Wang, J., *et al.* (2023). Innovative design method of children stroller based on A-Kano and FAST. Journal of Machine Design, 40(03), 142–148.

Wei, W., & Yang, L. (2022). Functional Requirements of WeChat Guide Program Based on A-Kano Model. Packaging Engineering, 43(02), 172–178+185.

World Health Organization. (2021). Aging and health.

Xu, Q. L., J. R. J., Yang, X., *et al.* (2009). An Analytical Kano Model for Customer Need Analysis (Vol. 30(1)).

Zalenski, R. J., & Raspa, R. (2006). Maslow's hierarchy of needs: A framework for achieving human potential in hospice [Review]. Journal of Palliative Medicine, 9(5), 1120–1127.

Zeng, Y., & Hesketh, T. (2020). The effects of China's universal two-child policy. The Lancet, 388(10054), 1930–1938. https://doi.org/10.1016/S0140-6736(20)30405-2

Zhang, D. D. (2019). Research on Improving Service Quality of Logistics Enterprises Based on KANO Model. 2019 4th International Conference on Social Sciences and Economic Development (ICSSED 2019), WuHan.

Zhang, Q., Robert, L. P., Zhou, F., & Yang, X. J. (2024). Designing Healthcare Robots at Home for Older Adults: A Kano Model Perspective. ACM/IEEE International Conference on Human-Robot Interaction.

Zhen, Z. H. (2024). Emotional Design of Slimming Diet APP Based on A-Kano Model. Packaging Engineering, 45(04), 307–316.

Zong, Y. (2022). Design and Research on Social Robot Design from Maslow Demand Hierarchy For elderly [Master thesis, Shenzhen University].