Research on the Design Strategy of Elderly Intelligent Screen Based on Analytic Hierarchy Process

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Abstract. With the continuous deepening of China's aging population, home-based elderly care has become the mainstream elderly care model. As the core interactive intelligent device in home-based elderly care scenarios, the elderly intelligent screen undertakes multiple key functions such as daily interaction, health monitoring, and remote assistance. At present, elderly smart screen products generally have problems such as vague user demand positioning, cumbersome operation logic, high learning threshold, and insufficient elderly friendly design, which cannot fully meet the actual usage needs of elderly users. In order to solve the above problems, this article takes elderly smart screen products as the research object and uses Analytic Hierarchy Process (AHP) to quantify and prioritize user needs. Based on the prioritized requirements after sorting, this article proposes targeted elderly friendly design optimization strategies, including simplified one click convenient operation and interface layout, effectively solving the usability pain points of traditional elderly smart screens.

Keywords: Smart Screen, Analytic Hierarchy Process, Elderly people.

1 Introduction

1.1 A Subsection Sample

Currently, the aging process of China's population is deepening, and home-based elderly care[1] has become the mainstream mode of elderly care. As the core interactive center in home care scenarios, elderly smart screens undertake various functions such as health monitoring, home linkage, information collection, and emergency assistance, there is currently a lack of systematic user demand analysis for smart screen design. The Analytic Hierarchy Process (AHP)[2], as a systematic and concise multi-criteria decision-making method, can transform vague user needs into quantifiable and evaluable indicator systems, effectively solving the problem of ambiguous prioritization of user needs. Based on this, this article focuses on user demand analysis and design strategy optimization of elderly smart screens using Analytic Hierarchy Pro-

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cess (AHP)[3]. The core objective of the research is to accurately identify the core needs and priorities of elderly users, construct a scientific needs assessment model, and propose targeted design strategies.

2 Design of Elderly Smart Screen Based on AHP

2.1 Construction of AHP Hierarchical Model

Construct a hierarchical structure model for AHP elderly intelligent screen products and form a research team consisting of 10 design researchersAfter organizing the survey results, the requirements for smart screens can be divided into three dimensions: the instinctive layer includes visual elements such as the appearance, materials, and craftsmanship of smart screens; The functional layer refers to the specific functions used, such as voice interaction, one click calling, automatic connection, remote screen control, entertainment resources, and remote monitoring; The experience layer refers to the subjective experience of users towards the usability and practicality of a product. Finally, a hierarchical structure model for elderly smart screen products was constructed, as shown in Figure 1.

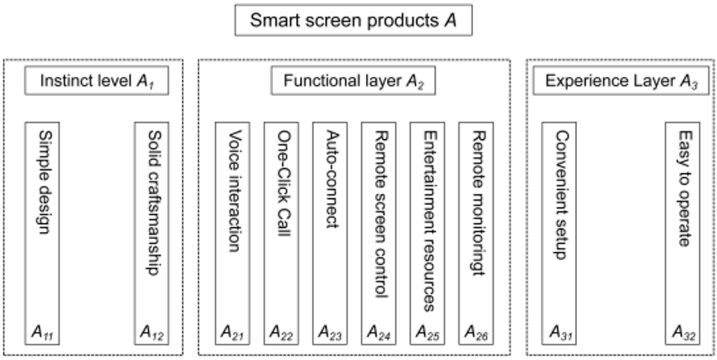

Fig. 1. Overall design requirements for smart screen

2.2 Judgment Matrix Design and Weight Calculation

To further clarify the user needs of elderly smart screen products, the research team constructed a judgment matrix model based on the criteria layer requirements and sub objective layer requirements in the overall user needs model[4]. To ensure the professionalism and authenticity of the evaluation results, the evaluation was conducted by an evaluation team composed of 10 design researchers.The criteria for judging the matrix are shown in Table 1. The analysis results are shown in Tables 2, 4, 5, and 7. The consistency test was conducted on the research results, as shown in Tables 3 and 6. The consistency test results showed that the CR was less than 0.1, and all data passed the consistency test. The evaluation results have strong logical consistency[5].

Table 1. Scaled quantificational consistency of judgment matrix.

Relative importance of evaluation index factor i compared to j	Quantitative scale value
Equally important	1
Somewhat important	3
Relatively important	5
Extremely important	7
Critically important	9
Countdown	$a_{ij}=1/a_{ij}$

Table 2. Evaluation results of criterion level indicator matrix.

Indicator	A_1	A_2	A_3	WeightW_1
A_1	1	1/9	1/7	5.67%
A_2	9	1	3	64.86%
A_3	7	1/3	1	29.46%

Table 3. Consistency test results of criterion level indicator matrix.

Maximum eigenvalue	CI	RI	CR
3.081	0.041	0.520	0.078

Table 4. Evaluation results of sub indicator matrix of instinctive layer indicators.

	A_{11}	A_{12}	W_2
A_{12}	1	1/5	16.67%
A_{12}	5	1	83.33%

Table 5. Evaluation results of functional layer indicator sub indicator matrix.

	A_{21}	A_{22}	A_{23}	A_{24}	A_{25}	A_{26}	W_2
A_{21}	1	1/3	3	1/5	3	5	13.26%
A_{22}	3	1	5	1/3	5	7	25.02%
A_{23}	1/3	1/5	1	1/7	1/3	1	4.29%
A_{24}	5	3	7	1	7	9	45.94%
A_{25}	1/3	1/5	3	1/7	1	3	7.90%
A_{26}	1/5	1/7	1	1/9	1/3	1	3.59%

Table 6. Consistency test results of functional layer indicator sub indicator matrix.

Maximum eigenvalue	CI	RI	CR
6.332	0.066	1.260	0.053

Table 7. Evaluation results of sub indicator matrix of experience layer indicators.

	A_{31}	A_{32}	W_2
A_{31}	1	1/3	25.00%
A_{32}	3	1	75.00%

According to the comprehensive weighted results, the top five requirements are remote screen control, simple operation, one click calling, voice interaction, and convenient settings, as shown in Table 8. This ranking intuitively reflects the core requirements of smart screens. Highlighting the core functional positioning of elderly smart screens in the context of home-based elderly care, namely convenient interaction, remote linkage, and safe emergency response. The high weight of remote screen control reflects the urgent need of elderly users for home contact and remote assistance, solving the pain points of operational barriers and nowhere to go faced by elderly people when using smart devices alone. The high ranking, which is easy to operate and set up, meets the expectations of the elderly for smart products with low learning costs and strong adaptability, avoiding the complex operation and tedious setup problems of traditional smart devices. As a core requirement for security and emergency response, one click calling further demonstrates the security value of elderly smart screens in the context of home-based elderly care.

Table 8. Comprehensive weight of each indicator.

Criterion layer	Indicator	Comprehensive weight	Sort
Instinct level	Simple design	0.94	10
	Solid craftsmanship	4.72	7
Functional layer	Voice interaction	8.60	4
	One-Click Call	16.23	3
	Auto-connect	2.78	8
	Remote screen control	29.80	1
	Entertainment resources	5.12	6
	Remote monitoringt	2.33	9
Experience Layer	Convenient setup	7.36	5
	Easy to operate	22.10	2

3 Design Strategies for Elderly Smart Screens

3.1 Strategy 1: Remote Collaboration

In response to the highest weight requirement of remote screen control, the design should break through the limitations of traditional smart screens being only used as local terminals, and build a multi terminal collaboration mechanism for families. Remote desktop assistance: Children or caregivers can remotely view and operate the smart screen interface in the elderly's home through a mobile app, helping to complete complex settings, app downloads, or content searches, and solving the problems of unclear viewing, inaccurate clicking, and inability to operate.

3.2 Strategy 2: Zero Threshold Interaction and Task Simplification

In response to the two requirements of easy operation (22.10%) and convenient settings (7.36%), the design should completely abandon the complex hierarchy of traditional

smart devices: zero learning cost main interface: the main screen only retains 3-5 core function cards - one click call, health monitoring, entertainment on-demand, weather, remote help.

3.3 Strategy 3: One Click Direct Access and Emergency Response

One click call (16.23%) reflects the strong demand of the elderly for a sense of security and emergency response capabilities. Hardware level one click call, simultaneously sending location information and real-time screen to children's phones, providing vibration and voice feedback when pressed. Software level floating call: In any interface, there is a red call floating ball permanently located in the bottom right corner of the screen. This strategy upgrades one click calling from a regular function to a secure foundation of the system, ensuring that elderly people can receive assistance with minimal cognitive load in any scenario.

3.4 Strategy 4: Voice Assisted Full Process Assistance

Voice interaction (8.60%) is not only an independent interaction method, but also an auxiliary enhancement channel for all operations: Global voice wake-up: supports custom wake-up words, and elderly people can directly say commands on any interface, as shown in Figure 2.

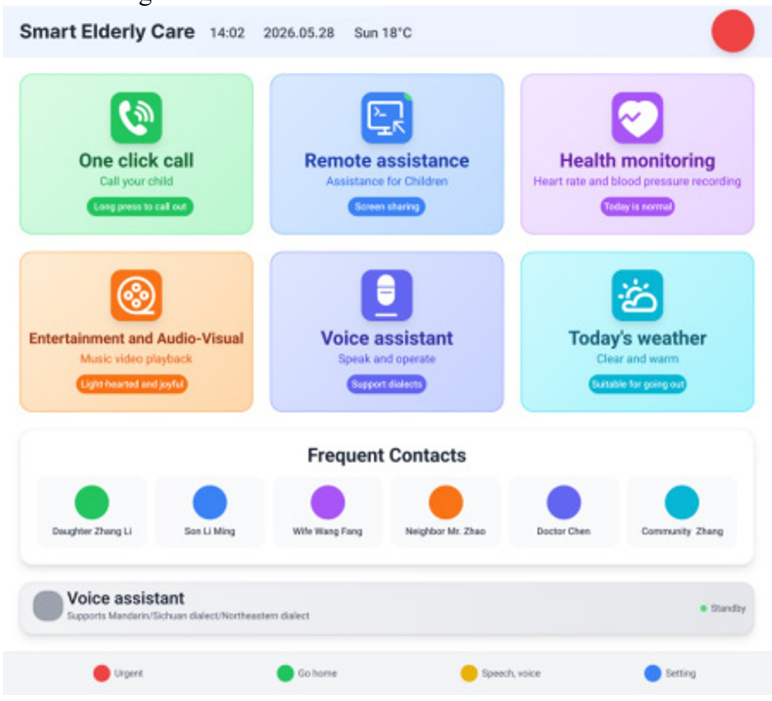

Fig. 2. Overall design requirements for smart screen

4 Conclusion

This study quantifies and prioritizes the user needs of elderly smart screens based on Analytic Hierarchy Process (AHP). In response to the high weight needs mentioned above, this paper proposes four aging friendly design strategies: remote collaboration mechanism, zero threshold interaction and task simplification, one click direct access and emergency response, and voice assisted full process assistance. These strategies directly correspond to and solve the key pain points of traditional smart screen products, such as complex operation, high learning threshold, and insufficient remote interaction capability.

Through strategic integration, elderly users can complete daily operations such as calling, entertainment, and settings with minimal cognitive load, and receive immediate assistance in emergency situations. This study has achieved the design goal of "low threshold, high availability, and high security" for aging friendly smart screens, providing quantifiable design priority basis for the development of intelligent interactive products in home-based elderly care scenarios. Subsequent research can further combine user usability testing to verify the actual effectiveness of the strategy and explore the integration of more age appropriate interaction modes.

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