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Research on Interface Design of Elderly-Friendly Medical APP under the Perspective of Scene Fusion

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Abstract: With the advancement of smart elderly care policies and the growing demand for digital health management among older adults, the need for accessible healthcare solutions is becoming increasingly urgent. Age-friendly medical applications play a pivotal role in bridging elderly users with healthcare services; however, existing designs still suffer from limitations such as small font sizes, low color contrast, insufficient voice guidance, and a lack of scenario-specific functions. This study reviews relevant policies and theoretical foundations, analyzes the needs of elderly users based on survey data, and develops a functional framework to address these deficiencies. It proposes physiology-informed visual strategies, habit-oriented interaction optimizations, and a closed-loop service model that integrates health monitoring with medical services to support multimodal information delivery and one-click operations. The findings expand the application of age-friendly design principles in healthcare, provide empirical support for scenario-integrated approaches, and offer practical recommendations to enhance app usability and user engagement, thereby promoting effective health management for older adults and advancing the inclusive, human-centered development of the smart elderly care ecosystem.

Keywords: Intelligent Elderly Care; Scene Integration; Age-friendly Medical APP; Interface Design.

1. Design Status and Challenges of Age-Friendly Medical APP in the Context of Intelligent Elderly Care

1.1. Industry Development Trend

Within the broader context of advancing smart elderly care policies and building a comprehensive smart elderly care industry ecosystem, age-friendly medical applications are increasingly recognized as vital bridges that connect older adults with healthcare services and ensure continuous access to reliable health information resources. The global elderly population is growing at an unprecedented rate, with projections indicating that by the mid-21st century the number of people aged 60 and above will more than double from 1.1 billion in 2021 to nearly 2.1 billion by 2050, representing approximately 21% of the world's population [1]. In response to this demographic trend, China's Ministry of Industry and Information Technology (MIIT) released the General Design Specifications and Evaluation System for Age-Friendly Internet Applications in 2021 and initiated the first batch of 43 projects to upgrade applications for elderly users. These initiatives span multiple domains including news and information, social communication, daily shopping, financial services, travel and transportation, and healthcare [2]. By establishing mandatory standards and development guidelines, these policies encourage the medical app industry to fully consider the physiological and cognitive characteristics of older adults. Through systematic optimization of interface interactions and functional logic, the goal is to foster genuinely user-centered design that shifts the focus from superficial interface adjustments to substantive enhancements in the overall user experience for elderly users [3].

National policies promote the transformation of digital medical services toward aging adaptation, with the intention of covering the entire process of elderly health management [4]. In practice, however, many mobile healthcare applications design their information content, operational workflows, and interaction systems with excessive complexity in the pursuit of comprehensiveness, which makes them difficult for older adults to navigate. These applications often lack standardized age-friendly design strategies and fail to translate technical functions into perceptible, accessible, and user-friendly service experiences [5]. As a result, older users face challenges in learning and mastering new products, which restricts their ability to benefit from the comfort and convenience that mobile medical applications are intended to provide.

Meanwhile, the demand for digital health management among older adults is increasing rapidly. Many seniors seek to record and analyze home health data and access remote medical consultations through simple and intuitive applications [6]. However, existing age-friendly medical apps still present notable deficiencies in both functional design and user experience [7]. First, their interfaces and interaction models often adhere to generic design principles that fail to account for age-related challenges such as declining visual acuity, slower reaction times, and reduced cognitive processing capacity. This oversight results in issues such as small font sizes, cumbersome operational workflows, and ambiguous feedback. Second, these applications devote insufficient attention to frequently encountered health-related scenarios and to scenario-specific functional adaptations, creating a persistent gap between intended purpose and actual usability. This gap leaves older users in situations where they wish to use the applications but are unable to do so effectively, thereby undermining the potential value these tools could provide.

1.2. Analysis of Existing Problems

Current elderly-friendly medical applications face three

major design challenges. From a visual perspective, small font sizes and low color contrast reduce information readability for users with age-related vision decline. From an operational standpoint, overly complex workflows with deep functional hierarchies, coupled with the absence of voice guidance and dialect recognition, create obstacles for users with reduced motor dexterity. From a contextual perspective, insufficient adaptation to common scenarios, such as home health monitoring and hospital visits, limits their relevance to seniors' everyday healthcare needs. This study investigates these challenges by analyzing their underlying causes and manifestations, and proposes targeted optimization strategies to address issues related to information recognition, operational complexity, and scenario adaptation. The proposed strategies aim to enhance both the usability and applicability of elderly-friendly medical applications, thereby enabling older adults to access healthcare services with greater convenience and efficiency.

2. Dynamic Characteristics and Scenario Mapping of User Needs for Aging Medical APPs

2.1. Dynamic Evolution Trend of Elderly Users' Needs

As people age and lifestyles undergo substantial changes, the demand for medical applications among older adults has expanded beyond basic functionalities, demonstrating considerable dynamism. Psychologically, older adults often exhibit heightened emotional vulnerability and reduced resilience. Experiences of isolation and marginalization, combined with increasing health concerns, create a strong need for emotional support and reassurance [8]. Physiologically, the incidence of chronic conditions such as hypertension and diabetes rises steadily with age, requiring continuous monitoring and management [9]. In daily life, many seniors must regularly measure blood pressure and blood glucose levels; however, manual recording of these data is both tedious and prone to error. This highlights the need for medical applications equipped with automated data recording and analysis capabilities. Given the limited ability of some seniors to interpret raw numerical data, these applications should convert recorded information into intuitive visual formats, such as trend charts, with normal and abnormal ranges clearly indicated through color gradients and graphic symbols. Such visual enhancements can help older adults clearly understand their personal health status and support better self-management.

In terms of digital habits, a growing number of older adults have become proficient in using smartphones, which has raised their expectations for the usability of medical applications. In the past, complex multi-step procedures involving extensive navigation and data entry often discouraged senior users, as even minor errors could result in operational failures. With recent advancements in the Internet of Things, big data, and artificial intelligence, medical applications can now support real-time health monitoring, remote consultations, emergency assistance, and other services, thereby significantly enhancing quality of life and improving access to healthcare [10]. Senior users increasingly expect simplified operational processes, such as voice-activated commands for medical registration and report retrieval, as well as the translation of technical terminology into plain, easily understandable language.

Social factors further influence these needs. The rising number of seniors living alone has heightened safety concerns, as unexpected health crises or accidental falls can occur without warning. Consequently, medical applications should incorporate user-friendly emergency response functions, including one-touch alerts that automatically transmit location data to family members and retrieve critical health records such as medical histories and allergy information, thereby securing valuable time for timely intervention. In addition, children and community healthcare providers can use these platforms for remote health monitoring, tracking key indicators such as heart rate and sleep patterns in real time and enabling immediate action when abnormalities are detected.

2.2. Analysis of User Demand Differences in Different Scenarios

The home environment represents the most frequent usage scenario for elderly users of healthcare applications. Many older adults with chronic conditions, such as hypertension and diabetes, require daily monitoring of blood pressure and blood glucose levels. Age-friendly medical apps can integrate with smart wristbands and electronic blood pressure monitors to enable automatic data synchronization, thereby reducing the need for manual input. Medication management is also a critical aspect of home healthcare, as seniors often forget dosages or schedules. This highlights the importance of functions such as medication lists with voice reminders and drug photo recognition. In addition, many elderly users seek applications that provide clear and accessible health guidance, including dietary recommendations and exercise videos, enabling them to acquire practical knowledge at any time as part of their daily routines.

In hospital settings, elderly patients often face unfamiliar environments and complex procedures, making clear and accessible guidance essential. The registration process can be particularly challenging. Age-friendly medical apps can address this by recommending departments based on reported symptoms, displaying physicians' specialties and patient reviews, and enabling one-click booking for high-demand appointments. Navigation within large hospitals, where departments are widely dispersed, can be streamlined through voice-guided systems that direct patients to examination rooms and consultation areas. Understanding examination reports also poses difficulties, as medical jargon can hinder comprehension. Translating report content into plain language and incorporating historical data comparisons can help seniors gain clearer insights into their health trends. In emergency situations such as sudden illnesses or falls, medical apps should ensure instant response and accuracy, enabling timely assistance even when no bystanders are present.

During the post-treatment rehabilitation phase, elderly patients increasingly require personalized guidance and real-time feedback. Age-friendly medical apps can facilitate continuous communication with rehabilitation specialists, enabling users to seek advice on recovery progress, upload relevant health data for professional review, and receive timely adjustments to their rehabilitation plans. By integrating remote monitoring with tailored recommendations, these platforms can ensure that seniors receive reliable support even during home-based rehabilitation, helping to maintain motivation, prevent complications, and promote a

smoother recovery process.

2.3. Design Strategy of Requirement and Scenario Integration

To achieve a deep integration of user needs and usage scenarios, design strategies for elderly-friendly medical apps should be precisely targeted across three dimensions: interface, interaction, and functionality. In terms of interface design, large font sizes and high color contrast should be adopted to enhance readability for users with declining vision. Interaction processes, such as health data entry, can be simplified by combining manual input with voice recognition and enabling automatic synchronization with external devices. Functionally, key features such as medication reminders and health monitoring should be prominently positioned for quick access. In medical consultation scenarios, integrating appointment registration with report interpretation can further reduce operational complexity. By adopting functional layouts and interaction patterns aligned with the habits and preferences of older users, aging-friendly healthcare apps can be transformed into truly convenient and practical health management tools.

The development of such applications requires a comprehensive understanding of the evolving needs of senior users. Drawing on user needs theory, this study investigates age-appropriate interface design for mobile healthcare platforms by analyzing a variety of scenarios in which elderly individuals present multifaceted requirements. Based on this analysis, their specific demands are systematically extracted, categorized, and prioritized, leading to the identification of key design elements that can enhance the effectiveness and accessibility of healthcare service delivery for older adults.

Furthermore, the system should maintain compatibility with a broad range of devices and terminals, while supporting multiple interaction modalities, including voice, gesture, and behavioral inputs. The optimization of interaction logic and information architecture should be grounded in an understanding of the behavioral and cognitive characteristics of elderly users, enhancing error tolerance and promoting user experiences that are natural, seamless, and intuitive [11].

Table 1. Summary of interface design requirements for elderly-friendly medical APP from the perspective of scenario integration

Demand classification	Specific dimensions of demand	Specific needs	Demand element	Demand feature analysis
User feature requirements	physiological characteristic	Visual degradation	Large type display, high contrast color, simple icon	The elderly group has decreased visual acuity and color discrimination
		Operational capability degradation	One-click operation, simplified process, voice interaction	Hand dexterity and operation complexity are weak
	characteristics of mentality	The need for security	Clear feedback, emergency help entrance, clear guidance	The elderly have low tolerance for uncertainty, so enhance security assurance
		Emotional companionship	Warm visual style, caring prompts, social interaction module	Emotions such as loneliness can enhance emotional experience
Scenario-based requirements	Home scenario	Daily health management	Health data recording/viewing, medication reminders	High frequency use at home requires the input of health information to meet the needs of health monitoring
	Outgoing scenario	emergency medical service	Quick call, offline first aid guide, location function	Simple first aid support is required in case of emergency during travel
		Medical assistance	Registration navigation, examination guidance and report query	The medical treatment process is complicated, so it needs clear guidance to help elderly users complete the medical treatment process efficiently
Industry and product requirements	Industry environment	Medical professionalism	Authoritative content presentation, doctor qualification display, professional terms popularization	Balance medical professionalism and understanding of elderly users, and deliver easy to understand medical information
		Policy adaptation	Interconnected access to medical insurance and interpretation of elderly-friendly policies	It meets the medical security needs of elderly users and facilitates access to medical insurance services
	Product effectiveness	Ease of use	Operation guidance, fault tolerance mechanism, interface reuse	Reduce learning costs and maintain uniform interface operation logic
		reliability	Data security, system stability, backup function	Strengthen technical support and eliminate concerns about use

3. Interface Design Method of Aging-Friendly Medical APP

3.1. Visual Optimization Design Based on Physiological Characteristics

Older adults often experience physiological changes such as visual deterioration and reduced color perception, making targeted optimization in visual design essential [12]. For text presentation, base font sizes should be increased to accommodate their visual needs, with clear and legible typefaces selected. Readability can be further improved through bolding and by increasing line and letter spacing, while decorative fonts that may cause visual interference should be avoided. Color schemes should emphasize high-contrast combinations, using vivid hues to distinguish information hierarchies and avoiding low-saturation or similar tones that may impair recognition. Icon design should follow the principle of minimalist concretization, employing intuitive graphics to convey functional meanings and supplementing them with concise text annotations. Interface layouts should adopt modular zoning, giving priority to high-frequency core functions and minimizing redundant information to create a clean, focused visual framework. Such design can help reduce cognitive load and support older users in more easily receiving and processing information.

3.2. Simplified Interactive Process That Fits the Usage Habits

Older adults, influenced by physiological constraints and long-established behavioral patterns, tend to have lower tolerance for complex interaction processes. Interaction design should therefore follow the principles of reducing operational steps and minimizing cognitive effort to streamline workflows. Multi-level navigation structures are best avoided, with flat design paradigms that integrate functional paths adopted instead. Consolidating operations into column-based layouts within single-page interfaces can eliminate repetitive page switching, enabling tasks to be completed more intuitively. For multi-step functions such as health data uploads and medical report retrieval, interaction processes should be simplified through both spatial and logical optimization, ensuring that operations remain straightforward and easy to follow.

Enhanced voice interaction and gesture optimization are also integral to age-friendly medical app design. Voice commands should be embedded across key processes such as registration and data retrieval, with dialect recognition enabling multilingual accessibility. Clear and concise voice prompts can guide users step-by-step through operations. Gesture controls should prioritize ease of use and error prevention, incorporating long-press confirmation and swipe gestures, while expanding input areas through spaced thermal zones to reduce mis-taps. Critical functions should be supplemented with guided interfaces that allow users to reverse actions or return to predefined safety checkpoints. Collectively, these measures reduce operational anxiety, enhance error tolerance, and enable elderly users to navigate the platform with greater confidence and efficiency.

3.3. Dynamic Adaptation of Scenario Functional Modules

The medical needs of elderly users vary considerably across different usage scenarios, making it essential for interface design to be both scenario-aware and behavior-predictive. Such a system should enable dynamic responsiveness and precise adaptation of functional modules. By integrating and analyzing multidimensional data, the platform can automatically detect specific user contexts and adjust functional displays and interaction patterns accordingly. High-frequency core functions should be prioritized and combined with related services to form scenario-based functional clusters. Interface layouts and interaction flows can then be optimized in alignment with the operational characteristics of each scenario, streamlining key pathways and reducing unnecessary steps. This dynamic adaptation mechanism addresses the limitations of traditional fixed interfaces by aligning functional configurations with evolving user needs, thereby achieving a deep integration of functions and scenarios. The result is a more practical, efficient, and user-friendly experience for elderly users. The design flow chart is shown in Figure 1.

4. Interface Design Practice of Aging-Friendly Medical APP

4.1. User Analysis

By systematically analyzing the operational pain points of elderly users, the system is designed to automatically pre-populate essential information, such as names, ages, and contact details. This automation transforms multi-step selection processes into intuitive option lists, streamlining workflows, lowering operational barriers, enhancing service accessibility, and reducing the likelihood of omitting critical information. From an interaction design perspective, the system minimizes page transitions and hierarchical nesting through one-click operations and voice commands with dialect recognition. It also adapts seamlessly to both offline medical facilities and home consultation contexts, ensuring smooth transitions between different service environments. By integrating functional design with the practical needs of elderly users, the system significantly enhances convenience, operational efficiency, and overall user satisfaction in accessing healthcare services. The function framework diagram is shown in Figure 2.

4.2. Interface Prototype Design

The interactive prototype (Figure 3) consolidates core telemedicine functions including registration, consultation, medical record management, health monitoring, and lifestyle guidance into a streamlined interface tailored for elderly users. High contrast layouts, enlarged touch targets, and simplified navigation structures effectively reduce visual strain and cognitive load. Voice interaction with dialect recognition enhances accessibility for users with limited literacy or motor skills. Modular page structures facilitate rapid access to high frequency tasks such as appointment booking, health data entry, and AI assisted health advice. Context aware design enables scenario specific functional configurations, ensuring consistent usability and efficiency across diverse telemedicine environments.

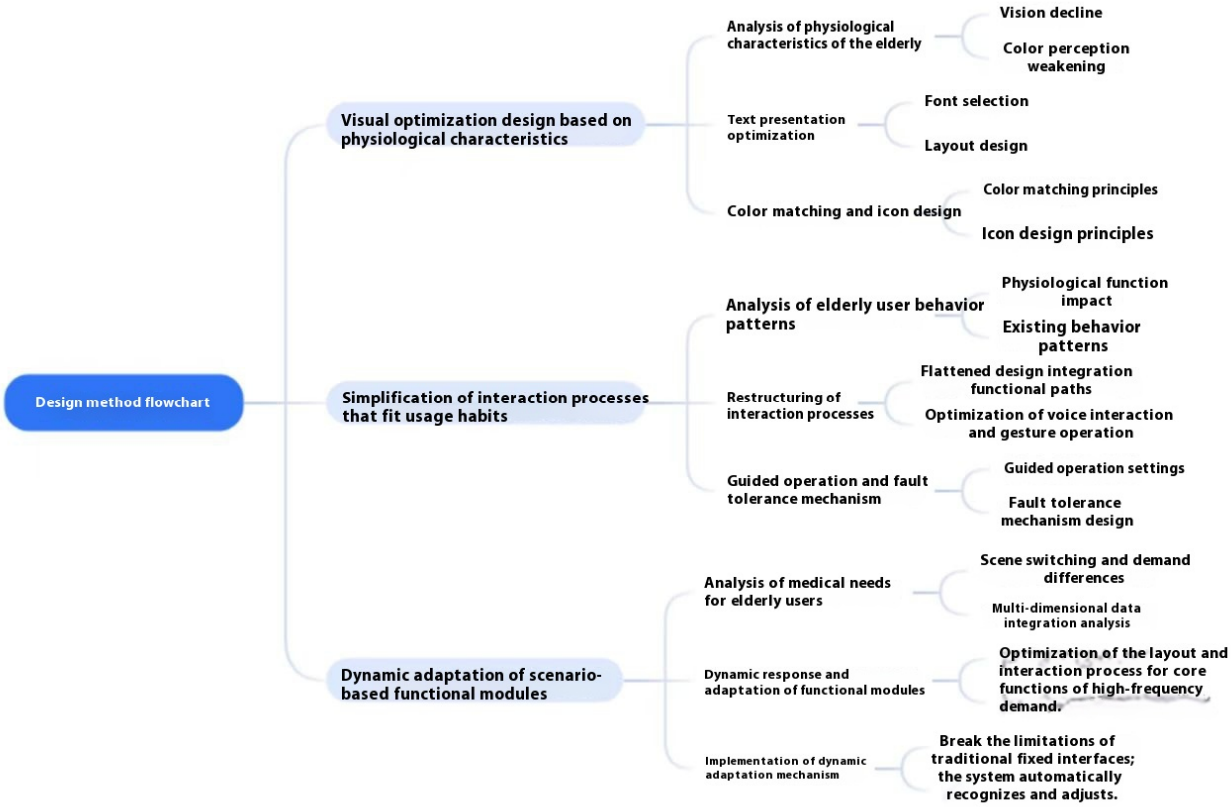

Fig 1. Design flow chart

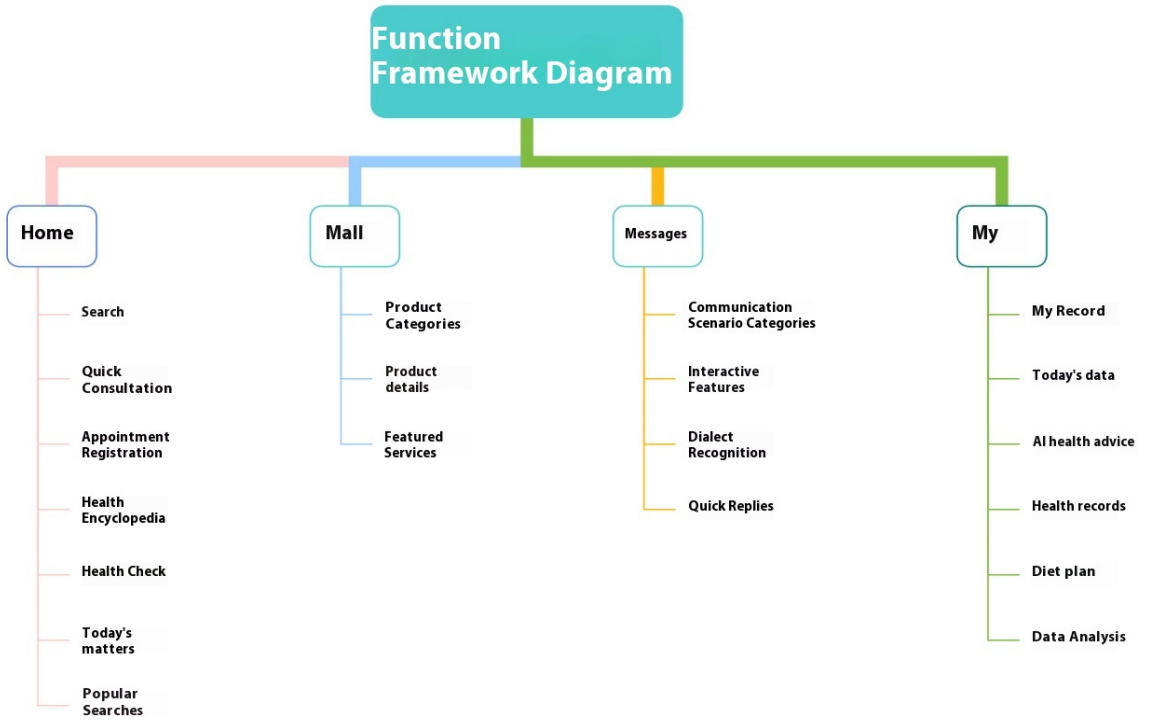

Fig 2. Functional framework

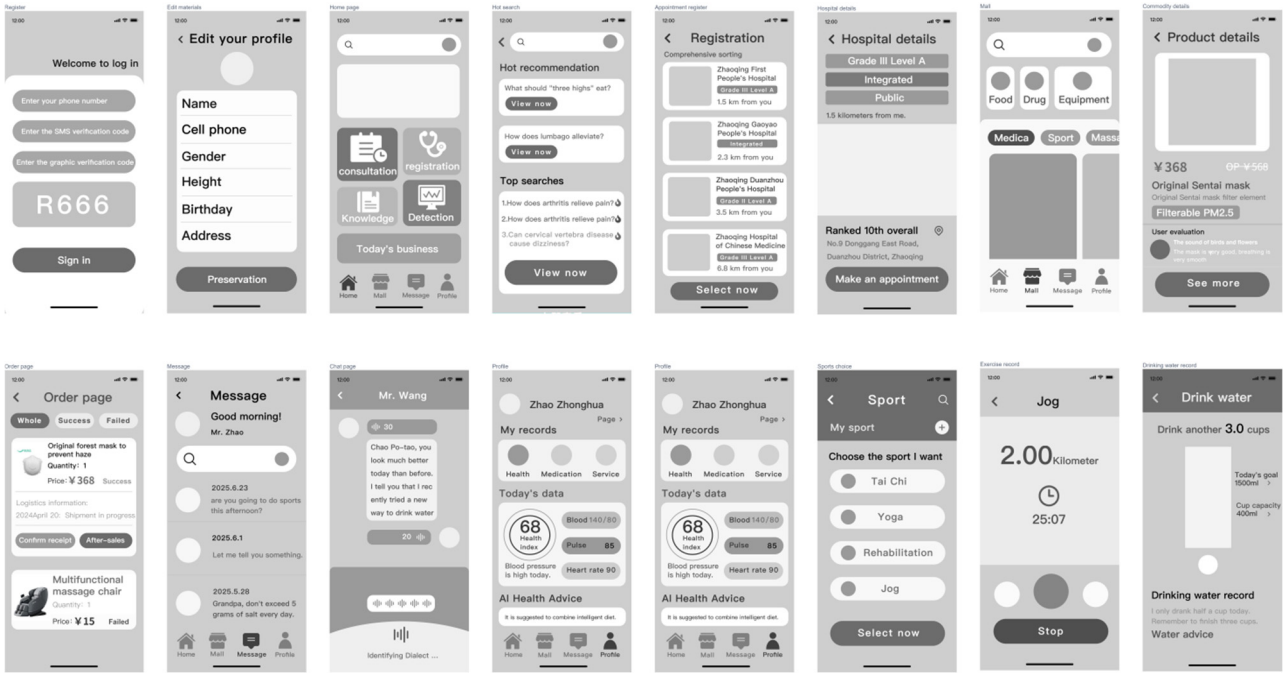

Fig 3. Interface prototype design

4.3. Interface Visual Design Style Localization

The design adopts a simple, approachable, and clear style, tailored to the needs of elderly users by removing complex and visually distracting elements. Emphasizing intuitiveness and clarity, it ensures visual comfort and enables senior users to efficiently comprehend interface information and functional logic. This approach fosters a warm and trustworthy interaction environment, ultimately enhancing the sense of well-being experienced by users.

(1) Design Positioning

The application prioritizes operational convenience and visual comfort for elderly users, addressing usability challenges associated with visual impairments and cognitive differences through optimized layouts, color schemes, and element presentation. The interface design presents essential medical functions, such as health record management and appointment scheduling, with clarity and in alignment with the interaction habits of older adults. By reducing the operational learning curve, the application serves as a user-friendly digital tool that enables elderly users to manage their health and access medical services with greater ease and efficiency.

(2) Design code

The interface adopts a modular and hierarchical layout that clearly distinguishes functional areas. A fixed bottom navigation bar provides quick access to commonly used functions, enabling elderly users to switch tasks efficiently, while the top section focuses on current page operations and integrates dialect voice input to reduce disorientation from interface transitions and prevent information overload. The color scheme uses a soft light blue as the primary tone, complemented by white and light gray. The low saturation and high brightness of light blue reduce visual strain for older adults with weakened vision while conveying a refreshing, health-oriented aesthetic. White maintains clarity and enhances readability, while light gray defines module boundaries and downplays secondary information to avoid distraction and support functional area recognition. Color contrast follows age-friendly accessibility standards, ensuring the clear legibility of text, icons, and backgrounds. Typography emphasizes readability through fonts with rounded strokes, with headings set at a minimum of 18 px and body text at no less than 16 px to ensure visibility under various lighting conditions. Icons are designed with simplified, concrete symbols drawn from familiar daily life contexts and are enlarged to facilitate easy tapping and quick recognition by elderly users.

4.4. Design Evaluation

(1) Advantage Level

The interface follows a unified design style with a clear functional orientation. Dominated by refreshing blue and green tones, all modules, including login, personal information management, medical services, and health management, maintain consistent visual elements. This coherence aligns with the professional aesthetics of healthcare applications and supports quick recognition of functional sections. Core operation buttons are prominently placed for immediate accessibility, while a fixed bottom navigation bar streamlines interaction pathways. Together, these features fulfill users' expectations for an efficient and user-friendly healthcare platform, lowering operational barriers and improving the overall user experience.

(2) Upgrading Direction

Opportunities for optimization remain in the areas of innovation and detail-oriented adaptation. The current layout and interaction patterns follow relatively conventional standards. In the competitive medical and healthcare application market, the integration of distinctive design elements could strengthen brand identity and enhance the memorability of the user experience, while further refining both interface aesthetics and functional engagement.

5. Conclusion

Amid the dual impetus of smart elderly care policies and the growing digital demands of seniors, age-friendly medical applications are poised to become pivotal tools for elderly health management. Yet their development remains hindered

by persistent mismatches between supply and demand. Deficiencies in visual presentation, interaction design, and contextual adaptation reflect a limited understanding of the nuanced needs of senior users. The dynamic nature of aging, characterized by evolving physiological conditions, shifting lifestyle preferences, and diverse usage contexts, further exposes the limitations of conventional and generic design approaches.

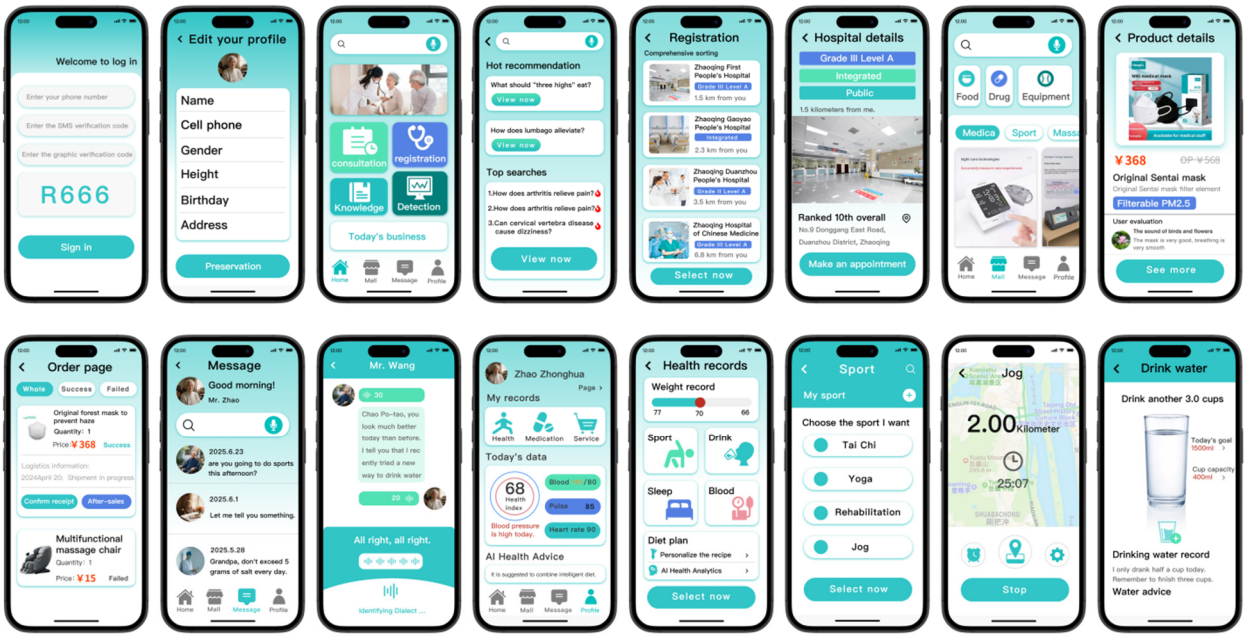

Fig 4. Visual design of aging-friendly medical APP interface

To address these challenges, scenario integration should be established as a core design strategy. This entails identifying real-world needs across varied contexts, embedding health monitoring, medical services, and safety features within specific usage scenarios, optimizing visual interfaces to align with age-related physiological characteristics, and connecting fragmented functions through scenario-based interaction design. Such an approach can transform applications into trusted, practical health assistants that older adults are willing, able, and confident to use.

By enabling seniors to integrate more fully into modern digital life and narrowing the digital divide, this strategy provides both theoretical grounding and practical guidance for the design of age-friendly healthcare applications. It holds substantial value in meeting genuine needs, bridging the supply and demand gap, and unlocking the full potential of medical apps for the elderly. Ultimately, it can strengthen digital safeguards for elderly health, accelerate the transformation of senior-oriented medical services, and ensure that the benefits of science and technology are tangibly extended to older populations, fostering a warmer, more inclusive, and resilient health and elderly care ecosystem.

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