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Inclusive Design in Digital Medical Interface Adaptation for the Elderly

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Abstract

Prompted by the challenges posed by an ageing society, this study contemplates design orientations from the perspective of inclusive design. It explores the adaptation of digital medical interfaces for the elderly to enhance design inclusiveness, catering to the senior user group and optimizing interactive experience in the medical system. This study employs the concept of inclusive design and analyzes its characteristics through literature. It distills the elements of the digital medical interface design for the elderly from three aspects: functional purpose, interactive behavior, and emotional expression. Using user research methods such as in-depth interviews and field research, it creates user personas and behavioral analysis diagrams for elderly patients with chronic diseases, organizing and categorizing their pain points. This study proposes principles for service touchpoint improvement based on inclusiveness. We optimize pain points and streamline the design process for age-friendly services, helping the elderly adapt to and integrate with digital life. By infusing inclusive design principles, we enhance the accessibility and inclusiveness of service design, elevating the service experience for the elderly. Our approach to age-friendly service design offers a valuable entry point for research focused on elderly-centered services and provides actionable strategies for developing age-friendly medical service processes.

Keywords: Inclusive Design; Age-friendly; Interface Design; Senior Citizens; Digital Medical.

1. INTRODUCTION

As advancements in information technology continuously propel us forward, we are witnessing an accelerated pace of digitization and intelligence in our daily lives, primarily through smart devices. This progress, however, has also given rise to the digital divide. Aging population has emerged as a significant societal issue worldwide, and the current rate of growth for China's elderly population leads the global trend. Faced with an expanding elderly demographic, an increasing number of scholars are delving deeper into the issues brought about by aging, progressively forming systemic design theories such as inclusive design, barrier-free design, and universal design. Service design, a domain dedicated to enhancing user experience, must evolve with the times. The aging trend in the user demographic necessitates an urgent exploration into how to make this field more age-friendly, especially within medical services. For the silver generation (used

in this paper to refer to those aged 50 and above - the primary users of age-friendly designs both now and in the future), the decline in physical function and resistance can lead to problems in product usage and health management. Current medical service processes often struggle to simultaneously meet the rigid medical demands and unique physiological and psychological needs of the silver generation, thus making the transition towards age-friendly thinking in service design of critical research value.

1.1 Challenges of Aging

Entering the 21st century, influenced by factors such as decreasing birth rates, the elderly population in most developed countries and some developing countries has seen considerable growth, transitioning into an aging society. The United Nations predicts a monthly net increase of two million people aged over 65 in the next 20 years [1]. China has already entered the phase of population aging; by 2040, the elderly population is expected to reach 374 million, accounting for 24.48% of the total population. By 2050, this ratio will hit 30.7% - the peak period of aging. China will be among the countries with the highest absolute number of elderly and the fastest pace of population aging worldwide.

From a design perspective, research and practice in age-friendly design often fall within the purview of governmental and public welfare sectors. With social benefits surpassing economic gains in the short term, few companies are willing to invest in this field. Consequently, compared to the international academic and industrial community, China's research and development and applications in age-friendly design are insufficient.

1.2 Diversity of Elderly Uses

Sociological research suggests that the needs of elderly users mainly span three levels: physiological, social, and cultural Traditional age-friendly design often perceives the silver generation as a homogeneous group in a biological sense, focusing on solving the common issues caused by physiological changes and the decline in bodily functions [2]. These studies indicate that the aging process involves the physiological decline across three levels: sensory, cognitive, and active. The behavior speed of the silver generation slows with age; the correlation between their sensation and cognition strengthens with age; and their operational skills require perceptual information assistance in specific contexts. The decline in these functions is likely to continue and become severe with age and changes in lifestyle, leading to partial or total disability in the late stages of life. Although these shared physiological characteristics are common in the aging process, Fozard (2000) pointed out that the aging process exhibits variation with different environments [3]. The needs of the silver generation are closely related to the cultural context they inhabit, pointing to the varied behavioral goals, patterns, values, and social subordination within different lifestyle groups. Research on elderly users should return to its social and cultural attributes and make contextual comparisons.Currently, international research is particularly concerned with the quality of life issues of these vulnerable groups. Therefore, related studies have proven that traditional cultural values play a vital role in propelling the demand system of elderly users, providing theoretical basis for traditional human-centered design. Under a multicultural background, the Maslow's hierarchy of needs model can no longer explain the genuine needs of the silver generation living in different social contexts.

1.3 Age-friendly Design Theory Under the Humanistic Philosophy Paradigm

Population aging is an irreversible global trend, and how to shape an age-friendly society through design has become a focal point in the design realm. The humanistic philosophy paradigm and the user-centered

design methodology provide effective theoretical and practical foundations for studying diverse aging populations and initiating social innovation designs. Inclusive Design, originating from the UK, and Universal Design from the USA, are the mainstream theories for tackling issues related to aging [4]. Inclusive Design refers to a framework that eliminates the need for specific adaptations, and instead enables mainstream products and services to be used by as many users as possible. Its goal is to allow diverse groups to participate equitably. The opposite of inclusion is rejection, hence promoting inclusivity is also a process of countering rejection. Building on many years of Inclusive Design research, the Engineering Design Center at Cambridge University proposed the theory of Countering Design Exclusion [5]. This theory attributes design exclusion to the mismatch between user capabilities and the ability requirements of the product, positing that exclusion is caused by the external environment. Therefore, promoting inclusive design is often achieved by reducing the ability requirements of products and the external environment on users.

2. KEY ISSUES IN THE INCLUSIVE DESIGN OF DIGITAL MEDICAL AGING

2.1 For Whom is Digital Medical Aging Designed

The concept of aging-friendliness is often paired with the notion of information accessibility. Information accessibility implies that anyone—able-bodied or disabled, young or elderly—can equitably, conveniently, and barrier-free access and use information under any circumstances. However, when we talk about digital aging-friendliness, it differs somewhat from total information accessibility. To make "aging-friendly" more focused, Differences exist among the older population in cognition, abilities, and willingness to engage with the digital world: Cognitively, most digital services are designed by people born in the 80s and 90s, which is different from the era where older adults come from. Memory and comprehension decline affect older adults, leading to a limited understanding of the younger generation's culture. In contrast, many people with impairments share similar cultural cognition with us because they live in the same period. From an ability perspective, older adults experience difficulties in accessing the internet due to declines in vision, hearing, and touch, which can be addressed by reducing operational thresholds. However, visually impaired and other impaired groups are unable to use certain functions due to physiological defects, requiring form substitution, such as auditory compensation for visual impairment. From a willingness perspective, older adults' psychological barrier to engaging with the digital world is significantly more noticeable because of their fear and aversion to new things. They fear mockery for not using digital devices and worry about being deceived. By contrast, these concerns are less pronounced among those with disabilities.

2.2 User Persona for the Application of Digital Medical Aging

Taking the service process of elderly patients with chronic diseases as an example, using questionnaires, in-depth interviews, and field research, we have constructed the user persona of the older population. They are largely retired or semi-retired, with abundant discretionary time and relatively leisurely lives. Their social circles have passively narrowed, dominated by acquaintances, with a short radius of life. They resist aging, worry about being disconnected from society, strive to understand new things, and fear burdening their families. Their physical health declines with age, but they view minor ailments as a norm, with more emphasis on maintaining a positive spirit.

2.3 For Whom is Digital Medical Aging Designed

To ascertain areas where inclusivity is insufficient in the service process, we classify service pain points

based on their inclusive characteristics. The four categories of solution priority are: cannot and not satisfied > able but not satisfied = cannot but satisfied > able and satisfied. This paper randomly selects 30 elderly users in Changzhou, Nanjing, and Zhenjiang. Through non-participatory observation research, we find that the older population primarily uses medical guidance systems to complete registration and consultation. Specific operations can be chronologically divided into four basic task links: entering the app for examination, diagnosis after examination, consultation with the doctor after diagnosis, and treatment after consultation with the doctor. Integrating and refining the behaviors exhibited by the older population in each task link, we find varying degrees of pain points. Parsing the aging-friendly design elements at each task link reveals that the functional purpose element is the goal set by the user on the basis of a progressive single-line consultation task, which also provides the prerequisite for the next step of work implementation. Interaction behavior elements are manifested in the user's cerebral analysis of behavior and physical interactive actions, which are decisive factors for interaction efficiency.

3. STRATEGIES FOR AGE-FRIENDLY DIGITAL MEDICAL INTERFACE DESIGN

3.1 Rooted in Medical Scenarios

Since 2015, the rapid advancement of virtual reality technology coupled with groundbreaking progress in artificial intelligence has been unmatched. These developments call for a reassessment of the roles of creators an urban designer and public artist, significantly contributes to enhancing the urban landscape. His approach integrates functional public art into civic design, as evident in projects like the "Art on the Signage" at the Boston Convention and Exhibition Centre. Initiated in 2012, this project amalgamates public media art with commercial and informational content, creating a novel digital platform for artistic expression. Faver mann's work underscores the role of innovative public art in stimulating civic discourse and community involvement, leveraging technologies such as augmented reality and virtual reality to enhance interactivity and accessibility [6].

3.2 Complemented by Embodiment

With the advancement of cognitive psychology research, it is gradually recognized that cognition is shaped by bodily activities. People understand the world through "body cognition", and the experience generated by using an online medical app emphasizes active intervention in physical activities. Hence, the thought processes of older adults naturally exhibit embodied characteristics. Considering the limited mobility and imperfect coordination of older adults, it is necessary to stimulate reasonable and feasible bodily interactions in the design of digital medical interfaces based on user abilities. Under the perspective of embodied cognition in psychology, the cognition and mentality of older adults present typical embodied characteristics. Embodied cognition pays attention to body structure, behavioural mode, and perceptual experience [7]. It encompasses the brain's positive influence on the cognitive process, cognition conducted through bodily experiences and activities. Embodied cognitive behavioural disorders can, to some extent, exacerbate older users' frustration and resistance during operation, and a blocked information transmission channel is a primary factor. Therefore, it is necessary to consider the transmissibility of visual information expression and use embodied interaction forms in design to map unconsciousness and efficiency directly onto behaviour, thereby providing older users with a psychologically safe and comfortable information environment.

3.3 Aiming for Inclusivity

Research reveals that approximately 90% of the elderly population encounters difficulties while using smartphones, the most common of which are impediments related to trial-and-error processes and information acquisition. A survey indicated that 87.8% of users experienced difficulties with smartphones, with attempt-related obstacles being the most prevalent (66.5%), followed by information processing issues 63.4% [8]. Constructing a society and psychological space marked by equality, tolerance, and mutual respect for the elderly is critical for promoting social interaction and pro-social behaviors. This represents the ultimate ideal and objective for the development and design of digital medical interfaces catered to the aging population. Inclusive design focuses on the welfare of every individual, acknowledging the diversity and differences among groups and scenarios. It strives for maximal product accessibility and enhanced user experiences within the constraints of limited resources, and seeks to accommodate various abilities [9]. Its objective is to ensure that all users can enjoy a sense of well-being and social recognition, thereby contributing to a more inclusive value creation process. The design of digital medical interfaces for the elderly should take users' skills and needs as the fundamental factors guiding design decisions [10]. The goal is to reduce or eliminate differences in physiology and perspectives between the elderly and the general population, ensuring that everyone can benefit from and use the product with minimal effort or without stratification. The intention is to minimize any exclusion in the design, resulting in a product that is both smooth and user-friendly for everyone. This user-friendly characteristic embodies not only physical ethical considerations but also emotional humanistic care [11]. Therefore, the interface design for digital medical services catering to the elderly needs to break down the barriers between the elderly and the general population at the ideological level of design. When drafting design guidelines, the classification method is used to re-cluster opportunity points derived from user pain points in the previous chapters from the perspective of product design. This gives the product characteristics of inclusivity, equality, convenience, and flexibility, improving the user experience across different scenarios. Ultimately, this seeks to provide more user-friendly products and services to a broader user base.

4. DESIGN PRACTICAL IMPLEMENTATION OF DIGITAL MEDICAL INTERFACE DESIGN FOR THE ELDERLY

4.1 Building the Information Hierarchy Framework

The design process is based on previous strategies for aging-appropriate applications (APPs), which broadly summarizes the features of a digital medical app for elderly outpatient services at the cognitive level . Starting from four dimensions: psychology, physiology, information, and environment, it proposes specific solutions for the elderly's outpatient waiting services, constructing the app's information hierarchy framework [12]. Given that the elderly's operation and perception processes are relatively prolonged, all major function modules related to medical appointments are concentrated on the home page "Always Smile Health" interface to improve patient operational efficiency. Other auxiliary function modules are distributed on three other interfaces, and users can access corresponding services by switching between these modules.

4.2 Usability Testing of the APP Interface Prototype

Based on the APP information framework, an interface prototype was designed and evaluated for elements such as "efficiency of information recognition," "ease of operation," "high fault tolerance," and "interaction interest" through user usability testing. Ten elderly individuals were invited to experience the prototype, completing three rounds of testing, each lasting 30 minutes. The tests involved learning product functions,

customizing medical tasks, and familiarizing themselves with functional modules [13]. The testing approach employed observational interviews, recording the feelings and suggestions of the participants after each round. Upon completion of the tests, a quantitative analysis was carried out using the Likert five-point scale, yielding an average score of 4, indicative of an "excellent" usability rating for the "Always Smile Health" APP interface prototype. Post-interview data analysis revealed a preference among the elderly for clean interface design and single-function orientation. However, two elderly users noticed brief periods of doubt and hesitation when choosing operating gestures, struggling to quickly determine which gesture would trigger the correct command. As a solution, dynamic cues for special operating gestures should be added to the prototype to alleviate fears associated with unknown operations.

4.3 APP Interface Design

The interface for older users, overall, incorporates unique features into a unified order at the experience level, balancing visual perception. In terms of color application, blue, a commonly used color in the medical field, is uniformly selected as the primary color, aligning with the real-world color environment and enhancing user trust in the platform. The use of orange and white as auxiliary colors improves visual recognition and provides a color hierarchy among the interface function modules. The page layout mainly adopts a list and card-style layout, allowing users to intuitively perceive the distribution of functions for optimal interface interaction and information transmission [14].

The icon is combined with a fresh skeuomorphic design style, adding a suitable amount of shadow to the icon to enhance the sense of two-dimensional space and highlight the spatial structure. Compared with existing online appointment platforms, the standout feature of this elderly outpatient waiting service APP is the integration of unique smartphone capabilities, providing older patients with more precise services and information assistance. For instance, the APP uses the smartphone as a medium for GPS positioning, voice guidance, vibration prompts, and animation demonstrations, enabling patients to gain greater information support through sensory compensation. Moreover, different waiting times and outpatient visit frequencies can be set for the elderly of different ages and conditions, satisfying the need for convenient medical services and improving customer satisfaction [15]. Nevertheless, the interface design from the visual to the interaction level ultimately differs from a real App. Although professional designers can filter out some of the effects, they cannot completely eliminate them. Therefore, there is still room for improvement in the overall interactive experience and emotional design. In subsequent design processes, improvements need to be made to the areas with lower inclusiveness assessment scores, enhancing visual design and interaction methods [16]. As the service system undergoes iterative refinement, its inclusiveness will correspondingly enhance, gradually elevating the user experience.

5. CONCLUSIONS

Confronted with the challenges of the 'digital divide' and the growing need for age-friendly design, we find that current design services often overlook inclusivity across user groups. However, the emergence of an aging society underscores the elderly as a vital consumer group. Our proposed inclusive digital medical age-friendly interface design process aims to offer both theoretical and practical guidance for enhancing inclusivity in service design. On a theoretical level, we develop principles for inclusive improvements, identify types of pain points specific to age-friendly services, and establish inclusive evaluation methods based on functional and emotional dimensions, thereby exploring a comprehensive design process for age-friendly services. Practically, we analyze the online medical service journey for elderly patients with chronic diseases, pinpoint and

categorize service pain points, and identify design opportunities in three strategic directions based on principles of service design inclusivity. We hope that this work provides a valuable reference for future research in inclusive, age-friendly service design.

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