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Research on the Interaction Design of Mobile Art Platforms for Hearing Impaired Groups: An Innovative Practice Centered on the Accessibility Experience

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Abstract: *This paper studies the interaction design of the cell phone art platform for the hearing impaired group in order to enhance their accessibility experience. By analyzing the characteristics and needs of this group and combining the current research status at home and abroad, it points out the deficiencies of the current design and proposes innovative points. Explaining the accessibility design principles and their application in enhancing the digital life experience of the hearing-impaired group, through case study and design practice, we propose the design of the art platform for the hearing-impaired group, including the functional design, interface design, etc., in order to satisfy their needs, to enhance the speed of art comprehension, and to reduce the difficulty of learning. Finally, we summarize the significance of the study, emphasizing the promotion of the quality of life of hearing-impaired people and the development of social inclusion.*

Keywords: *Hearing-impaired community; mobile-based art platform; interaction design; accessible experience*

1. Introduction

In recent years, human-computer interaction technology has made remarkable progress, enriching the way people interact with digital devices. However, hearing-impaired people still face many challenges in the digital era. Their needs for barrier-free access to information and integration into social life are increasingly pressing. This research focuses on the interaction design of art platforms on mobile phones for the hearing-impaired group to enhance their barrier-free experience through innovative practices. It is of profound significance as it improves their usage experience and quality of life, promotes inclusive development of society, enhances communication and integration among different groups, and is an exploration and leadership of human-computer interaction technology, expected to promote technological innovation and provide a scientific basis for building a more perfect barrier-free digital environment.

1.1. Overview of the current research situation

This study focuses on the interaction design of mobile phone-based art platforms for hearing-impaired groups, and by synthesizing the research progress at home and abroad. It is found that although the current design has achieved results in a number of fields, challenges such as insufficient depth of research, imbalance between technological realization and user experience, and limited social cognition still exist. For example, the research of "Research on New Media Use and Social Integration of Hearing Impaired Youth under the Perspective of Technological Empowerment" [1] focuses on the fusion of technological realization and user experience, and proposes that in the era of the mobile Internet, the high-speed development of information and media technology penetrates into the people's social life [2], and mobile devices such as cell phones have become one of the "organs" that everyone needs. Therefore, it is emphasized that it is important to create a space for the hearing-impaired people to express themselves and take action, and to awaken the sense of social citizenship of the hearing-impaired young people, so as to help them to integrate into the social life. Foreign studies emphasize interdisciplinary cooperation and systematic design strategies, and provide an in-depth analysis of the needs for accessible communication experiences for hearing-impaired people. [3] To address these shortcomings, this study

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proposes the following innovations: First, construct a set of comprehensive design strategies to comprehensively cover the multiple needs of the hearing impaired population. Second, adopting a user-centered design methodology[4] ensures that the design meets users' real needs and optimizes the experience through iteration. Furthermore, while focusing on technological innovation, the study focuses on optimizing the interaction process and feedback mechanism, and draws on the systematic perspective of foreign research to improve the fluency and satisfaction of user experience. Finally, this study is committed to promoting the understanding and acceptance of the hearing-impaired group in the society through the practice of design, and to promoting the popularization of the concept of accessible design to enhance the inclusiveness of the society [5]. These innovations aim to fill the gaps in existing research and bring more convenient and barrier-free art enjoyment experience to the hearing-impaired group.

2. Theoretical foundation and literature review

2.1. Interaction Design Theory

Interaction Design (abbreviated as IXD) is a design field that defines and designs the behavior of man-made systems. Its core lies in defining the content and structure of communication between two or more interacting individuals, so that they cooperate with each other to achieve a certain purpose. From the user's perspective, interaction design is a technique for how to make a product easy to use, effective and enjoyable. It focuses on understanding the target user and their expectations, the behavior of the user when interacting with the product, and the psychological and behavioral characteristics of the “human being” itself.

2.2. Characteristics and needs of the hearing impaired

In exploring how interaction design can benefit various user groups, special attention should be given to those with special needs. Since the core concept of interaction design is to create an intuitive, convenient, and inclusive user experience, it is particularly important to understand the characteristics and needs of the hearing-impaired community. The following table systematically summarizes the physical, psychological, and differentiated characteristics of this group, as well as their daily needs, to provide a solid theoretical basis and practical guidance for the development of subsequent design strategies as shown in Table 1.

Table 1: Characteristics and needs of the hearing impaired

Characteristics	Content	Needs
Physical characteristics	Hearing impairment; Difficulty in speech recognition	Hearing aid, Rehabilitation services, Barrier-free environment, Psychological support, Social support
Psychological Characteristics	Loneliness and Social ,Difficulties, ,Low self-esteem and anxiety, Dependency	
Differential characteristics	Differences in expression, Differences in access to information	

2.3. Principles of accessible design

2.3.1. Principles of barrier-free design

In research literature like the Review of Domestic and International Literature on Urban Barrier-Free Design, the principle of applicability is central, requiring designers to deeply understand and carefully address the specific needs of persons with disabilities during planning and implementation to ensure they are met. This care is not only reflected in the material construction of facilities like ramps, handrails, and lifts, but also extends to the non-material level such as information communication and service provision, to ensure that people with disabilities can access information, enjoy services, and participate in the community without barriers, like other community members. Therefore, the principles of publicness, accessibility, and openness advocated by barrier-free design are a deepening and expansion of the principle of applicability. These principles emphasize that design should go beyond individual needs and address the whole society, ensuring that everyone, regardless of gender, age, or physical condition, can access, use, and benefit from public facilities and services on an equal basis.

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2.3.2. Application of Accessible Design in Enhancing the Digital Life Experience of the Hearing-Impaired Community

Huawei, on the other hand, automatically generates subtitles for voice content in video, call, and other scenarios through the AI subtitle function, which greatly improves the efficiency of information access for hearing-impaired users. In addition, Huawei's Xiaoyi Calling feature combines Smart Answer with intelligent text-to-speech technology to simplify the communication process for hearing-impaired users, enabling them to communicate more confidently and without barriers.

Apple's VoiceOver feature, as another example of accessible design, opens up a whole new digital life experience for the hearing-impaired. VoiceOver, a powerful screen reader, uses advanced speech synthesis technology to clearly describe the interface elements of iPhone, iPad, Mac, and other devices, allowing users to “hear” the device with just a touch. It allows users to “hear” the device and realize the purpose of browsing and operating the device independently just by touching it. Whether reading text, browsing the web, or operating applications, VoiceOver provides accurate and smooth voice navigation, ensuring that hearing-impaired users can seamlessly integrate into the digital world and enjoy the convenience and fun of technology. Together, these examples demonstrate the great potential and value of barrier-free design in promoting social inclusion and equality.

3. Case Study and Design Practice

3.1. Case study

3.1.1. “Little Trumpet” Elderly and Hearing Aid APP

The “Little Trumpet” elderly and hearing aid APP, developed by 10 college students from Xi'an University of Technology, is designed specifically for the elderly with hearing difficulties. This APP, through its sound amplification function, helps hearing-impaired elderly people hear the voices of others more clearly when communicating with others. At the same time, it also has a voice recognition function that can convert dialogue content into text for the elderly to read and understand easily. Its software has the following characteristics:

(1).Sound amplification: Cooperating with headphones, it effectively amplifies sound and helps hearing-impaired elderly people listen better.

(2).Voice recognition: Converts voice into text for the convenience of the elderly to read, especially for important medical advice and other information.

(3).Alarm function: Sets alarm sounds such as fire, 110, and earthquake to improve the safety awareness of the elderly.

3.1.2. “Listening Freely without Barriers” APP

The “Listening Freely without Barriers” APP developed by Harbin Yishidai Digital Technology Development Co., Ltd. is based on Huawei Cloud artificial intelligence technology and is committed to meeting the barrier-free communication needs of hearing-impaired people in daily life, learning, entertainment, and professional public service fields. Its software has the following characteristics:

(1).Real-time voice transcription: Generate accurate subtitles in real time for unsubtitled videos played on mobile phones to facilitate the viewing and understanding of hearing-impaired users.

(2).Mutual translation between voice and text: Through Huawei Cloud's voice recognition and voice synthesis technologies, achieve accurate mutual translation between voice and text in daily conversations.

(3).Online live sign language translation: Establish an online live sign language translation center to provide remote video sign language translation services for hearing-impaired people.

3.2. Design Practice

The design of the art platform on mobile phones for the hearing-impaired group includes multiple aspects such as the analysis of user needs, research background, function introduction, design framework, interaction design, and visual design. It focuses on the good experience brought by the platform to users, helps the hearing-impaired people improve the difficulties encountered in the field of art, and can better help the hearing-impaired people build a friendly bridge for artistic communication. Based on the above concepts, the design of the art platform on mobile phones for the hearing-impaired is carried out.

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3.2.1. Research Background

Globally, there are many hearing-impaired people. In China, the hearing-impaired community is large. According to a survey, there are about 87 million disabled people in China, with 27.8 million having hearing disabilities. Domestic art platforms lack interaction and barrier-free designs for the hearing-impaired. Compared to those without hearing impairments, the hearing-impaired have narrower information channels, weaker logical thinking ability, resulting in slow information reception, low understanding, weak communication, and insufficient problem-solving awareness. This greatly increases the difficulty of learning art for them. Based on these problems, corresponding functions are designed to meet their needs, improve understanding speed and reduce learning difficulty, and form a barrier-free art platform.

3.2.2. Design Framework

The construction design of the framework can integrate scattered information and express the composition of the product in a more intuitive form, making the transmission and acquisition of information simpler and more direct. After determining the functional scope of the product, the logical sorting and flow chart drawing of each component of the product are carried out as shown in Figures 1.

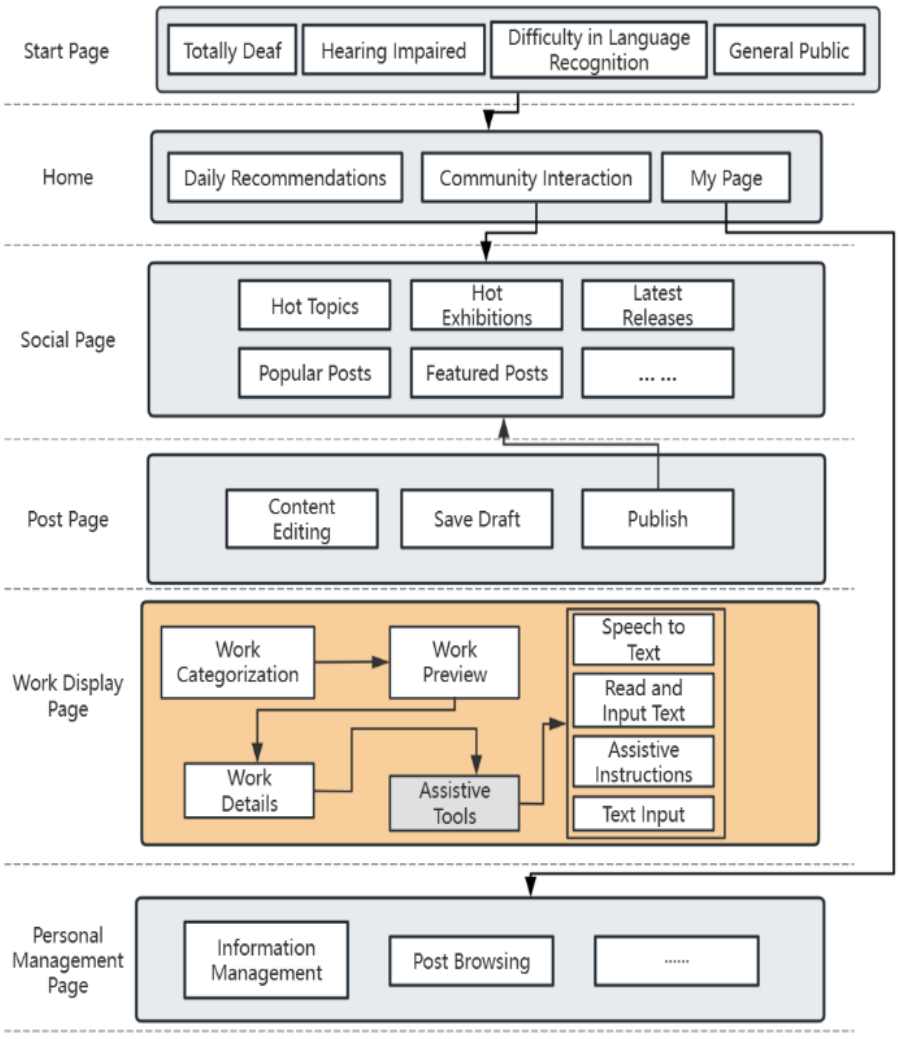

Figure 1: Design Flowchart

3.2.3. Design Difficulties and Solutions

Based on the research, Table 2 summarises the problems of mobile phone interaction for people with hearing impairments and the solutions that correspond to them.

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Table 2: Design Difficulties and Solutions

Design Difficulties	Description	Solution
Communication Barriers	Hearing-impaired users are unable to communicate effectively through voice when using an app, which limits their ability to access information and interact socially.	1. Real-time speech-to-text service: integrates real-time speech recognition technology to convert speech into text so that it can be understood by hearing-impaired users. 2. Sign Language Video Interpretation: Provides sign language interpreted video content to help hearing-impaired users understand artwork presentations and social interactions.
Content accessibility	Works of art often contain rich audio information that is difficult for hearing-impaired users to experience in traditional ways.	1. Detailed text description: Provide rich text description for the artwork, including the background of creation, artistic style and so on. 2. Visual guide: help users understand the artwork through images, animations and other visual elements.
Interface Design	The interface design needs to take into account users who are colorblind or have limited vision to ensure that all users can easily access the app.	1. High-contrast color scheme: High-contrast color design is used to ensure that the information is clearly visible. 2. Assistive Reading Tools: provides assistive reading functions such as font size adjustment and screen reader compatibility.
Social interaction	Hearing impaired users may feel excluded or unable to participate fully when engaging in social interactions due to the inability to use their voice	Text and image-based communication tools: .develop text and image-based communication tools such as emoticons, image sharing, etc

3.2.4. User Needs Analysis and Function Introduction

According to research, hearing-impaired users face great challenges in communication, especially in scenarios such as answering calls, making emergency calls for help, social chatting, working, and seeking medical treatment. Therefore, the app should provide efficient voice-to-text and text-to-voice functions to improve the accuracy and stability of information transmission. Therefore, when designing the art platform on mobile phones for the hearing-impaired group, language assistance functions are added so that users can realize convenient communication with others when exploring and learning art, and assist users to quickly understand relevant audio information when learning art as shown in the Figure 2.

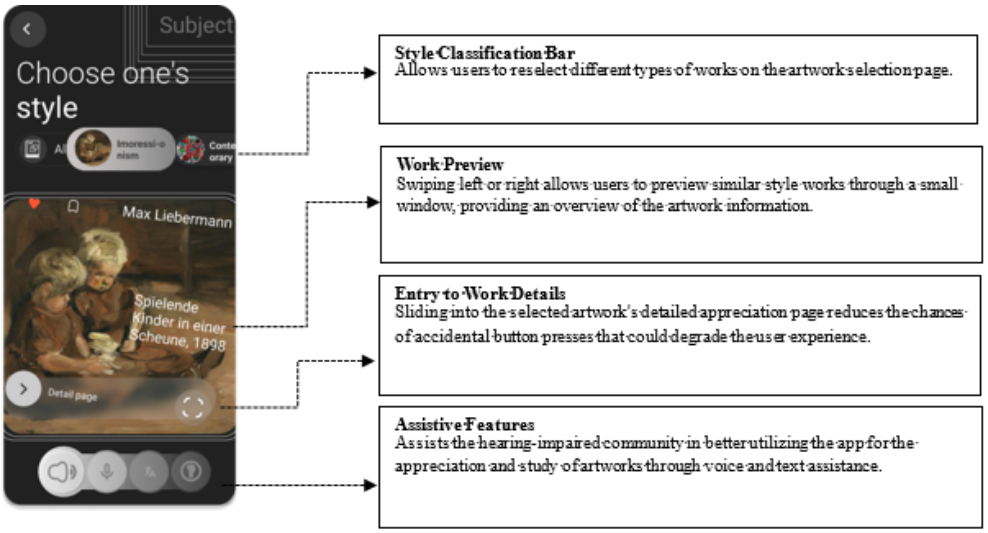

Figure 2: Voice-assisted function

UI design, as a bridge for human-computer interaction, has self-evident importance. However, traditional UI design often only focuses on the needs of mainstream users and ignores the experience of marginalized groups. Therefore, considering the particularity of the hearing-impaired population, the UI design of the app should follow the principles of barrier-free design, such as ensuring sufficient color contrast and avoiding using only color to convey important information.

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Ultimately, according to this principle, the overall visual color contrast is enlarged, mainly in black and white to enhance the visual experience. At the same time, excessive colors are reduced to avoid affecting the user's original color perception of artworks.

Hearing-impaired users may be more inclined to use vision and touch to experience art. Therefore, the design of the app should take this into account. For example, by providing high-definition art pictures, videos, and interactive elements, they can experience artworks more deeply.
Therefore, a dedicated page for works is set up. The work information is presented in the form of cards. Users can enter the detail page by clicking on different cards to obtain a more detailed and clear introduction to the works.

Users of art apps may use the app in different scenarios, such as browsing artworks at home, using the app at art exhibitions to obtain more information, or learning art knowledge in an educational environment. For hearing-impaired users, the app needs to provide effective support in all these scenarios.

Therefore, when designing the art platform, functions such as popular exhibition recommendations are added. This allows users not only to study and appreciate art on mobile phones but also helps users quickly understand the art exhibitions around them and experience the charm of art offline. In addition, a community communication function is added so that users can quickly communicate and learn with art-loving groups even at home.

4. Conclusion

The research indicates that to meet the special needs of the hearing-impaired group in obtaining art information, social interaction, and digital life, the design should focus on integrating functions like real-time voice-to-text, sign language translation, detailed text descriptions, and visual guidance to remove barriers. The design strategy should follow the principles of barrier-free design, ensuring the application of high-contrast color schemes and auxiliary reading tools to enhance the inclusiveness and usability of the interface. Additionally, by introducing popular exhibition recommendations and community communication functions, the art experience and social interaction channels of hearing-impaired users are further expanded. This research not only improves the experience and quality of life of the hearing-impaired but also promotes the inclusive development of society and provides references for future interaction design in the digital life field for this group.

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