Practice of human-computer interaction behavior recognition and experience optimization in intelligent tour guide equipment

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Abstract: With the widespread application of smart devices, smart guide equipment has become a core component of major museums, tourist attractions, exhibitions and other places. How to improve user experience through effective human-computer interaction behavior recognition and experience optimization has become an important topic in the development of smart guide equipment. Based on behavior recognition technology, this study explores how to capture and analyze user behavior to achieve personalized content recommendation and dynamic interactive feedback, and further optimize the user experience of smart guide equipment. The study proposes optimization strategies for multiple terminals and multiple scenarios, focusing on analyzing the differences in user behavior in different devices and environments and their impact on experience. Through case analysis, this study demonstrates the innovative application and optimization practice of smart guide equipment in actual applications, and proposes potential directions for future development. The innovation of the study is to combine behavior recognition and experience optimization methods to provide a comprehensive design framework, providing theoretical support for the continuous innovation and development of smart guide equipment.

Keywords: Intelligent Tour Guide Equipment; Human-Computer Interaction; Behavior Recognition; Experience Optimization; Personalized Recommendation

1 INTRODUCTION

With the rapid development of information technology, smart guide equipment is increasingly used in places such as tourism, museums, and shopping malls. These devices can not only provide instant and personalized guide services, but also enhance user experience through various interactive methods such as voice, image, and touch [1]. One of the core functions of smart guide equipment is human-computer interaction, and how to identify behaviors efficiently and optimize user experience has become the key to improving the quality of equipment services. With the continuous advancement of technologies such as artificial intelligence, sensor technology, and cloud computing, the interaction mode and behavior recognition technology of smart guide equipment are also evolving. However, in practical applications, user behaviors and needs are diverse and complex [2]. How to accurately identify and respond effectively based on user behaviors is still a major challenge facing smart guide equipment. Therefore, studying human-computer interaction behavior recognition and experience optimization in smart guide equipment not only helps to improve user satisfaction, but also has important significance for promoting the widespread application and technological innovation of smart guide equipment.

The importance of human-computer interaction in smart guide equipment cannot be ignored. Compared with traditional guide methods, smart guide equipment can not only achieve more accurate information transmission, but also interact with users through multiple sensory channels to enhance user participation and immersion. By intelligently identifying the user's behavior and needs, the device can adjust the content presentation, interaction mode, etc. in real time, thereby providing users with more personalized and accurate guide services. However, user needs are often dynamically changing, and there are significant differences in the behavior habits of different users, which brings great challenges to the design and optimization of intelligent guide devices [3]. Therefore, how to improve the interactive experience through effective behavior recognition technology for different users and different scenarios has become an important topic in current research.

The main goal of this study is to improve the human-computer interaction experience of intelligent guide devices, especially in terms of behavior recognition and interactive feedback. Specifically, the study will explore how to identify user behavior patterns through advanced sensor technology, data analysis and artificial intelligence algorithms, and adjust the guide content and interaction methods in real time according to these patterns to maximize user needs. On this basis, this study will further explore how to optimize the user experience and improve the ease of use and affinity of the device in different usage scenarios and user groups. The core issue of the study is how to accurately identify user behavior and combine the feedback mechanism of the device for effective interaction to improve user satisfaction and usage efficiency.

2 RELATED WORK

With the continuous advancement of science and technology, smart guide equipment has become an indispensable part of modern public service places. These devices are not limited to traditional text or voice guides, but enhance the interactivity and intelligence of user experience through a variety of technical means. Smart guide equipment usually has multiple functions such as positioning, voice recognition, touch screen operation, etc., and can provide personalized and instant information according to user needs. There are many types of these devices, including guide applications based on mobile devices, touch screen information terminals, portable voice guides, etc. In places such as tourism, museums, and exhibitions, the functions of these devices are constantly expanding, from simple geographic positioning and path guidance to diversified interactive experiences such as voice explanations and virtual guides, gradually moving towards a smarter and more personalized direction[4]. With the continuous maturity of new technologies such as 5G, the Internet of Things, and big data, the application of smart guide equipment has also shown a broader prospect. Especially with the help of artificial intelligence technology, the response speed and interactivity of the equipment have been significantly improved, and it can make intelligent adjustments in real time according to user behavior, thereby greatly improving the user's sense of participation and immersion.

Human-computer interaction behavior recognition is a vital component of smart guide equipment. Human-computer interaction (HCI) is a discipline that studies the interaction between people and computers or other intelligent devices. Its core purpose is to optimize the communication efficiency between people and devices and improve the operating experience. Traditional interaction methods mainly rely on screens and buttons, but with the development of technology, multimodal interaction methods such as touch, voice, gestures, and eye tracking have been widely used [5]. In intelligent tour guide equipment, behavior recognition technology mainly uses sensors, image processing, voice recognition, deep learning and other means to identify user behavior in real time, and adjust the tour content and interaction methods according to changes in behavior. When a user stays in front of an exhibit, the device can automatically identify its location and start playing related commentary content; when the user moves, the device automatically adjusts the viewing angle or plays the next step of information. Behavior recognition technology not only improves the responsiveness of the device, but also makes the user's interactive experience smoother and more natural [6]. With the development of artificial intelligence and big data technology, behavior recognition technology has become more accurate and intelligent, and can capture users' emotional changes, points of interest and their needs in real time, thereby providing more personalized services for intelligent tour guides.

Regarding the relevant research on user experience optimization, in recent years, scholars have conducted in-depth discussions on the definition and optimization strategies of user experience. User experience (UX) refers to the overall feeling and reaction of users in the process of using products or services. The user experience of smart navigation equipment is not only reflected in the convenience of equipment operation, but also includes the equipment's perception of user needs, the fluency of interaction, the accuracy of content and other aspects. The core purpose of optimizing user experience is to reduce the user's cognitive burden and improve the efficiency and comfort of interaction through technology and design means. In smart navigation equipment, the strategies for optimizing user experience can be divided into three aspects: hardware optimization, software optimization and interaction optimization [7]. Hardware optimization mainly focuses on the portability, display effect and sensory interaction design of the equipment; software optimization focuses on the accurate push and intelligent recommendation of content; interaction optimization emphasizes improving user participation and satisfaction through personalized services. In recent years, with the development of machine learning and artificial intelligence technology, the user experience optimization of smart navigation equipment has increasingly focused on providing more customized and intelligent navigation services by analyzing user behavior and preference data. At present, the research on user experience optimization in smart navigation equipment mainly focuses on the innovation of interaction methods, personalized push of information content and the design of intelligent feedback mechanisms [8]. Although some progress has been made, how to further improve the intelligence level of equipment to adapt to a wider range of user groups and usage scenarios remains an important direction for future research.

3 HUMAN-COMPUTER INTERACTION BEHAVIOR RECOGNITION IN INTELLIGENT TOUR GUIDE EQUIPMENT

The application of human-computer interaction behavior recognition in intelligent guide devices is crucial. It optimizes the interactive experience of the device by analyzing the user's behavioral characteristics. In this process, we first need to understand the theoretical basis of user behavior recognition. The core theory of human-computer interaction behavior recognition comes from cognitive psychology and behavior. It studies how users process information through multiple perceptual channels such as vision, hearing and touch when using intelligent guide devices, and respond to environmental changes. Behavior recognition theory believes that user behavior is not only a response to external stimuli, but also a dynamic cognitive process involving all aspects of information perception, decision-making and execution [9]. In intelligent guide devices, user behavior performance usually includes stay time, browsing path, click action, voice command, etc. By analyzing these behaviors, the device can identify the user's interest points, needs and current status, so as to respond intelligently.

During the tour, the user's behavioral characteristics are diverse and personalized. Different users have different behavioral habits in different scenarios, which requires the device to have flexible adaptability. In a museum or exhibition hall, users may selectively stay in front of certain exhibits for a long time to watch according to their interests, while rushing past other exhibits. This difference in behavior characteristics requires that smart guide devices must be able to dynamically identify and respond to user behavior, such as automatically starting to play relevant audio commentary or displaying more information. In addition, during the tour, users will also make corresponding adjustments based on environmental factors. These behavior characteristics need to be captured in real time through smart sensors and behavior recognition technology to optimize the tour experience.

The application of behavior recognition technology is one of the keys to optimizing human-computer interaction. In smart guide devices, sensor technology plays an important role in data collection. Through various sensors, the device can obtain the user's position, movement, sight direction and other related behavior data in real time. These sensors provide basic data for subsequent data analysis and behavior pattern recognition. Through in-depth analysis of these data, the device can identify the user's behavior patterns and respond according to these patterns. Pattern recognition algorithm is one of the core technologies in behavior recognition. Through machine learning and deep learning technology, it can extract useful information from a large amount of user behavior data and identify the user's points of interest, behavior habits and demand changes. Based on these recognition results, the smart guide device can predict the user's next needs based on the user's behavior and dynamically adjust the guide content or interaction method [10]. If the device detects that the user stays for a long time at an exhibit, it can automatically push more information or relevant background introduction of the exhibit.

The application of user behavior prediction and dynamic feedback mechanism in smart guide can further enhance the personalization and intelligence of user experience. In behavior prediction, smart guide devices not only rely on the current user's immediate behavior, but also combine historical behavior data, user preferences, scene settings and other factors for prediction. Through this prediction, the device can proactively make appropriate responses before the user has clearly expressed his needs. When the user stays in a specific area for a long time, the device can automatically push relevant content to prevent the user from getting bored or lost waiting for information. In terms of dynamic feedback mechanism, the device continuously monitors the user's behavior changes, adjusts the interactive design and content display method in real time, and ensures that it always keeps pace with the user's needs.

In smart guide devices, the application examples of behavior recognition are already very rich. Many modern museums and tourist attractions' smart guide devices use sensor technology to track the user's location changes, and automatically push relevant text, voice or video explanation content based on the user's stay at different exhibits or attractions. These devices can adjust the content of the guide in real time according to changes in user behavior, improving the personalization and interactivity of the guide. In addition, different types of user behavior analysis have an important impact on experience optimization. For users who prefer detailed explanations, the device can provide more information content; for users who browse quickly, the device improves the efficiency of the guide through concise information display or voice prompts. Through in-depth analysis of user behavior, the device can more accurately adjust its service content, avoid redundant or missing information, and ensure that each user can get the guide experience that best suits their needs. This intelligent behavior recognition and experience optimization has greatly improved user satisfaction and usage stickiness, and has also promoted the widespread application of smart guide equipment in various fields.

4 EXPERIENCE OPTIMIZATION STRATEGIES IN SMART TOUR GUIDE DEVICES

The experience optimization strategy in smart navigation devices is the key to improving user satisfaction and enhancing device performance. In order to effectively evaluate and analyze user experience, researchers usually use a variety of evaluation methods and tools, the most commonly used of which include user testing, questionnaires and data analysis. User testing can help researchers understand users' real needs and problems and promptly discover inconveniences and obstacles in interaction by directly observing users' behavior when using smart navigation devices. Questionnaires collect user feedback on device functions, operation fluency, information transmission, etc. through structured questions, providing a direct basis for optimization. Data analysis tools can extract user behavior patterns from device usage data, including user clicks, dwell time, path selection and other information. These data provide a scientific basis for analyzing user needs and usage habits. Combining these methods, designers can construct key indicators and evaluation criteria for user experience, such as ease of operation, efficiency of information acquisition, comfort of interaction and user satisfaction. These indicators help designers evaluate the performance of navigation devices from multiple dimensions, identify weak links in the experience, and thus provide direction for subsequent optimization.

In the experience optimization method based on behavior recognition, personalized navigation content recommendation is a common and effective means. Through behavior recognition technology, smart guide devices can capture user behaviors in real time, such as dwell time, click preferences, exhibits or attractions of interest, etc., so as to push content related to user interests. Personalized recommendations not only enhance user participation, but also make the guide content closer to user needs and interests, avoiding the limitations of the traditional single content display mode. The system can recommend exhibition information or new attractions that users may be interested in based on the user's historical behavior and real-time feedback. This intelligent content recommendation greatly enhances the flexibility and interactivity of the guide. At the same time, dynamic interaction design and feedback mechanism are also one of the core methods of experience optimization. In smart guide devices, the interaction design should be highly responsive and adaptive, and be able to adjust the interaction mode in real time according to changes in user behavior. Through voice recognition, touch screen operation and other means, the device can flexibly provide the information required by the user, and when the user makes a choice, the system should provide feedback in time to help the user confirm the operation and the next step. The feedback mechanism not only enhances the intelligence of the device, but also enhances the user's confidence in operation and reduces operation errors.

Optimizing the interface and interaction design is also an important part of improving user friendliness. The interface design of the device should be concise and easy to operate, avoiding excessive complexity or information overload. During the navigation process, users may be troubled by unclear interfaces or inconvenient operations. Therefore, the layout of the interface, the size of buttons, the readability of fonts, the hierarchy of information, etc. should be carefully designed to ensure that users can quickly find the required functions and information. In addition, smart navigation equipment should focus on humanized design, and help users get better visual and operational experience during use through voice prompts, icon display and dynamic guidance.

In the experience optimization under multiple terminals and multiple scenarios, the design strategy that adapts to different terminals and usage scenarios is crucial. With the popularization of smart navigation equipment, the needs and environmental differences of users using equipment on different terminals have become more obvious. Mobile devices usually have small screens, and users may need to use navigation services anytime and anywhere, so the interface should focus on the simplicity of information and the convenience of interaction; on desktops or large display devices, users can browse more information, and the interface design can be richer and more detailed. Therefore, designers need to optimize the interface layout and information presentation method according to the characteristics of different terminals to ensure a consistent and smooth user experience on different devices. For multi-scenario applications, smart navigation equipment also needs to be adaptively adjusted according to the different characteristics of the venue. In museums and tourist attractions, the types of content and user behaviors that the guide equipment may need to handle will be different, so it is necessary to design personalized interaction strategies according to the actual scenarios to meet the needs of different users in different environments.

Finally, the optimization method of multi-device collaboration is also one of the important strategies to improve user experience. In real applications, users often switch between multiple devices, such as from mobile phones to tablets, and from indoor to outdoor guided scenes. In order to ensure the continuity and consistency of user experience, smart guide equipment should have the ability to work with multiple devices. The guided tasks started by users on mobile devices can be seamlessly connected on other devices to ensure information and progress synchronization. By realizing data synchronization and task inheritance between devices, the convenience of users can be greatly improved, the discomfort caused by device switching can be reduced, and the overall guided experience can be optimized.

5 CASE ANALYSIS AND APPLICATION PRACTICE

In the application practice of intelligent tour guide equipment at home and abroad, some successful cases have provided valuable experience for intelligent tour guide equipment in human-computer interaction behavior recognition and experience optimization. Taking museums and tourist attractions as examples, many intelligent tour guide equipment have been widely used and achieved remarkable results. Taking the intelligent tour guide system of the "Beijing Palace Museum" as an example, the Palace Museum has successfully achieved real-time tracking and intelligent guidance of tourist behavior by using advanced voice recognition

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and positioning technology. When tourists use intelligent tour guide equipment, the equipment can push detailed introductions of relevant exhibits in real time based on the user's location information and stay time, and even predict the user's points of interest based on the user's behavior, and actively recommend relevant exhibits or explanations. In addition, the system can also collect user operation data in real time, and provide a basis for optimizing the museum's exhibition content and tour routes through back-end behavior analysis. This personalized service based on behavior recognition not only improves the sense of participation of tourists, but also greatly improves the efficiency of tourists' visits, avoiding the limitations of traditional tour guide methods. Similar successful cases also include some internationally renowned museums and scenic spots, such as the smart guide devices of the Louvre in France. These devices, through the combination of touch screen and voice control, help visitors easily find artworks of interest in complex exhibition environments, and achieve a more personalized tour experience.

Innovative applications of smart guide devices in human-computer interaction continue to emerge. Some scenic spots and museums combine augmented reality (AR) technology with traditional guide devices, so that when visitors scan exhibits through smart guide devices, they can not only see text and voice explanations, but also display more historical background and artistic details through virtual images. This innovative interaction method not only enhances the immersiveness of the user experience, but also greatly enhances the visualization and interactivity of information. In addition, some devices also incorporate gesture recognition, facial recognition and other technologies, allowing visitors to interact with the device through natural body language without the need for touch screens or other input devices. This innovative application not only makes the interaction more convenient, but also improves the response speed and intelligence level of the device, giving users a smoother and more pleasant experience.

In the application of smart guide devices, the collection and analysis of user feedback is an important part of optimizing the interactive experience. In order to continuously improve the design and function of the device, it is essential to collect user feedback. Many museums and tourist attractions collect visitors' opinions and suggestions on guide devices through online questionnaires, on-site surveys, social media interactions, etc. By analyzing these feedback information, designers can clearly understand the pain points and needs of users during use. Users may reflect that the device's voice explanation speed is too fast, or the device's positioning is not accurate enough, resulting in missing the exhibits of interest. Through these feedbacks, the development team of smart guide devices can make targeted functional adjustments, such as optimizing the speed of voice playback, improving positioning technology, and even redesigning the layout and interaction of the interface to ensure that users can get a smooth experience in different scenarios.

The practice of interactive optimization based on user feedback is also deepening. Many smart guide devices can not only understand users' real-time needs by collecting user behavior data, but also make dynamic adjustments based on feedback data. When a user stays in an exhibition area for too long, the device can provide more relevant information by adjusting the voice prompts or image display to avoid user fatigue; if the user shows interest in a certain type of exhibits, the device will automatically recommend similar exhibition content. These optimization measures have greatly improved the intelligence level of the equipment and made the guide service more personalized. In addition, feedback-based optimization is also reflected in the diversified design of the equipment. For example, users with different cultural backgrounds or language needs can choose different language versions. The system will provide corresponding services according to the needs of users, ensuring that a wider range of user groups can enjoy a high-quality guided tour experience.

These successful cases and practices show that the behavior recognition and experience optimization of smart guide equipment in human-computer interaction can not only improve user satisfaction, but also promote technological innovation and development. By continuously optimizing the functions and interaction methods of the equipment, smart guide equipment can better adapt to the changing user needs and usage scenarios, and improve the scientific and technological level and service quality in the public service field.

6 CONCLUSION AND OUTLOOK

This study focuses on the recognition and experience optimization of human-computer interaction behavior in smart guide devices, and explores how to improve user experience and optimize interaction design through behavior recognition technology. The main result of the study is to propose a smart guide experience optimization strategy based on user behavior analysis, focusing on analyzing the behavioral characteristics of users in different scenarios and terminals, and combining advanced sensor technology and data analysis methods to explore how to achieve personalized content recommendation and dynamic interactive feedback by capturing user behavior in real time. In addition, this study also proposes a design method for optimizing user experience in multiple terminals and multiple scenarios, emphasizing the realization of seamless and unified visual experience through the collaboration between devices. The innovation of the study is to combine behavior recognition with user experience optimization, and propose a smart guide device design framework based on behavior analysis, which provides theoretical support and technical path for practical application.

However, this study also has some limitations. First, although the study proposes a variety of behavior recognition and experience optimization methods, it is still a challenge to verify these optimization strategies in a wider range of scenarios due to the involvement of different devices, different user groups and changing usage environments. Secondly, although this study has conducted in-depth discussions on data analysis, more field tests and optimization are needed for the accuracy and real-time performance of behavior recognition technology. In addition, the personalized recommendation and dynamic feedback mechanism mentioned in the study may be limited by hardware performance and algorithm complexity in practical applications. How to balance the needs of intelligence and computing resources still needs further exploration. Finally, this study mainly focuses on the application level of intelligent guide equipment. The adaptation of equipment in different cultural and language backgrounds is less considered and needs to be further expanded in future research.

The future research direction will promote the continuous innovation of intelligent guide equipment in human-computer interaction with the support of emerging technologies. The development of technologies such as artificial intelligence, the Internet of Things, and 5G networks will provide intelligent guide equipment with more powerful data processing capabilities and more intelligent interaction methods. In particular, artificial intelligence technology can more accurately identify user needs and preferences through deep learning and big data analysis, and realize more personalized and adaptive guide services. The application of augmented reality (AR) and virtual reality (VR) technologies will also make the guide experience more immersive and interactive, providing users with a new sensory experience. In addition, with the improvement of interconnection between devices, the intelligent guide system will become more intelligent and collaborative, and users can switch freely between different terminals to obtain a seamless guide experience.

In terms of experience optimization, future research will focus on how to improve the naturalness and convenience of user experience through multimodal interaction methods (such as voice recognition, gesture control, eye tracking, etc.). As users' demands for smart guide devices become more and more diverse, how to design equipment and services that can meet the needs of different user groups has become an important direction for experience optimization. At the same time, the popularization of smart guide devices will enable them to be more widely used in public places, cultural heritage protection, education and training and other fields. Future research will also involve how to adapt and optimize in different application scenarios to further improve the versatility and universality of the equipment.

In summary, the research on smart guide devices in the recognition of human-computer interaction behavior and experience optimization has broad prospects and application potential. With the continuous development of new technologies, future smart guide devices will be more intelligent and personalized, and user experience will be further optimized and improved.

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