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Research Article

Multimedia Analysis of Digital Museum User Interface Based on Goal-Oriented Theory and Information Fusion and Intelligent Sensing

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Introduction. The development of network technology is promoting the process of digitalization. The digital museum, an emerging museum display mode, is gradually highlighting its great value in the wave of digitalization. In the context of the rapid development of digital museums and mobile applications, the user interface of digital museums, as the integration point of human-computer interaction, the artistic expression of its visual design is also more important. This paper takes the digital museum application (APP) user interface design as the research direction. By optimizing the visual design of the interface, the user's operating experience is improved, so that users can enjoy an orderly, time-saving, efficient, comfortable, and interesting interactive experience. *Methods*. User interface design to analyze related theories such as target-oriented design and visual hierarchy design and dig out the manifestation of user goals in the museum's APP visual hierarchy and clarify the design content. Use qualitative and quantitative user research methods to conduct demand research for museum users and build user role models. Build user role target task model. Determine the function settings of the museum's APP and establish an information structure. Secondly, build a low-fidelity model through the level analysis of the visual elements in the interface and use the low-fidelity prototype test to guide the museum's APP visual level design. The interface visual level elements are integrated into the museum's APP visual level framework and integrated with the museum's characteristics Together, put forward the visual hierarchical design strategy of the museum APP. *Results*. A new model for the dissemination and display of cultural information resources by transposing the display of museum information content fusion to the works of the digital platform. The ease of use, fun, and artistic quality of the user interface of the digital museum are the keys to attracting users. Through the summary of the theory and the construction of the design strategy, we build and design a museum APP that meets the user's experience, meets the user's goals, and has a good visual hierarchy. The experimental results show that the largest number of people, 62.6%, wanted to learn about local culture by visiting museums. The number of people whose purpose was to travel and the study was the next highest, and they accounted for an equal share, 43.1% and 40.6%, respectively. A smaller number, 23.4%, attended museums for hobbies and interests. The number of people who visit museums for research purposes is even lower, at 11.9%. Through usability testing and user satisfaction analysis of the design model, the rationality and effectiveness of the design strategy are verified, which can provide appropriate guidance for museum app design. *Conclusion*. The problems encountered in the visual design and production of digital museums and the solutions were discussed, and through a comparative analysis with other digital museum visual designs, it provided theoretical and practical basis for the construction and research of digital museum visual design in the future. Our digital museum user interface design is based on user needs and solves the previous problem of users not understanding how to use the museum app effectively.

1. Introduction

As a window for displaying culture and disseminating knowledge to the audience, the digital museum makes full use of the advantages of the "fast communication" of the Internet, extracts cultural information points in the collection, and selects 720-degree panoramic roaming and 360-degree surrounding objects to promote China's excellent traditional culture and spread the works of Chinese civilization. Digital museums enable the information fusion and the need for audiences to use digital technology to view exhibitions and learn about heritage wherever they are, whenever they are [1]. Han [2] suggests that user interfaces can meet the basic needs of users by integrating the disciplines of technology, art, and psychology. Text images [3], interface colors [4], interactive buttons [5], and overall layout [6] are important design elements. Designers must rationally design these elements according to the characteristics of different museums to form an organic whole, so as to achieve the unity of ease of use and interest, thereby inspiring the audience [7].

Li [8] puts forward suggestions for establishing a brand image, strengthening the publicity of museums, and enhancing the interest of museum app through the problems of existing museum app. Due to the imperfect information management of the collections and the outdated visiting mode of traditional museums, under such circumstances, digital museums have emerged [9]. Digital museums use text, images, audio, video, and other media forms for information transmission. Virtual reality technology and three-dimensional technology promote the growth of digital museums, making them look like physical museums [10–12]. Its basic advantages are as follows: it can break through the limitation of exhibition space, making the number of exhibitions and exhibition collections unrestricted; it can break through geographical restrictions, so that more people can visit and browse without visiting physical museums; and it can use museum resources as content to pass establishing an educational network connection can assist students in classroom learning and enable audiences to get a good learning experience through a new interactive form [13, 14].

Goal-oriented design is a design that starts with the specific needs of the user [15, 16], Chu [17] found that a simple and clean interface is good for the user to read and a moderate interaction experience can bring a good feeling to the user. The user interface is also known as the human-machine interface or human-computer interface. It consists of the intersection of human and computer hardware and software, between the user and the computer system, is the medium for the transmission and exchange of information between the human and the computer, and is a comprehensive operating environment for the user to use the computer system [18–20]. User-friendliness refers to the complexity of the subjective operation of the user operating system. For example, the lower the complexity of the subjective operation, the easier the system is to use, the higher the user-friendliness of the system [21]. The user interface's ease of use, fun, and artistry are all key to attracting readers [22]. Liu [23] suggests in his goal-oriented interaction design about users that it is important for designers to understand users' psychological perceptions and usage habits. Sun [24] argues that a visual interface that meets users' needs is not limited to local aesthetics, but rather the comfort of the overall interface. As shown in Figures 1(a)–1(c), an example of a successful interface design for the navigation function, the uniform interface style is designed to make it more accessible to users.

The museum's first attempt to introduce mobile phone APP applications was in Japan, and there are many museum APP applications researched and developed in European and American countries. The APP applications of excellent and mature museums abroad include the following: The British Museum, Musée du Louvre, Metropolitan Museum of Art, American Museum of Natural History, The Museum of Modern Art (MoMA), Miraikan, and Tokyo National Museum.

This research field involves knowledge of museology, mass communication, and mobile technology, as well as comprehensive research in the field of design including user experience design, user interface design, design psychology, and visual communication design. Regarding the research innovations of this thesis, from the perspective of visual communication, through the sequence and orderly design method analysis of the layout, text, color, and other elements in the interface, as well as the combing of the interrelationships, the author can design the interface information level. There is a certain degree of in-depth research on the specific visual elements.

Through sensing technology, in real life, such as touch-sensitive elevator buttons (tactile sensors) and lights that are dimmed or brightened by touching the base, there are also many applications that most people have never realized. With the development of micromachines and easy-to-use microcontroller platforms, the application of sensors has surpassed the traditional temperature, pressure, or flow measurement fields. In this research, the sensing technology will be combined with the interface design of the digital museum, through vision and touch to optimize the navigation of the museum, making the research more innovative.

Most of the existing museum APP designs are based on the stylistic features of the museum for interactivity. Our paper, however, takes into account the object of use of the museum APP and starts with the user's target needs. Based on the goal-oriented theory, the information fusion and the combination of museum APP with modern intelligent sensing technology, based on the user perspective model, multimedia analysis of the digital museum user interface, clear user demand for the functionality of the museum APP, complete the construction of the functional visual hierarchy. To achieve a more convenient to use and meet the needs of users' museum APP. Combined intelligent sensing technology with computer communication technology, the networked intelligent sensor is widely used in process control field.

2. Methodology

The digital museum APP uses the Internet as a carrier. As an Internet product, it allows users to "participate" in product

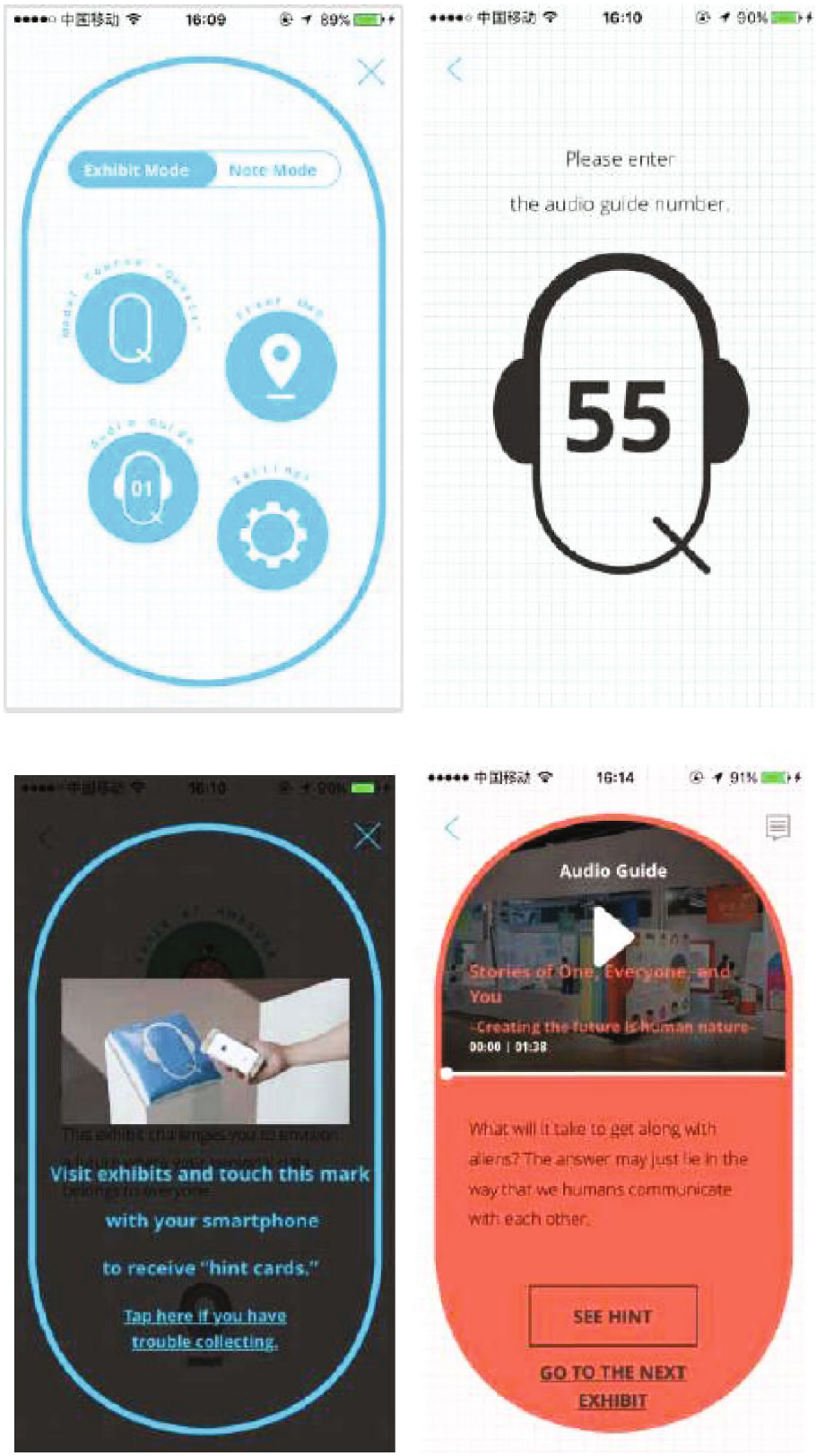


Figure 1: (a) The interface design for the navigation function. (b) Interface design for the "MOMA APP" guide positioning of the Museum of Modern Art in New York. (c) The "Explorer APP" developed by the Smithsonian Museum of Art.

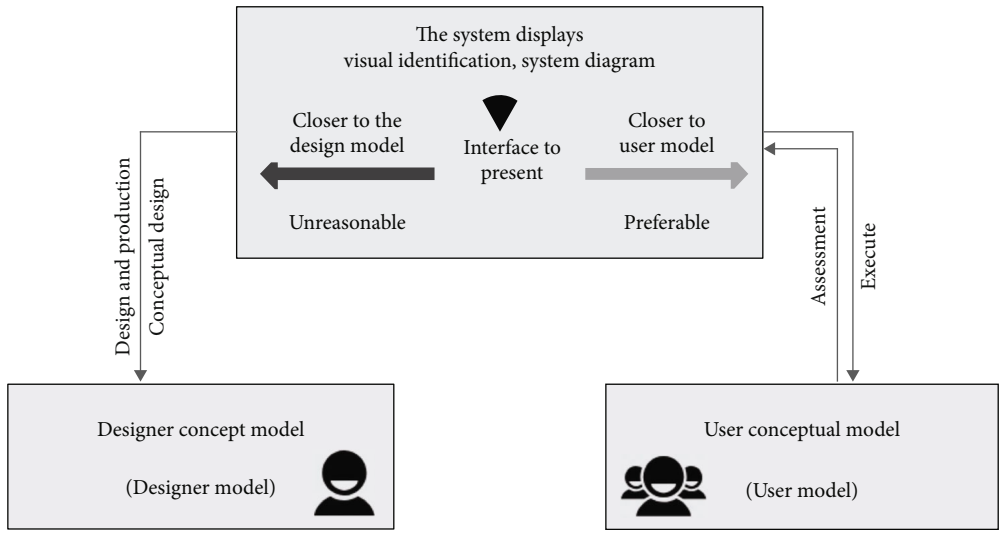


Figure 2: The relationship between the designer's conceptual model, the system image, and the user's conceptual model.

design. Users drive product designers and quickly iteratively update, transforming designer-centric thinking into user-centric product development [25]. The relationship between designers and users is no longer a simple supply-demand relationship, users have become "designers" in a certain sense, and real designers are more from an observation and coordination standpoint. The user interface is the platform for human-computer interaction in the digital museum. The visual design of the digital museum user interface is a comprehensive study that combines multiple disciplines. This paper proposes a quantitative research-based approach to intuitively distil users' target needs and expectations for museum APPs from their APP usage habits, and to study the visual design of digital museums based on the user role model construction method and low-fidelity prototype testing method to help guide the establishment of visual hierarchy design strategies.

2.1. Designer Conceptual Model. A concept model is a clear idea of how a product will be made and presented by the designer when designing the product. The system image is all the visual cues, system illustrations, and other content presented in the product, which the designer can present through the concept model. It also determines the interface visuals that the designer will present to the user after integrating the museum information [26]. This is the most intuitive way of presenting products such as functions and interfaces in a museum app. Its most important purpose is to serve the user, so it is important to design a conceptual model that will meet the user's experience needs.

As shown in Figure 2, there is a strong link between the designer's conceptual model, the system image, and the user's conceptual model. The system image contains the interface functions, information integration, and visual design of the digital museum, which are derived from the feedback of the designer's conceptual model. The system image is the bridge between the designer's conceptual model and the user's conceptual model, and the designer's ideas are presented directly to the user through the system image. Only when the system image fully demonstrates the designer's conceptual model can the designed museum app meet the user's needs, and the designer's conceptual model and the user's conceptual model will then be perfectly matched.

2.1.1. Web Builds a Five-Layer Model. In order to better analyze the needs of users, a five-layer model needs to be established when building a website, namely, the strategy layer, the scope layer, the structure layer, the framework layer, and the presentation layer. The structure is shown in Figure 3. The user experience elements include five layers. The content of each layer forms a complete system from bottom to top. Each layer influences each other, and each part guides each other. The five-layer structure and establishment takes user needs as the most important consideration of the product and integrates user experience into the design.

The strategic layer contains the product objectives and user needs. In the interface design of a museum app, the product objectives refer to the brand image that the museum wants to convey. The scope layer contains the functional planning and content requirements; here, we need to clearly know the characteristics that we want to present to the user of the museum for which we are designing the app. The structural layer is a translation of the user's needs, identifying further the elements to be presented to the user. It is necessary to examine whether the information presented to the user meets the user's needs. The framework layer is the integration of the content we want to present and the layout through the page design. The presentation layer is the visualization of the results of the preliminary research and the final interface presented to the user. The presentation layer integrates functionality, text, images, etc. and makes it easier for the user to operate through the visual presentation. As shown in Figure 4(a), if we further focus on the accuracy of functional icon design, it will facilitate the operation and recognition of the user.

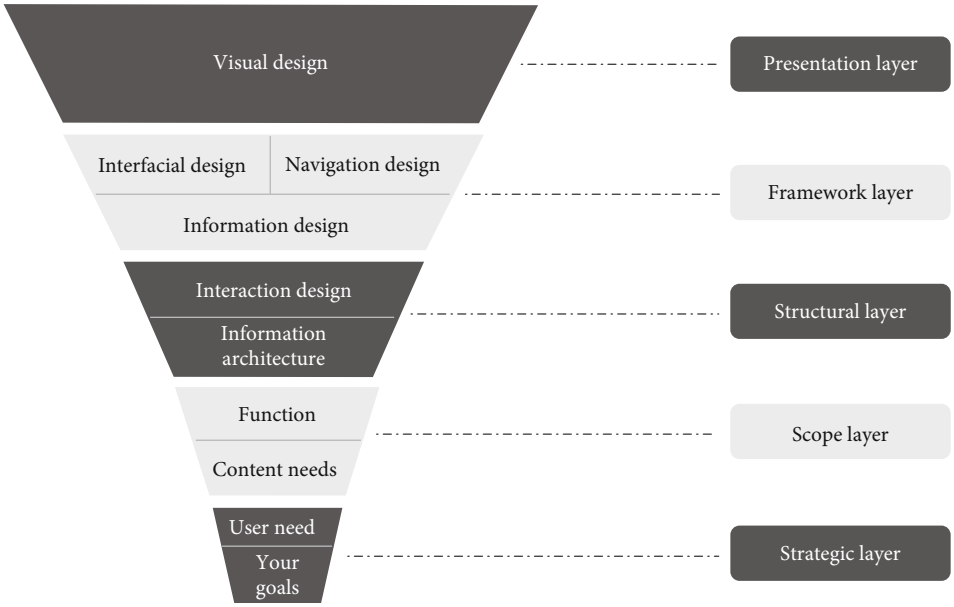


Figure 3: Five-layer model established by the web.

2.1.2. User Role Model Construction Method. The concept of the user role model was proposed in the second step of modeling in the target guide design. The user role model is a virtual representative of real users. The product design solution is established according to the target needs of real typical users. It can show most of the user needs and user goals. It can also extract and refine typical users and use the user role model. It can better make user goals and needs become the center of subsequent design and production. Clear and representative users can make the design more targeted and avoid the addition of too many functions. The user role model is generated by the user himself, and the consistency of the user's thinking and behavior is also ensured. The structure is shown in Figure 5.

In order to determine the different goals of different user types, the user's purpose of visiting the museum, the user's purpose of downloading and using the APP, the basic functions that the user needs most, the characteristics that the museum APP should have, and the current users are obtained from the previous user research. The data analysis of the reasons why certain functions are not needed or rarely used and the relevant factors that affect the user's use of APP are clearly identified.

2.2. Quantitative and Qualitative Research. As the audience of the product, the user is the core service object of the designer in the whole process of designing the product. Defining product audiences and understanding user groups are the most important part of all project development and APP design. After determining the user group and its positioning, the research on the user's target direction can be advanced more accurately. Understanding the user group is also the initial stage in the goal-oriented design, which lays the foundation for the subsequent analysis of user goals and user needs. The usual user research methods are divided into qualitative research and quantitative research [27, 28]. The combination of qualitative and quantitative research can deeply explore user goals and user behaviors from multiple angles and provide reliable user analysis.

2.2.1. Two-Dimensional Matrix Diagram of User Research Methods. As the audience of the product, the user is the most core service target of the designer in the whole process of designing the product. Identifying the product audience and understanding the user group are the first considerations in all project development and APP design. After determining the user group and its positioning, the research on the user's target direction can be advanced more accurately. Understanding the user group is also the initial stage in the goal-oriented design, which lays the foundation for the subsequent analysis of user goals and user needs. The structure is shown in Figure 6.

We distinguish between qualitative and quantitative user research methods. By using these two research methods, we can gain a more comprehensive understanding of the target needs of the user. By combining the two research methods, we can better integrate user needs into the design of the digital museum pages.

2.2.2. Ease of Use of Information Architecture. After clarifying user needs, there is roughly a prototype for the functions that the APP should have, but the prototype also needs specific support, which requires the creation of a structural layer of information architecture for the APP. In the digital museum APP application, it involves the concept of information architecture and the transformation of the digital museum APP information architecture. These topics will occur in the creative and conceptual stage before the introduction of the framework layer and the presentation layer. The information architecture is designed to design the specific components of system classification and navigation, so that users can quickly and effectively read the information

Figure 4: (a) Functional icon design. (b) APP interface display.

in the APP [29]. The perfection of the information architecture can play a key role in the subsequent provision of perfect intelligent sensing. Information architecture can organize and program huge data, design a platform for users to clearly communicate information, and bring a good user experience. In the information architecture of the museum app, the functions are divided by the goal-oriented theory, and the user's needs are sorted, some complicated functions are integrated and streamlined, and the visual presentation of the core content is highlighted, so that the overall information architecture of the museum app is clearer and more explicit.

In the construction structure, the basic unit of measurement is the node, and it can be distributed freely. Here are the main types of information architecture: tree diagram, which is the most widely used hierarchical structure; matrix structure; and natural structure, with freedom. This structure does not have a strong concept of "classification." The structure is shown in Figure 7. It is more suitable for exploring a series of apps, such as entertainment, education [30], or interactive games [31]. This structure will turn the user's experience into a challenge. This structure is suitable for functions such as enhanced exhibition experience of museum APP and virtual browsing of museums. The structure is shown in Figure 7.

For the museum app, the visit guide, booking the ticket, exhibition information, and exhibit introduction should be presented in the main interface. By improving the previous museum app interface as shown in Figure 7(a), we have reengineered the functions according to the user's objectives and obtained a more user-friendly digital museum interface as shown in Figure 7(b).

2.3. Low-Fidelity Prototyping of the Interface. In order to better understand the visual hierarchical design strategy corresponding to the user behavior level and the target level, the low-fidelity prototype design of the museum's APP is carried out based on the APP information framework of the museum. For this low-fidelity prototype test, we used a mobile phone user terminal as the test device and imported the preset low-fidelity interface to form a simulated interface for interaction with the Digital Museum App. The low-fidelity prototype is the information of the visual expression framework. Because the main interface requires more display functions and has a certain amount of text and pictures interspersed, the tabbed interface board layout is used in the presentation of important functions, and the card design is used in the collection and exhibition information display, which can clearly distinguish the two functions. In the case

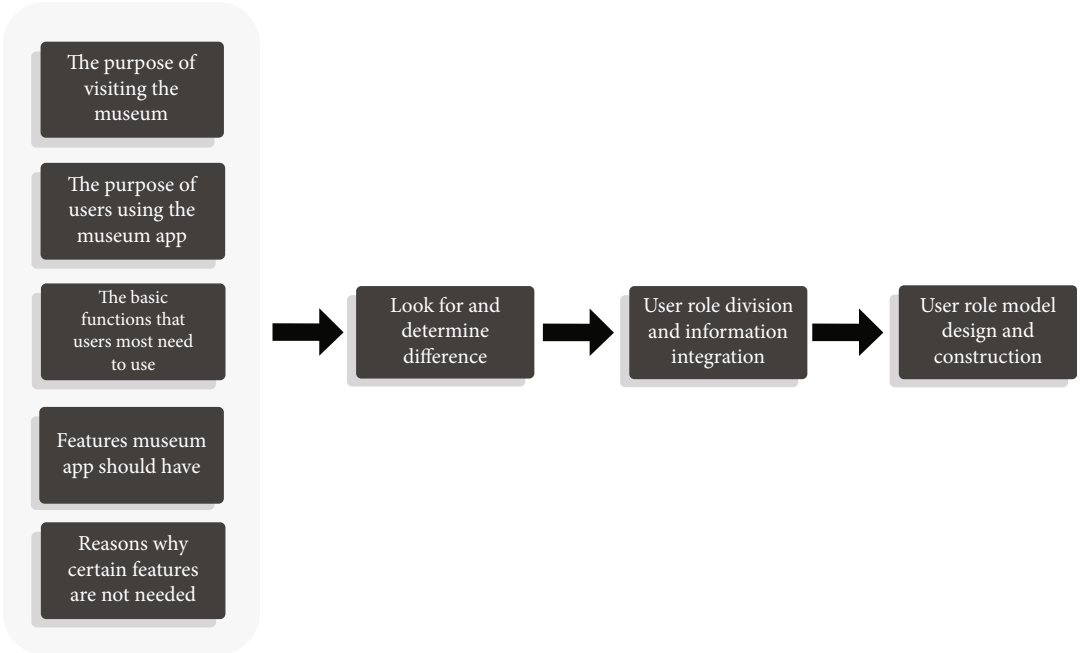


Figure 5: User role model construction method.

of the theme, the picture and the text are effectively combined, and the structure is shown in Figure 8.

The integration of information in the interactive interface is very important in order to present the user with an at-a-glance operating interface that perfectly matches the intelligent sensing of the phone. We clarify the sensory needs of the majority of users, based on user-orientation theory, in order to show them a good smart-sensing experience when operating the phone. As shown in Figure 8(a), in the first level of the interface, we present the main operations, such as Booking the ticket, Museum introduction, and Map guide. The Tab Category at the bottom of the page allows users to access the secondary interface. The layout of the area is designed to differentiate the content in order to meet the visual and aesthetic needs of the user.

As shown in Figure 8(b), we have made Make an appointment to buy tickets, Activity appointment, Cultural relics display function, Details of cultural relics, and Museum visitor guide interface according to the results of the information fusion provided by the user's needs. The visual layout of the secondary interface was based on the user requirements of Make an appointment to buy tickets, Activity appointment, Cultural relics display function, Details of cultural relics, and Museum visitor guide interface. It is understood that users have a greater need for the presentation of museum app exhibition information when buying tickets. By clicking on the exhibition information in the primary interface, we will automatically jump to the exhibition information details interface in the secondary interface. In the exhibition details, we can also learn about the specific information of each exhibit. By understanding the exhibition information, the user's ticketing needs are facilitated. Clicking on the ticketing option in the primary interface automatically jumps to the ticketing interface in the secondary interface, which substantially satisfies the user's target needs.

3. Results

3.1. Goal Guides to Assist Low-Fidelity Prototype Testing at the Design Framework Stage. Museum cultural relic exploration is one of the main functions designed for secondary users of "exploration and research." The museum's focus on cultural relics on the main page is only part of the collection, while the cultural relic information in the cultural relic exploration area is more comprehensive. This facilitates the operation of the user under intelligent sensing. The first-level interface of this function displays cultural relics in two parts: cultural relics and cultural relics. The navigation bar of the first-level interface is at the top of the interface, and the cultural species are designed in waterfall flow format to ensure cultural relics. The visual distinction on the variety display allows more cultural relic information to be presented. When designing the page hierarchy, we try to ensure that the primary functions of the Digital Museum interface can be presented in the main page, so that users can easily access the relevant functions at the first time. In order to ensure the convenience of user operation, we fuse some functions of the secondary and tertiary interfaces into a primary interface and differentiate the functions in the secondary interface. Avoiding a large number of levels of interface switching will reduce the user's APP experience and keep each function in 2-3 levels of interface as far as possible, as shown in Figure 9. We have used a timeline visual presentation to make it easier for the user to use the chronology to find the artefacts on the one hand and to enhance the user's knowledge of the chronology of the artefacts on the other. At

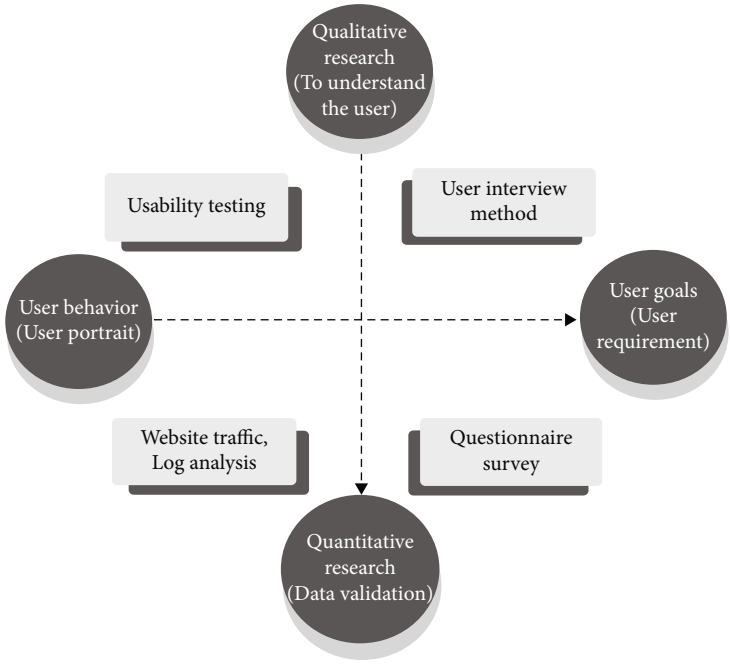


Figure 6: Two-dimensional matrix diagram of user research methods.

the same time, it is visually clearer and simpler. In our research, the simplicity and clarity of the interface are preferred by users.

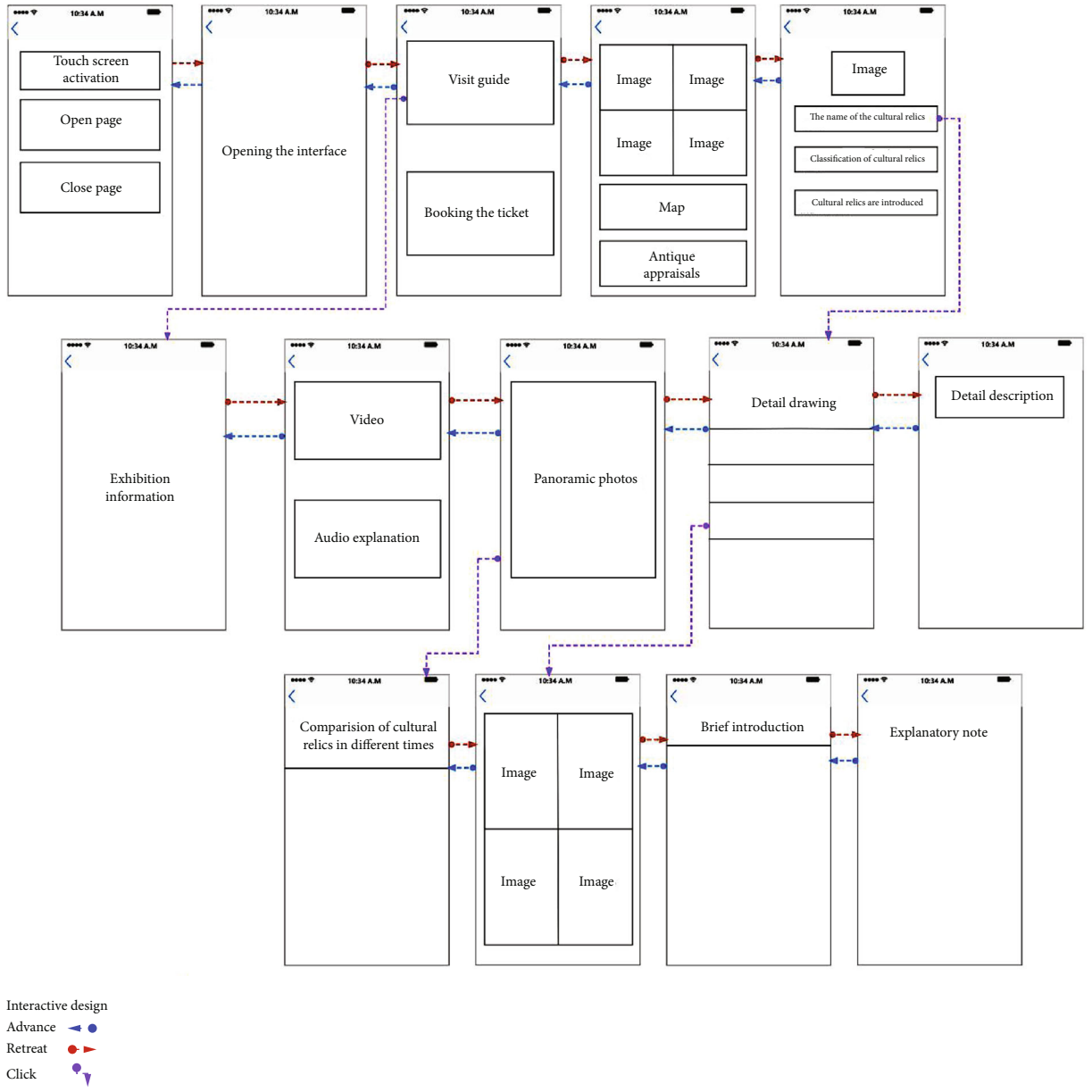
The interactive display of some of the key functions in the low-fidelity prototype of the personal center interface. The most important ticket purchase, reservation, and collection details display functions in the personal center interface have their own branches. The ticket purchase function includes museum ticket reservation information and special exhibition purchases. Ticket information, the reservation interface contains event and lecture information, and the collection interface contains details of exhibitions and collections. The structure is shown in Figure 10.

Low-fidelity prototype testing is user testing using interactive wireframe diagrams. It can directly help designers find problems with users in a goal-oriented design, thereby helping designers to modify functions or interaction methods in the early stage. In a goal-oriented design theory, the interaction framework establishes the overall product behavior architecture, which includes the interactive form elements, functional combination, and functional levels. In the construction of the interactive framework, the elements need to be integrated and arranged. This is also the transition from the information architecture to the low-fidelity prototype design. It is proposed in the interface expansion architecture in the visual hierarchy above, through the interface, information, and navigation. After the design of the elements, a wireframe needs to be used to present the visual part of the content of this part. This is closely related to the integration of behavior, form, and content in the refinement phase of the target-oriented design. The wireframe diagram is the display of the composition of all the elements on the page, and it is also the most intuitive visual representation. The wireframe for basic user interaction is also the basic content of the low-fidelity prototype test, as shown in Figure 11. When the number of users tested is around 5, the number of usability problems found tends to increase rapidly, indicating that the number of users tested at this time is beneficial to usability problem finding. When there are more than 9 users, the increase in usability problems tends to level off. Therefore, the number of testers can be limited to 5.

The design structure and process proposed in the definition framework part of the goal-oriented theoretical design is an information architecture based on the existing functions after previous user research, role modeling, and requirement definition. Jackob Nielsen, in a 2012 survey of usability tests conducted by the Nielsen Norman Group, found that the greater the number of users tested, the better the detection of problems. It can guide the design of low-fidelity prototypes and start testing. As shown in Figure 12, the horizontal axis represents the number of test users and the vertical axis represents the Number usability findings. When the number of testers reaches five users, almost all interface usability problems can be found through the test results. The fewer users we have, the better the usability of the questions we collect. When there are more than 5 users, it gradually becomes impossible to find more problems.

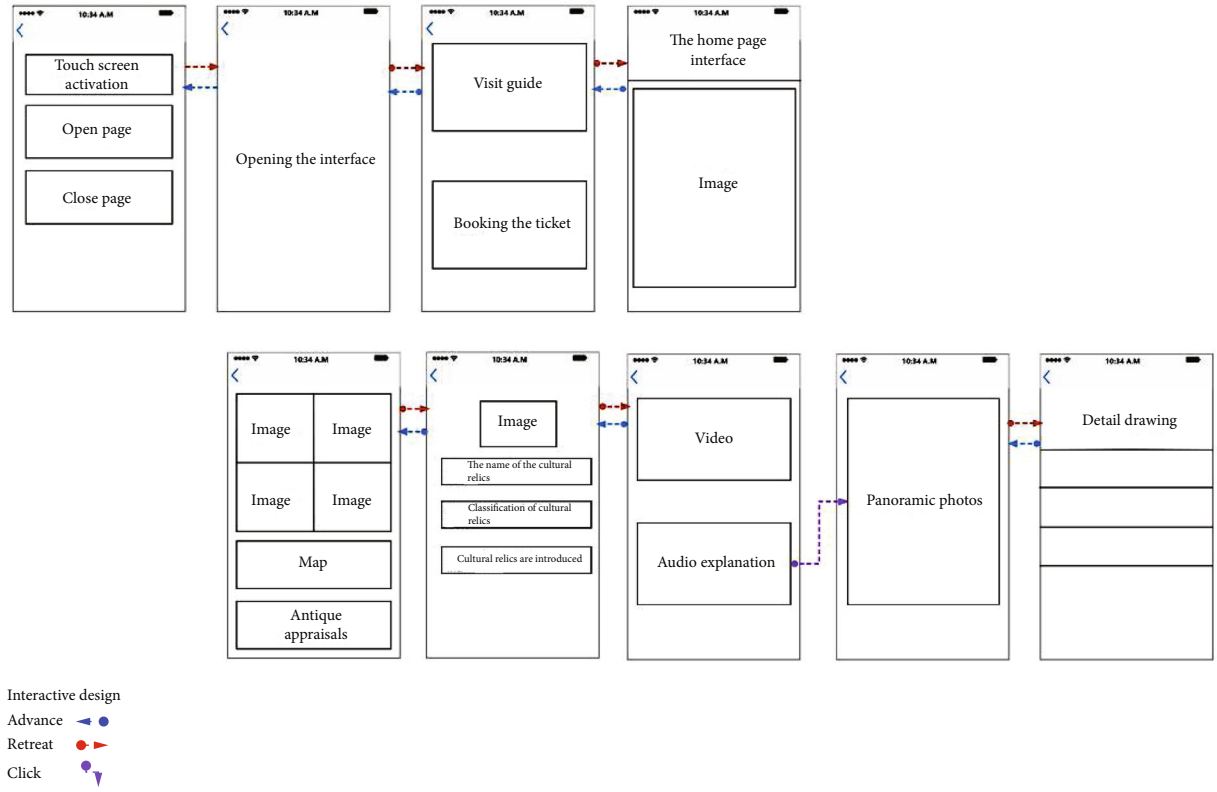
3.2. Demand Positioning. In our questionnaire, we asked survey respondents who had visited the museum in-depth questions about the "shortcomings of visiting the museum." Multiple answers were provided for respondents to choose from, and the results of the survey are shown in Figure 13, where the number of choices made by respondents for the different options was about equal.

This shows that there are many drawbacks to visiting physical museums, especially in the three options Abstract



(a)

Figure 7: Continued.



(b)

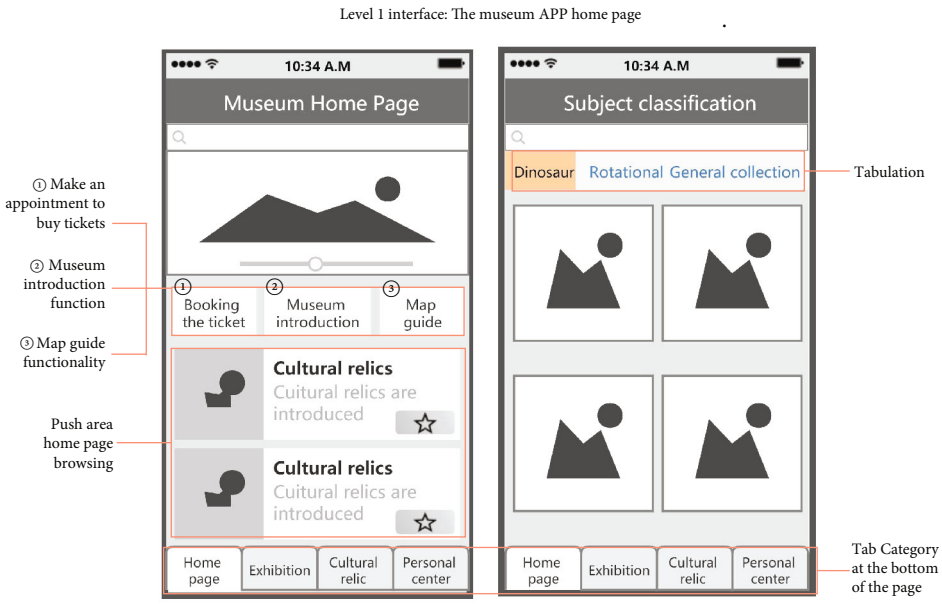
Figure 7: Ease of use description of information architecture: (a) Early layout frame structure diagram. (b) Final layout frame structure diagram.

content, Space is too far away, and Less harvest, which were chosen by the majority of respondents. The percentage of respondents who thought that Abstract content was too far away was 32%, Space is too far away was 30% and Less harvest was 20%. There was less demand for museums to offer Less interaction, at 4%. The results show that the majority of people have the problem of not being able to visit museums independently, so we can add the function of online audio guide or tabs for exhibit annotations to the design of the museum app. Because people do not understand the content of museum exhibitions well, most people do not think they will get what they expect from a visit to a museum. We can focus on deepening this point when designing the museum app. People can miss the opportunity to visit a museum because it is too far away, so our digital museum can solve this problem. Even if visitors do not get to the museum, they can still have a remote view of the exhibition.

The user visit habits given to users of the same category in the interview volume have the same characteristics. Therefore, the interview results of user museum visit habits are summarized and summarized according to the three user categories, as shown in Table 1. In the analysis of the content related to the Museum App, we have consolidated and summarized the results based on the results obtained from different user groups. For those who have used the Museum App before, they recognize the need for the Museum App to exist. For those who have not been exposed to the Museum App, they have certain concerns. From the results of the interviews, it is clear that most users are supportive of the existence of the Museum App and have a great deal of longing for the Museum App to be put into use. Most users want the Museum App's operating pages to be simple and to allow them to access the information they need quickly. They want to be able to see information about the museum's exhibitions on the Museum App and already have a guided tour. Then users can easily access museum-related knowledge on the Museum App through intelligent sensing.

Before conducting user interviews and user questionnaire surveys, this paper publishes multiple-choice questions about exploring museum user groups based on the reasons why tourists visit the museum. In order to clarify the categories of user groups and facilitate the user role setting in the later period, the purpose of the user's visit to the museum is set to understand the local culture, tourism, leisure, learning, hobbies, accompanying visits, and research six categories. The purpose of setting multiple-choice topics here is to be more objective and to cover as many aspects of the user group as possible and to summarize the data through the six types of user visits, and to integrate the user groups, as shown in Figure 14.

From the results of the survey, we can see that the largest number of people, 62.6%, wanted to learn about local culture by visiting museums. The number of people whose purpose



(a)

Level 2 interface: The layout of the functions in the interface.

(b)

Figure 8: Human-machine interface interaction design depiction: (a) first-level interface interaction and (b) second-level interface interaction.

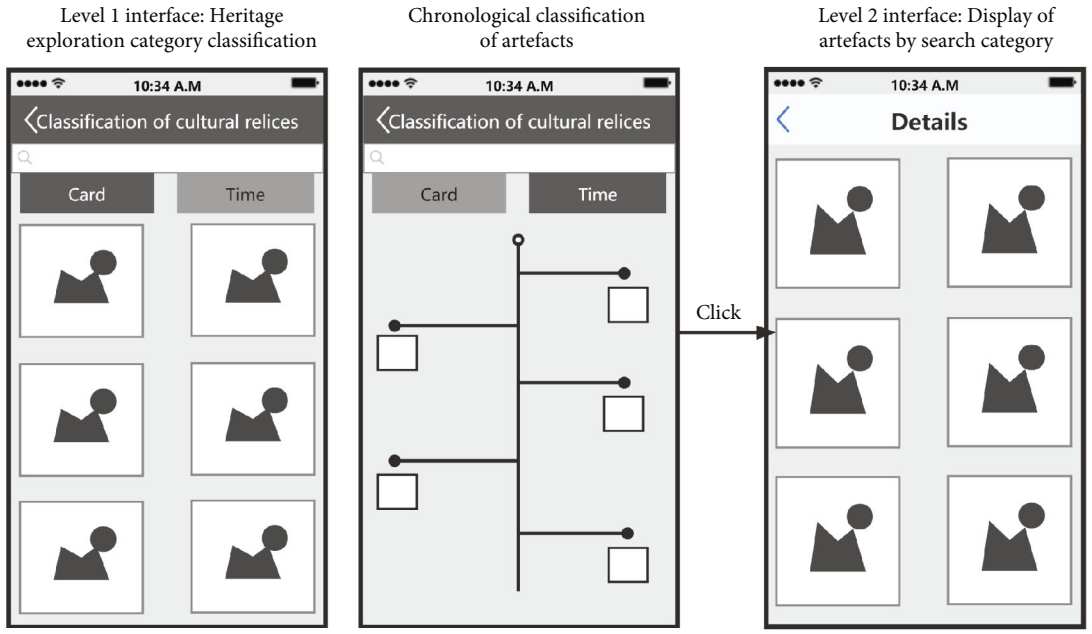


Figure 9: Interactive display of key functions in the low-fidelity prototype of the cultural relics' exploration interface.

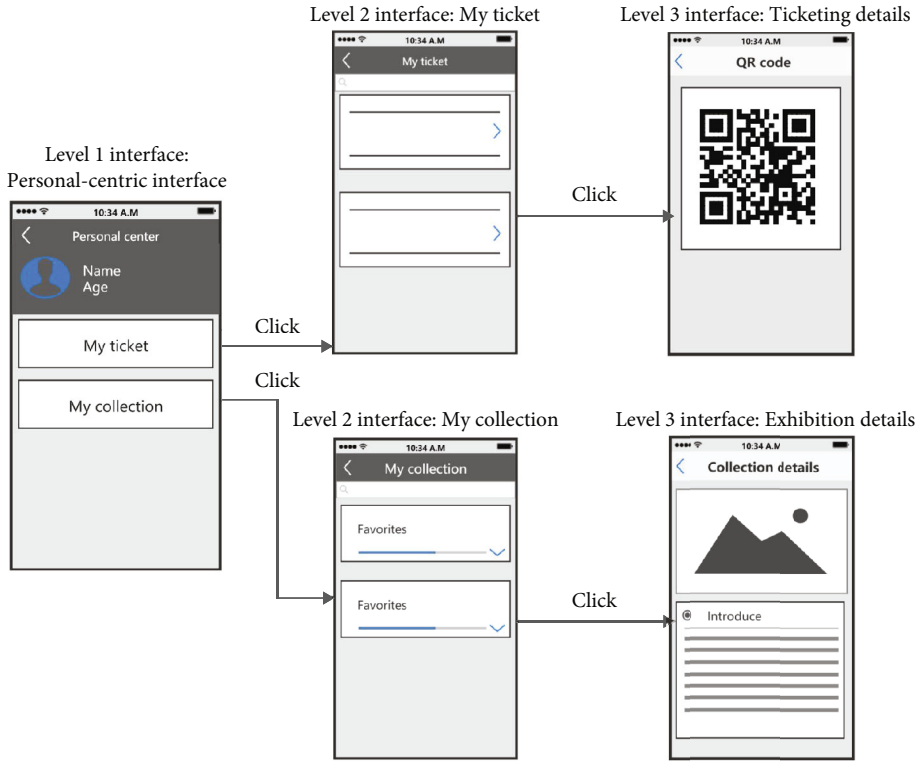


Figure 10: Cross-based display of some key functions in the low-fidelity prototype of the personal center interface.

was to travel and study was the next highest, and they accounted for an equal share, 43.1% and 40.6%, respectively. A smaller number, 23.4%, attended museums for hobbies and interests. The number of people who visit museums for research purposes is even lower, at 11.9%. We should therefore weaken the academic nature of the digital museum when designing its pages. Designers need to keep the pages simple and integrate information about the museum's culture so that cumbersome and difficult knowledge can be easily understood and made accessible to a wider range of users.

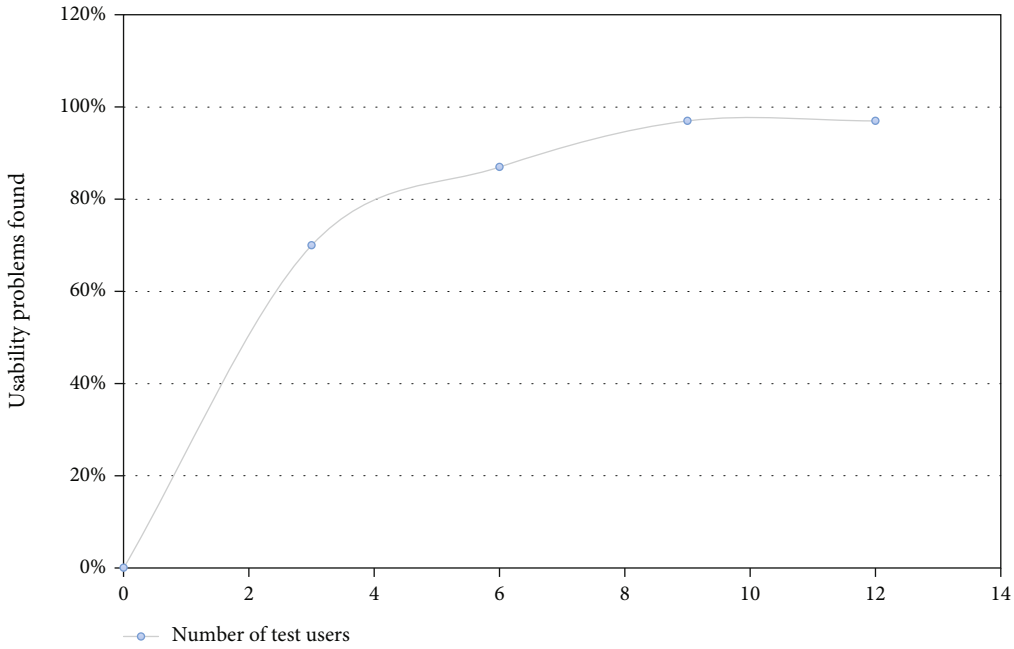


Figure 11: The ratio of the number of users in the low-fidelity test to the problems found.

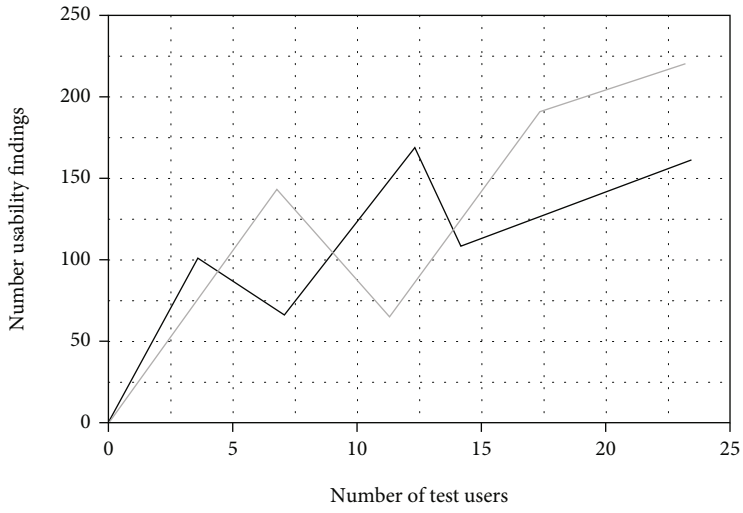


Figure 12: The relationship between the number of tested users and the number of problems found in the usability test.

4. Discussion

Experimental research has shown that modern digital museum user interface design is not only about the promotion and publicity of the museum but also about meeting the user's understanding and application of the museum app's functions. The user interface of the museum app is presented in a form of visual communication that is more in line with the user's preferred programming. While having the characteristic humanistic connotations of that museum, the designer should combine the modern technology of information fusion and intelligent sensing to meet the user's goal-oriented needs. The digitalization of museums follows the trend of the times, and the museum's APP, as a mobile display for digital museums, should also be constantly updated and developed. As shown in Figure 4(b), the APP interface display case of the Nanjing Museum which provides a good reference value. This paper looks at the current situation of museums and finds that the current design of museums' APP lacks consideration for users. Problems on the visual level lead to products that do not meet the needs and experiences of users. By summing up and summarizing the problems of museum APPs, a research method that meets the needs of users is found.

The designer concept model considers the needs of the target audience and some of the target users of the museum app. The design conceptual model and the user conceptual model play an interplay through the connection of the

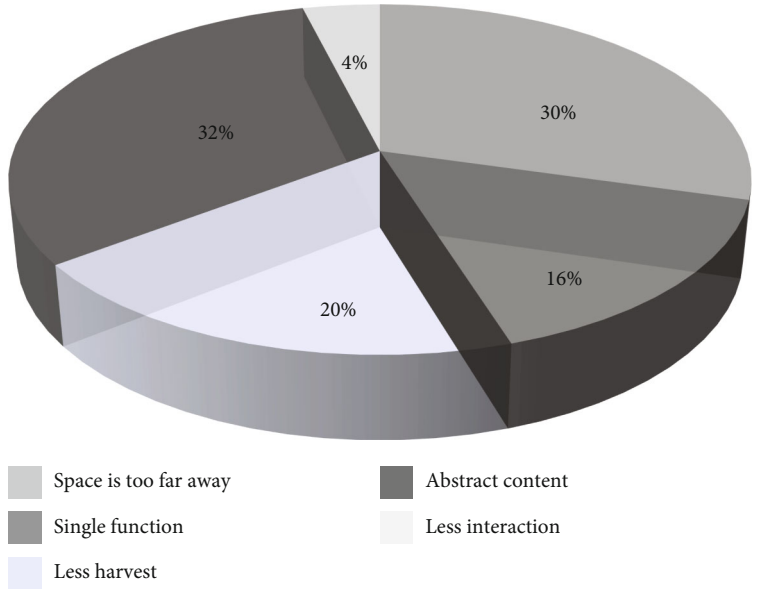


Figure 13: The shortcomings of visiting museums.

Table 1: Three types of user museum visiting habits.

Users' category	Museum visit preferences	Museum visit needs	Museum visit time	Existing problems in the museum
Tourism visit class	Visiting large provincial and municipal museums, more interested in the main museum pavilion and provincial and municipal special exhibitions.	Surrounding supporting facilities, arrival mode, venue structure, exhibition location and other information.	1-3 h	There are deficiencies in queuing, reservation and ticket purchase system, explanation service and other contents.
Learning and research	Visit niche museums with specific themes.	Relevant cultural relic text and picture's introduction, for a detailed, rich and comprehensive introduction of the museum content.	'There is no planning	It is more difficult to find the collection needed to find in the museum.
Interest and hobbies	Like the related activities and special exhibitions held by museums, museums with different themes and features.	We need to introduce more detailed and interesting exhibits, and search relevant museum information and research through the Internet.	2-3 h	Insufficient guide tour and explanation.

system image. In this paper, we first analyze the design content of the visual level through the different levels of user goals in the goal-oriented design theory and find the problems that exist in the visual level of the museum APP, where the functions do not meet the user's goal needs and the information architecture does not match the user's order of use. The Museum App combines information fusion with advanced intelligent sensing technology and we have established a web five layer model. The functionality and importance of the visual hierarchy in interactive products is analyzed, and the problems that need to be solved in the visual hierarchy are investigated in depth, providing theoretical guidance for the study of the visual hierarchy of the museum app.

The framework layer serves as the beginning of the visual design, presenting the page layout through the information architecture; presenting the product architecture in a visual hierarchy; realizing the interface, navigation, and information design; and visualizing the structure gradually. The presentation layer is the top of these five layers and is the first thing that users notice when using the interface. The presentation layer brings together function, content, and aesthetics to produce a final design that meets all the objectives of the other four layers. The visual presentation in the presentation layer needs to link all the structures more closely, adding visual elements to make product functionality and information clearer to the user and easier to recognize.

Based on the goal orientation theory, the functional, and information architecture, visual element design and stylistic features of the museum app visual hierarchy are analyzed according to the user instinctive, behavioral, and reflective levels of goals. Through the user research guided by goal-oriented design, user needs for visiting museums and for the museum app are explored in depth, user role models

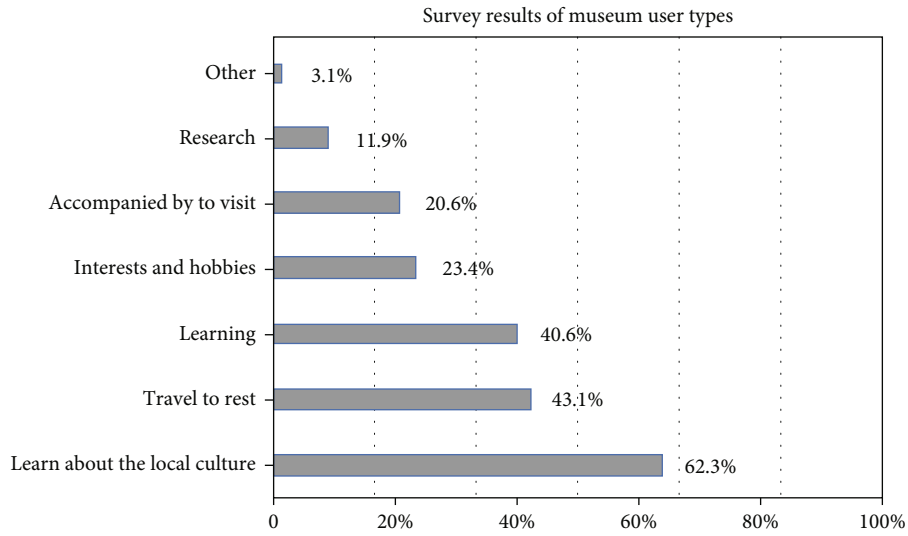


Figure 14: Survey results of museum user types.

are created, and user role task models are established. In the questionnaire, two main aspects were included. The first aspect was a survey of users' habits of visiting museums, the purpose of their visits, and the channels they use to learn about museums; the second aspect was a survey of users' knowledge and needs for museum APPs, which included the current popularity of museum APP downloads, the reasons for using museum APPs. The second aspect of the survey was the knowledge and needs of users of the museum app, the reasons for using the museum app, the basic functions that users need to use most, the features that the app needs to have, and the addition of more information functions. Through the questionnaire, we accurately grasped the users' needs for museum APPs in terms of functionality, information integration, smart sensor operation, and purpose of visit.

The information framework of the digital museum user interface is set by functional level and serves as the basis for the visual level. A low-fidelity prototype is created and used to understand the real goal-oriented needs of the user, and the visual layer is further guided by means of low-fidelity prototype testing. The purpose of this test is to set up user tasks for important functions in the APP. Conduct a multimedia analysis of the museum's digital user interface based on a user perspective model to clarify the user's functional requirements for the museum app and to complete the construction of a functional visual hierarchy. In our future implementations, we may use autoencoder-extreme learning techniques [32, 33] for interaction design. To achieve a greater degree of ease of use and to meet the user's needs for the Museum App.

5. Conclusion

We use quantitative user research methods, user role model construction methods, and low-fidelity prototype testing methods to study the visual design of digital museums. Through our research, we have learned that the largest number of people, 62.6%, wanted to learn about local culture by visiting museums. The number of people whose purpose was to travel and the study was the next highest, and they accounted for an equal share, 43.1% and 40.6%, respectively. A smaller number, 23.4%, attended museums for hobbies and interests. The number of people who visit museums for research purposes is even lower, at 11.9%. Starting from the perspective of the user's target needs, we understand the user's need for information. The various seemingly disorganized museum information fusion will be perfectly integrated in the museum app. After integration, it can be clearly and unambiguously presented in the museum app we designed.

The goal-oriented visual hierarchy research first obtains the audience of the product and its user behavior characteristics through quantitative research methods and then summarizes and refines the group users through the role model construction method. Using the user role model can better make the user goals and needs become the follow-up design. Finally, through the low-fidelity prototype test method, combined with the museum APP information architecture established in the early stage, low-fidelity prototype design was carried out according to the five major functional areas required by the museum APP. Use the interface low-fidelity prototype test method to list and analyze the operational errors and doubts that occurred in the user's use, and put forward the modification opinions of the museum's APP visual level based on the user's instinct and behavioral goals in response to the operational problems. It provides a basis for the museum's APP visual hierarchical design strategy.

The multimedia analysis of the user interface of digital museums is a contemporary and superior tool that combines information fusion and intelligent sensing. The digitization of museums follows the trend of the times, gathering information about the user experience in multiple dimensions and integrating feedback from users to design user interfaces that meet their needs. Starting from the perspective of the user's target needs, we understand the user's need for

information. The various seemingly disorganized museum information will be perfectly integrated in the museum APP. After integration, it can be clearly and unambiguously presented in the museum APP we have designed. The multimedia application of the digital museum interface is perfectly integrated with today's smartphones. We need to study in detail the various functions of the user interface, such as ticketing, guided tours and online visits, and combine them rationally with modern intelligent sensing to achieve a better user experience.

In summary, although the method proposed in this paper can be better applied to the development of interface applications of digital museums, the research on this topic is still at the visual level. In the future, it is necessary to continue to further improve and optimize other related auxiliary functions to explore more. A comprehensive system platform.

Data Availability

Data available on request from the authors due to privacy/ethical restrictions.

Consent

All human subjects in this study have given their written consent for the participation of our research.

Conflicts of Interest

The authors declare no conflicts of interest.

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