

Research on the Application of Digital Display of Ancient Books in the National Museum of Classic Books

Taking "the Exhibition of Return and Reconstruction of The Yongle Canon" as an Example

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Abstract: At present, the digital development of museums appears to be a new trend. Ancient books are vulnerable, illegible and unfit for display, but digital technology can provide better protection, research and display for this. Digital display serves as a significant way to inherit ancient books. By studying the application of digital display in the exhibition of "Return and Reconstruction of *The Yongle Canon*" in the National Museum of Classic Books, it is hoped to provide some references and inspirations for relevant researchers and designers.

Keywords: ancient books, National Museum of Classic Books, *The Yongle Canon*, digital display, and interactive experience design

1. Introduction

The protection and inheritance of cultural heritage has been a concern both at home and abroad. With the development of digital technology, digital protection, research and display of cultural relics in museums are new trends at present. As the main carrier of Chinese culture, ancient books are much more literary and precious than calligraphy, painting and porcelain. However, due to the fragility of ancient books, it has been facing constant extinction since its production and dissemination. In order to better inherit Chinese civilization in protection and research, and make words written in ancient books "live", the application of digital technology is a top priority. Relying on the rich collection of the National Library, the National Museum of Classic Books has the courage to explore and innovate in the digital display of ancient books, bringing valuable experience of Chinese ancient books. In June 2021, the "Recovery · Reproduction - Return and Reconstruction of *The Yongle Canon*" exhibited in the National Museum of Classic Books, applied a variety of digital display methods to fully demonstrate the precious values and shorten the distance between the audience and ancient books. *The Yongle Canon* is one of the four collections of the National Library and a treasure of world cultural heritage. The study of the digital display application of this exhibition has a significant reference for the digital display of Chinese ancient books.

2. Deconstruction of Digital Display Elements of Ancient Books

Digital display refers to the digital processing of contents to be displayed with the help of computer technology, which can present different display methods, emphasizing the functionality of display,

experience and interaction. The significance of digital display is ultimately realized by the experience of the audience. Elements of digital display of ancient books in the exhibition can be analyzed from the perspective of the audience's experience, and four levels of "perception layer, interaction layer, emotion layer and meaning layer" can be deduced based on the sequence. However, design can be considered from a reverse perspective and put forward as "meaning and object, object and turn, scope and connection, and perception and extension". These four elements can be adopted as the basic framework of digital display of ancient books, so as to discuss the display experience and solve problems of display experience through design methods.

2.1. Meaning and object -- Constructing display content

The exhibition of Chinese classics has a long history, with the Airing Books Fair of Han and Song Dynasties the earliest prototype. The original meaning of "airing books" was only to expose books in late summer and early autumn to prevent from mildew, but from the Northern Song Dynasty, it became a gathering for the pavilion to dry books. The significance was to show the ideological and cultural achievements of the rulers, and participants could view paintings, enjoy posts and exchange skills in the exhibition. The exhibition of ancient books is closely related to the significance of the exhibition itself, and the modern exhibitions can construct its contents that conform to the exhibition direction with display significance according to its purpose, significance, theme and positioning. Although ancient books have always given people an obscure impression, they are rich in content and have diversified characteristics in binding, layout, style, drawing and font. The research and selection of the display contents can deeply explore the material and non-material properties of ancient books from different perspectives such as culture and art based on the exhibition direction, abstracting cultural thoughts with eternal value and modern significance in the characteristics, of which presenting contents in simple terms is in urgent need by the audience on the basis of profound cultural accumulation and academic foundation.

2.2. Object and turn -- Analyzing target audience

The interactive experience crowd of digital display is different from the "audience" of exhibition visitors. For the digital display design of ancient books, it requires profound analysis of the target audience of "who they are", "what their needs are", and "what characteristics they have", so as to abandon their personal positions and review the design from the perspective of the audience. Firstly, the category of audience can be analyzed from the perspective of objects. According to the research, visitors to the National Museum of Classic Books are divided as: more foreign visitors than local ones, more male visitors than female ones, more young and middle-aged audiences than children and the elderly, and most audiences with bachelor's degree or above. Digital display requires the match of target audience based on the audience category, so as to facilitate the analysis of their experience motivation. Secondly, the audience's experience motivation can be analyzed from the subjective perspective of the subject. Analyzing the audience's experience motivation from the subject perspective can transform their experience demands. Although the background of the differentiation of the target audience will lead to the differentiation of experience motivation, it will show certain characteristics and trends from a macro perspective. According to the research, although the number of visitors motivated by education accounts for a large proportion of the National Museum of Classic Books, the number of active and single educated visitors is decreasing, and the number of visitors motivated by entertainment and exploration is obviously on the rise. The research results reflect the macro characteristics and trends of the audience's experience demands. Thirdly, we can turn to the body perspective to analyze the audience's intermedium. The body of interactive experience is the carrier of audience perception and consciousness, as well as the medium of integration in virtual and

real space. Audiences perceive and recognize information through their bodies in the experience, and information will be changed and created while being perceived. The analysis and use of intermedium of the body to explore the relationship and characteristics of the audience's body perception as well as the perceived world will help to inspire the interactive experience design and meet the experience needs of different audiences.

2.3. Scope and connection -- Combining base modules

The purpose of "scope and connection" is to combine the component modules analyzed above to form the infrastructure of interactive experience. Firstly, it is established from the content scope. The content scope of digital display of ancient books involves the context, level and volume, which is similar to a visual relationship model of XYZ axis. Elements as variables will affect its depth and number. The content scope plays an enlightening role in design, and the reasonable content scope is the key to the audience's interactive experience goal. Secondly, it is established from multimedia devices. With the help of multimedia device to be interpreted, the content of ancient books can be displayed in a specific way to realize its connection with the participants. Combined with the types, functions, parameters and technical development trend of the multimedia device, digital display design establishes and innovates experience methods, so as to meet diversified display needs. Thirdly, it is established from the interactive prototype of connection content and multimedia devices. Based on the selection of content scope and device parameters, the logic and framework of interactive prototype are the key to the implementation of the whole interaction design, which plays a decisive role. The interactive prototype is audience-centered, considering every action that the participant is likely to take, and analyzing their expectations at each step of the process.

2.4. Perception and extension -- Presenting design effect

The design of digital display should conform to the interactive interface of ancient books to satisfy the two-way communication and interaction between the audience and the display of ancient books. The interactive interface mainly includes layout design, navigation design and information design. Layout design should focus on color, font, icon, layout and other elements, analyze and organize the most commonly used behavior of the audience, and make these elements accessible and experienced in the easiest way. Navigation design is referred to as "interactive coordinate", which consists of a series of elements that guide the audience to interact with the exhibition and achieve the experience objectives, such as: buttons, switches, menus, bars, areas, etc. A seamless navigation should be able to guide operations and assist in switching between multi-level interfaces. Information design is the core plate to convey knowledge and ideas. The layout of information can be designed based on methods such as alignment, repetition, comparison and intimacy, considering the clarity and delicacy of information, unified conditioning, prominent focus, readability and understandability. Besides, the audience ultimately experiences through the sensory organs of the body. The design of the body perception layer, as an extension of the interactive interface, determines how the material properties of ancient book will be felt by the audience. For conventional interactive experience, visual design is the focus, but synesthesia transformation design can also be adopted. Regardless of the design, the ultimate goal is to shape the experience by guiding the audience's perception of the object, and emphasizing the attributes of a certain part of the object in the design.

3 Analysis of Digital Display of Ancient Books of *The Yongle Canon*

The theme exhibition of "Recovery · Reproduction - Return and Reconstruction of *The Yongle Canon*" systematically describes its compilation process, layout appearance, gathering and dispersion, and compilation photocopying, and comprehensively displays its rich and valuable knowledge system,

ideas and humanistic spirits, in which rich digital display means are applied. At the entrance of the exhibition hall, there is an immersive experience area around the screen to flashback the compilation, characteristics and return of the Canon in film style. Inside the exhibition hall, there are interactive games of writing brushes, ink sticks, paper and inkstones, touch screen copying of "Famous Masters Take You to the Canon", interactive experience of transparent screen of *The Yongle Canon*, showing its application materials, secretariat style calligraphy and layout knowledge. The interactive game of the Canon shows the knowledge of health maintenance of traditional Chinese medicine, calligraphy, animals and plants. The touch screen of the return chart of *The Yongle Canon* shows its return process. The database of *The Yongle Canon* shows its digital images in an all-round HD way for the audience to search and consult (Figure 1 - 6). According to the characteristics of elements of the digital display of ancient books, this paper will focus on two groups of digital exhibition items: the transparent screen of *The Yongle Canon* layout and the database of *The Yongle Canon*.



Figure 1: Interactive games of writing brushes, ink sticks, paper and inkstones



Figure 2: Touch screen copying of "Famous Masters Take You to the Canon"



Figure 3: Transparent screen of *The Yongle Canon* layout



Figure 4: Interactive game of the Canon



Figure 5: Touch screen of the return chart of *The Yongle Canon*



Figure 6: Database of *The Yongle Canon*

3.1. Layout of the Yongle Canon - Reproduction of the Beauty of Ancient Books

In terms of material properties, *The Yongle Canon*, written by the Palace Academy, embodies the Royal noble temperament and rigorous attitude in every detail including the layout. For example: The frame of each page of the Canon adopts the hand-painted design of bilateral sides, red mouth, red fishtail and vermilion column. With wrapped-ridge binding and hard-mounted multi-layer rice paper, the paper, solemnly wrapped with yellow silk, features by brightness and flexibility, making it excellent for writing on. The body text of the Canon is transcribed by calligraphers in Hui ink-stick and official regular script "secretariat style" in the Ming Dynasty. The main target audience of the current exhibition is students aged 19 to 28. According to the research, contemporary college students have a certain accumulation of knowledge and good aesthetic quality. Their quest for knowledge

requires a thorough and in-depth understanding, and their perception of novelty is sensitive and positive. Based on the material properties of the Canon and the audience's demands for experience, the exhibition shows the beauty of its layout and the knowledge Q & A layout for the audience through the digital display mode of the physical copy of the Canon and the transparent touch screen. Meanwhile, the logic of digital content is simple and easy to operate, and the overall design is achieved with breathtaking lightness and accessibility. The comparative exhibition, combining virtuality and reality, satisfies the audience's curiosity, and the interactive Q & A also meets their exploration of the layout knowledge of the Canon.

The interactive interface design of the transparent screen exhibition is distinguished from the conventional one, which requires to combine the copy of *The Yongle Canon* behind the transparent screen, so that the audience can see the real object behind, and experience the interactive content in combination with the real object. The design method of this exhibition is worth learning from. First of all, the home page of the interface adopts a transparent design to effectively deal with the spatial relationship between the interface information and the real object behind. For example: The title of "Beauty of Layout - Transparent Screen Interactive Game" is designed in the upper left corner of the standby screen, and two buttons of "Beauty of Layout" and "Start Answering" are designed in the center and right of the screen respectively. The rest of the screens are transparent. The overall design not only reflects the composition balance of the left and right pictures, but also highlights the Canon real object displayed behind the screen (Figure 7). In the second place, the interface makes full use of the advantages of virtual and real comparison to carry on comparative design of the layout knowledge of the Canon. For example: When the audience clicks the "Beauty of Layout" button, information such as dimension and process materials by the layout of *The Yongle Canon* appears in the middle of the screen, which can be combined with the Canon for comparative study. When the information introduction is over, the screen will automatically expand a page layout, and corresponding knowledge will be marked on the layout, such as "head margin, boundary line, frame, fishtail and type area". The page layout is the same as the proportion of the Canon, which is very convenient for viewing (Figure 8). At last, all titles in the interface are designed in the special secretariat style "Regular Script" of the Canon, with traditional Chinese painting pigment earthy yellow and ochre color. Meantime, simple and abstract moire and ink elements are used for decoration. The overall design echoes the cultural temperament of the Canon, reflecting neat scriptorium, and exquisite painting of the Canon



Figure 7: Standby Interface



Figure 8: Layout example of Level 1 Interface

Besides, the interface navigation is designed in combination with the real object, so that the interactive experience is guided clearly and purposeful. For example: Click the "Start Answer" button on the standby screensaver to enter the answering interface. The question number, question, selection box and close button on the page are reasonably designed to leave space for the audience to watch the real object. Audience can answer the questions in turn according to the question number, and analyze the ancient books according to the questions. If they select the right one, they will enter the next question, and if they select the wrong one, the correct answer will appear. If they leave the question, they shall click the close button. Audience must answer 10 questions in sequence before they can get scores (Figure 9). The overall operation is simple. While answering the questions, the audience analyze answers with reference to real objects, and finally realize the purpose of in-depth learning of the layout knowledge of the Canon. In addition, the perception layer of interactive experience is designed with visual and tactile senses to guide the audience's perception of the Canon. The texture of paper and the color of Hui ink-stick have even transformed taste and smell. In brief, the digital exhibition design, combining virtual and real exhibition, emphasizes the material properties of the Canon, and the interactive experience activates and extends the audience's perception and deep-seated cultural experience, awakening their emotional identification to the Canon.



Figure 9: Interactive Quizzes of Level 2 Interface

3.2. The Yongle Canon Database - Ancient and Modern Dialogue Platform

With 22,877 volumes of text, 60 volumes of catalogue, 11,095 volumes of binding, and a total word count of about 370 million words, *The Yongle Canon* is known as the largest reference library in the world at that time. This "database" is characterized by "complete content and unique style", of which the "complete content" is reflected in its collection of more than 8,000 kinds of ancient books and

classics from the Pre-Qin Dynasty to the early Ming Dynasty. In addition to the famous sub-collections of classics and history, there are also various works, including philosophy, literature, history, geography, religion, and medical divination. "Unique style" is reflected in the fact that it is a reference book combining two different styles: reference book (arranged according to categories) and rhyming book (arranged according to the rhyme of Chinese characters), highlighting the characteristics of "rhyme to unify words and words to set things". In order to meet the demands of the target audience for deeper learning and research, the exhibition adopts digital HD color images of *The Yongle Canon* collected by the National Library to build a real database of modern significance. The database constructs a basic retrieval platform based on the 10 volumes of digital color images of *The Yongle Canon*, including the origin of *The Yongle Canon*, existing collections, and Hongwuzheng rhyme, which are supplementary instructions to the database and retrieval platform to assist users in understanding and query. Through interaction between the computer console and projection screen display, the exhibition sets the visiting experience mode of one-person-operating and multi-person-viewing (Figure 10).



Figure 10: Display Environment of *The Yongle Canon* Database

The interactive logic of *The Yongle Canon* database is mainly divided into standby layer, functional layer, and content layer. Level 1 Interface is a function page, including two parts: One part covers three retrieval entrances: retrieval by "volume", by "rhyme" and by "keyword", and the other part covers three information buttons of "origin", "existing" and "Hongwuzheng rhyme" of *The Yongle Canon*. Level 2 Interface is the content page, covering all the Level 2 content page of the Level 1 Interface. The "three retrieval methods" in the database is the highlight, which is not only the core of the whole exhibition, but can best reflect the material properties of "unique style" of the Canon. Logic of the retrieval method refers to arrangement of "rhyme" in the reference book of *The Yongle Canon*. This method is similar to the Pinyin retrieval method in today's dictionary, but it is based on Hongwuzheng rhyme of the Ming Dynasty (Figure 11). With the style of "rhymes for all words, and words for all things", it can be understood that there are many words under each rhyme, and each word is divided into relevant astronomy, geography, personnel, famous objects, poetry and songs. It can be seen that the logic of database retrieval by "rhyme" is full of characteristics, and the information retrieved by "volume" and "keyword" in the page is also output based on the content arranged by "rhyme". "Keyword" retrieval in the page is the product of the development of modern technology. The comparative use of the three retrievals also reflects the cultural conflict and integration across ancient and modern times (Figure 12). Audience can choose the retrieval mode based on their usage habits, for example: If the audience choose to search by rhyme, they can click the "Rhyme" button on the left of the Level 1 Interface, and two rhyme directories of "one building" and "two branches" will pop up automatically under the column. If they click "one building", the five words "loyalty, capacity, praise, moderation, agriculture and poetry" will appear below. If they click

"two branches", the word "poetry" will appear below. If they click any "word", the corresponding Canon volume name will appear below. Continue to select the volume name, the middle area of the page will synchronously display the digital HD cover of this volume, and the subdivision column on the right will synchronously display the "Rhyme" to which this volume belongs and the title covering "content category" under "word" (Figure 13). If they click the title of any category, it will enter the secondary interface. The book title or article title referenced by this category will be displayed on the right side of the Level 2 Interface, and the text page of relevant book title or article title in the middle area will be automatically expanded for the audience to read (Figure 14).

The screenshot shows a digital interface for the 'Hongwuzheng Rhyme' page. At the top, there is a header with the title '永樂大典' (Yongle Daquan) and a search bar. Below the header, there is a table with multiple columns. The first column lists various rhyme categories, and the subsequent columns list specific rhyme words and their corresponding volume numbers. The interface has a traditional Chinese aesthetic with a yellow and orange color scheme.

Figure 11: Page of Hongwuzheng Rhyme

The screenshot shows a digital interface for the 'Three Retrieval Methods' page. It is divided into three main sections: '按“音”检索' (Search by Sound), '按“韻”检索' (Search by Rhyme), and '按“義”检索' (Search by Meaning). Each section contains a table with columns for the search method, the search term, and the corresponding volume number. The interface has a traditional Chinese aesthetic with a yellow and orange color scheme.

Figure 12: Description of the Three Retrieval Methods



Figure 13: Level 1 Interface



Figure 14: Level 2 Interface

The interactive interface design of *The Yongle Canon* database clearly points to the "instrumental" characteristics of the exhibition, and also emphasizes its material properties. First of all, the interface design applies the contrast and matching of yellow and white which is similar to the Canon, showing its brightness, sanctity and dignity as a whole. The overall interface belongs to "full version", which takes the HD color map of Canon as the main visual display, with small and fine icons and information auxiliary decoration around, successfully highlighting the sense of existence of the main image, with intuitive and eye-catching visual communication. Secondly, the interface navigation design belongs to the "horizontal scrolling mode", and the interactive experience scrolls in the left and right horizontal direction to facilitate the operation experience and maximize the regional content browsing. Moreover, the menu column is designed to be located at the top and left and right sides of the page, giving a large display space for the HD images of *The Yongle Canon*. Some auxiliary switching and return buttons provide good guidance for audience and make the experience seamless. Thirdly, the information design of the interface is based on the reading habits of the audience, using left and center alignment to establish a clear reading panel. The search columns on both sides of the Level 1 Interface are arranged vertically and symmetrically, which increases the unity of vision and operation, and reduces learning cost. Furthermore, the title of the search column and its extended additional title are arranged in close groups, highlighting the unity of visual information. In addition, in the "content category" directory column on the right side of Level 2 Interface, the category title is in black, and the extended book title or article title is in red, which is consistent with the corresponding information color in the HD color page in the middle, so as to facilitate audience to quickly and effectively consult information. For example, the category title "Zhongyi 15th" on the right is in black, and the article titles "Liao History" and "Jin History" covered below are in red, which all correspond to the text color of the title and article title in the exhibition page of the Canon (Figure 15). Besides, vision directly guides the perception when "people and things" meet. *The Yongle Canon* database guides the audience to perceive its tool characteristics through vision, and meets their needs and expectations through emotional experience design. For example, the clear interactive logic that is predictable before operation, feedback during operation and revocable after operation, adapt to the exploration and research needs of the audience, also meeting their desire to quickly and effectively obtain deep-seated knowledge. The emotional text applications such as "input keywords for retrieval", "origin" and "existing" in the interface also help stimulate the emotional reproduction of the audience' instinct layer, behavior layer and reflection layer.



Figure 15: Right Directory Column of Content Type

4 Suggestions on Design Optimization of Digital Display in Exhibitions

The application of digital display in the exhibition of *The Yongle Canon* is worthy of recognition in terms of display content, display method and interactive experience design. Based on the design foundation of the existing exhibition items, this paper puts forward some superficial optimization suggestions to expand and perfect the design ideas, as well as promoting the communication and discussion in the industry.

4.1. Three-dimensional presentation of display content of the Canon

The flat expression of the content of ancient books will bring monotonous experience. The display contents can be refined from different disciplines, themes, contexts and hot topics, or the material properties of the Canon can be three-dimensionally interpreted from different levels of points, lines, and surfaces, as well as adding related expressions. Increasing focus of the exhibition can make the participants more willing to watch and participate in it.

4.2. Audience intermedium body to enhance interaction

Digital exhibition is only the carrier of cultural information of the Canon. Only in the process of use, operation and experience can the audience produce its value. Intermedium can be fully explored by the design, considering how the body, as a mobile or non-mobile medium, can participate in the experience and independently explore the construction of digital contents of the exhibition items in the process of commuting between physical and virtual world in the digital era. It also completes the shaping of noumenon emotion, attitude and values.

4.3. Adding narrative expression of the display content

If the display content is narrative, the multimedia form is narrative mode, and the interactive logic is the narrative process. The audience is not only the concatenator of "things", but also the builder and disseminator of "culture". Narrative text can be added to the display content, emphasizing on narrative structure and coherence. Therefore, multimedia can choose a variety of technical means supplemented by narration, which can enable the audience to immerse themselves in the story plot, multimedia environment and interactive experience, so as to achieve a better experience.

5 Conclusion

"Recovery · Reproduction" not only refers to *The Yongle Canon*, but also reflects the fate and status quo of other ancient books and documents. The vulnerability of ancient books is in urgent need of

digital protection, research and display. The digitalization of ancient books is in the infancy. It is hoped that the research on the application of the digital display of ancient books in the National Museum of Classic Books can provide some reference and enlightenment for relevant researches or design workers. It also calls on more professionals to visit the National Museum of Classic Books to carry out deeper and broader exchanges, exploration and research, and jointly promote the application, innovation and development of the digital display of ancient books and cultural relics.

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