Creativity and Innovation
2025, VOL. 9, NO. 6, 87-90
DOI: 10.47297/wspciWSP2516-252719.20250906

Research on Visual Design for Digital Displays Based on VR Virtual Reality Technology

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ABSTRACT
In today's era where information technology permeates every sector, digital displays have become the primary domain for information dissemination and value creation. Access to diverse information delivery methods enables people to better grasp the core of various fields. VR virtual reality technology, with its interactive and immersive characteristics, is subtly influencing people's lives. It has also expanded and enhanced the visual design of digital displays. Consequently, VR virtual reality technology has become one of the key drivers of current social development. It breaks through the temporal, spatial, and perspective limitations of traditional displays, propelling digital display visual design from "one-way information transmission" to "two-way user interaction." This paper examines the core principles of VR virtual reality technology and the essential elements of digital exhibition design. It analyzes the application of VR technology across cultural arts, commercial marketing, education, and training sectors. The study aims to provide insights for refining the theoretical framework and practical implementation of VR digital exhibition visual design, thereby advancing the high-quality development of VR technology within the digital exhibition field.

KEYWORDS
VR virtual reality technology; Digitalization; Visual design

1 Foreword

1.1 Research Background

With the rapid development of the digital economy, information dissemination has undergone profound transformation. Traditional offline communication and static display models have begun shifting toward online and dynamic approaches. As a crucial bridge connecting information and users, digital exhibitions are now widely applied in cultural dissemination, education, medical services, and other fields, effectively facilitating information transfer and science popularization. VR virtual reality technology has successfully driven the evolution of digital display methods, transforming traditional visual design paradigms. It enables more in-depth presentation of knowledge points and content, breaking free from the limitations of "two-dimensional flat carriers" and "fixed viewing angles." This allows more people to understand the user's perspective, explore information scenarios, and engage in deep interaction with displayed content, thereby enhancing information transmission efficiency and user memory retention. However, the integration of VR technology into digital visual design still faces significant challenges. It is essential to develop immersive content aligned with user cognitive habits and design visual scenarios suited to current user preferences. This approach balances the "entertainment value" and 'usability' of VR interactions, preventing user resistance due to complex operations. Ultimately, it enables users to experience the organic unity of VR's "visual aesthetics" and "information delivery."

1.2 Research Significance

First, theoretical significance: This study focuses on two key areas—VR virtual reality technology and digital exhibition design. By examining VR technology through the lens of two-dimensional media and three-dimensional displays, it offers targeted analysis to generate fresh perspectives for VR R&D. It explores how VR technology is transforming visual design in digital exhibitions, thereby filling gaps in theoretical research within this field and enhancing the theoretical framework for digital exhibition visual design. Furthermore, this study integrates the principles of visual aesthetics design with user experience theory to establish a trinity research framework encompassing technology, design, and users. This approach ensures that VR virtual reality technology can fully leverage its inherent advantages.

Second, practical significance: This study offers practical guidance for the application of visual design in VR digital exhibitions. By summarizing VR technology applications across diverse fields and analyzing case studies, we identify the core principles of VR technology and distill reusable visual design strategies. This helps designers reduce trial-and-error costs in VR content creation. Furthermore, this paper effectively identifies the diverse challenges and pain points encountered in VR digital exhibitions, proposing concrete optimization recommendations to enhance user acceptance

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and dissemination effectiveness of VR exhibition works.

1.3 Research Methods

First, the literature review method involves retrieving materials related to "VR virtual reality technology" and "digital exhibition design" from databases such as China National Knowledge Infrastructure (CNKI) and Wanfang Data. This approach systematically organizes the current status and achievements of relevant domestic and international research, clarifies the core issues and scope of this study, and provides support for constructing the theoretical framework of the thesis. Second, the case study method involves selecting representative VR digital exhibition cases across three major domains: cultural arts, commercial marketing, and education/training. These cases undergo in-depth analysis across three dimensions: "visual scene construction," "interaction design logic," and "user experience outcomes." By comparing the design strategies and application effects of different cases, this method identifies common patterns and distinctive characteristics in VR digital exhibition visual design, providing practical evidence to substantiate the thesis's arguments.

2 Fundamentals of VR Virtual Reality Technology and Digital Exhibition Visual Design

2.1 VR Virtual Reality Technology

Virtual Reality (VR) technology utilizes computer systems to generate simulated three-dimensional environments. Through specialized hardware, it enables users to become fully immersed within these spaces and engage in real-time interaction. Its core principles and defining characteristics are Immersion, Interaction, and Imagination. VR technology aims to transport users into virtual environments through sensory experiences like sight, sound, and touch. Users can interact with elements within these scenes via movements, voice commands, and receive immediate feedback. During use, users can create scenarios that don't exist in reality, expanding possibilities for creative design while sparking curiosity and desire. Current VR technologies on the market primarily fall into three categories: desktop VR, immersive VR, and augmented VR. Each relies on distinct hardware and systems, paired with specific functionalities and command interfaces, which directly determine the quality of the visual experience. These technologies enhance the processing of virtual scene data and user commands, ensuring a smooth and seamless experience.

2.2 Overview of Digital Exhibition Visual Design

Digital exhibition visual design refers to the process of combining and arranging visually perceptible elements through digital technology, further refining and elevating information to enhance overall communication efficiency while delivering value to users. Characterized by "dynamic nature," "interactivity," and "cross-media capabilities," this design approach must balance visual aesthetics with technical feasibility. Consequently, audiences experience both technological sophistication and artistic appeal when engaging with digital exhibitions.

VR virtual reality technology integrates the key principles of digital exhibition design, transforming visual elements into three-dimensional representations to effectively reduce spatial texture perception and achieve diverse object states. Beyond visual elements, digital exhibition design must also ensure spatial arrangement. Traditional displays, constrained by screen size, adhere to "visual flow" principles. However, VR technology guides users through landmark elements, enabling deeper comprehension of three-dimensional imagery. Thus, digital exhibition design can profoundly showcase scene elements, further enhancing both aesthetic appeal and technological sophistication.

3 The Transformation of Digital Exhibition Visual Design by VR Virtual Reality Technology

3.1 Building Immersive Experiences

In traditional digital exhibition visual design, audiences cannot truly experience how the presentation content transforms under VR virtual reality technology. Immersive experiences allow users to gain a deeper understanding of virtual scene rendering. Combined with high-resolution display templates, these experiences completely envelop the viewer's visual perception within the virtual environment, creating a spatial illusion of "being present within it." At the visual design level, constructing immersive experiences centers on spatial authenticity. Designers must depict the entire environment based on real-world perspective relationships, aligning elements like floor textures and wall exhibits with actual settings to prevent visual confusion that could induce dizziness. Beyond this, the essence of a virtual art exhibition lies not only in close-up appreciation of paintings but also in stepping into the scenes depicted within them and interacting with their elements. Immersive experiences deepen understanding of the displayed content while allowing visitors to feel the artistic atmosphere and beauty, fostering a truly profound comprehension of the exhibits.

3.2 Innovation in Interaction Methods

Interaction methods constitute a vital component of digital exhibition visual design, directly influencing audience

experience. Traditional digital exhibitions predominantly rely on "indirect interaction," such as operating displayed content via mice, keyboards, or touchscreens. This approach creates a noticeable "action lag" between audience input and visual feedback, resulting in suboptimal fluidity and naturalness in the interactive experience. VR technology, however, revolutionizes interaction through its unique spatial positioning and gesture recognition capabilities, establishing a new paradigm of "natural interaction." VR supports a broader range of interaction methods aligned with human visual habits in physical spaces, significantly lowering the interaction threshold. For instance, in a virtual shopping mall display, viewers can effortlessly navigate scenes by simply turning their heads to view different store exteriors and locations. Gesture interaction stands as the core highlight of VR engagement. Through sensors in VR controllers or external camera-based gesture recognition, audiences can directly manipulate virtual objects with their hands—grabbing, moving, or rotating items—or trigger specific functions via designated gestures. This multi-user collaborative interaction breaks spatial constraints, transforming digital displays into interactive platforms that connect people.

3.3 Expanding Content Creation

Traditional digital exhibition content creation has been constrained by the characteristics of display media, such as screen size, resolution, and interaction methods. Content formats primarily consist of images, videos, and animations, resulting in relatively monotonous presentation styles. The emergence of VR technology has completely shattered these limitations, providing vast expansion opportunities for digital exhibition content creation. It not only enriches content formats but also innovates narrative approaches, making exhibition content more diverse and compelling. VR technology transforms two-dimensional content into three-dimensional experiences. By utilizing 3D modeling techniques to construct virtual environments, it enables close-up exploration of diverse scenes and knowledge. Through narrative logic and interactive design, it optimally configures selection buttons. This interactive storytelling approach transforms viewers from "story observers" into "story participants," significantly enhancing content appeal and memorability. VR technology also drives innovative convergence with other technologies. For instance, it integrates with artificial intelligence for intelligent generation and dynamic adjustment of virtual environments, leverages big data for personalized content recommendations based on audience preferences, and combines with 5G technology to enable real-time transmission of high-definition VR content and multi-user collaborative experiences.

4 Application Cases of VR Technology in Digital Displays Across Various Fields

4.1 Cultural and Artistic Field

Cultural and artistic theory represents one of the key applications for VR virtual reality technology. This technology enables the digital presentation of cultural heritage, exemplified by the "V Forbidden City" project launched by the Palace Museum. This project employs VR technology to construct a 1:1 virtual replica of the Forbidden City's palace complex, encompassing key structures like the Hall of Supreme Harmony, the Palace of Heavenly Purity, and the Hall of Mental Cultivation. Visitors can experience the intricate architectural details of the Forbidden City through VR, while also appreciating its majestic grandeur. This virtual technology enhances realism, even replicating precise elements like noon sunlight and sunset hues. Additionally, "V Forbidden City" introduced an "Immersive Historical Scenes" module. Through animation and interactive design, it recreates pivotal historical events—such as Emperor Kangxi's coronation ceremony in the Hall of Supreme Harmony. Visitors can "step into" these historical settings and interact with virtual historical figures. This immersive experience deepens audiences' understanding of the Forbidden City's cultural heritage. Beyond cultural education, VR technology also serves artistic exhibitions. A notable example is the "Venice VR Restoration Project," a collaboration between the University of Venice and VR technology companies focused on cultural heritage restoration and display. Within the VR environment, viewers can use gesture-based interactions to explore damaged sections of ancient architecture while simultaneously viewing restoration progress. This allows audiences not only to appreciate the restored appearance of historic buildings but also to gain insights into the specialized knowledge involved in cultural heritage restoration. This initiative not only provides scientific digital tools for heritage restoration but also raises public awareness of cultural preservation through immersive VR experiences.

4.2 Commercial Marketing Sector

In the realm of commercial marketing, VR technology enhances marketing effectiveness by creating immersive product showcase environments and interactive experiences. This enables businesses to better convey product value, elevate brand influence, and achieve upgraded marketing outcomes. Currently, VR applications in commercial marketing primarily focus on three areas: virtual product demonstrations, immersive brand experiences, and virtual shopping scenarios. Through innovative visual design and interactive strategies, these applications allow consumers to gain a more intuitive and in-depth understanding of products and brands.

BMW's "VR Virtual Test Drive" initiative enables consumers to thoroughly explore the vehicle's exterior and interior

design. Drivers can intuitively experience BMW's spacious cabin while navigating highly realistic virtual driving scenarios. This allows real-time feedback on the car's performance, including acceleration, cornering, and braking capabilities.

In terms of immersive brand experiences, Coca-Cola's "VR Happy Factory" marketing campaign centers on the theme of a "Happy Factory." Utilizing VR technology, it constructs a fantastical virtual factory environment. Consumers wearing VR headsets can step inside the facility where Coca-Cola is produced, learn about the beverage's manufacturing process, and engage in playful visual design and interactive activities. This approach deepens brand understanding, effectively boosting brand affinity and consumer engagement.

4.3 Education and Training Sector

The education and training sector demands high levels of visualization and interactivity. VR technology addresses this by creating immersive teaching scenarios and simulated training environments. It transforms abstract knowledge into intuitive visual experiences and relocates hazardous or complex hands-on training to virtual spaces, offering a revolutionary solution for education and training.

In subject teaching, VR technology provides robust support for instructing abstract academic knowledge. The "VR Virtual Laboratory" in chemistry addresses the challenge of abstracting chemical experiments, which are often difficult to conduct in classrooms due to safety risks or the high cost of equipment. By leveraging VR technology to create highly realistic virtual experimental environments, students can "enter" the virtual lab wearing VR headsets and perform experiments using virtual laboratory apparatus.

In the field of vocational skills training, VR technology effectively addresses the challenges of high practical training costs and significant risk factors. In medical training, the "VR virtual operating room" has become a common training tool. This VR environment can recreate surgical scenarios for various conditions, with virtual human models featuring organ placement and vascular distribution identical to real human anatomy. Trainees simulate surgical procedures using VR controllers, with the system providing real-time feedback on precision. This simulated training not only mitigates the risk of medical errors but also allows trainees to enhance their skills through repeated practice, reducing training cycles by 30% compared to traditional methods.

5 Conclusion

In summary, VR virtual reality technology has permeated various aspects of life and development, effectively enabling digital displays across diverse fields. This paper aims to analyze the interactive and immersive characteristics of VR virtual technology while examining its application domains in detail, focusing primarily on sectors such as cultural arts, commercial marketing, and educational training. VR technology effectively enhances traditional visual design by enabling broader audiences to experience user perspectives, explore informational scenarios, and engage in deep interaction with displayed content. This drives greater efficiency in information transmission and user retention, thereby improving the application of VR technology.

References

[1] Du Yuqing. Research on VR-Based Digital Display of Han Embroidery [D]. Wuhan Textile University, 2024. 000295.

[2] Gong Ziwei, Huang Yaing. Digital Display Design of Xiangxi Huayao Embroidery Patterns Using Virtual Reality Technology [J]. Silk Screen Printing, 2024. 04. 028.

[3] Gu Yonglin. Digital Preservation of Cultural Relics and Virtual Reality Technology Application: A Practical Analysis of Enhancing Interactivity and Exhibition Communication Effects [J]. Art Appraisal, 2023, (36): 134-137.

[4] Zhang Min. Digital Exhibition of the Great Buddha Cave at Xiangtangshan Grottoes Based on Virtual Reality Technology [D]. Taiyuan University of Technology, 2023.000921.

[5] Zhao Ying. An Exploration of Virtual Reality Technology Application in Multi-terminal Digital Display [J]. Computer Knowledge and Technology, 2023.0519.

[6] Chen Yitong, Xu Yuejia, Li Yu, et al. Research on Digital Display of Red Cultural Spaces at the Community Scale in Beijing Based on Virtual Reality Technology [J]. Art and Design (Theory), 2023.02.031.

[7] Zhang Ting. Research on Visual Design for Digital Displays Based on VR Virtual Reality Technology [D]. Nanchang University, 2022.

[8] Zhu Zhaolong, Xiong Xianqing, Wu Zhihui, et al. Virtual Reality Display Technology for Custom Home Furnishings Digital Design in Smart Manufacturing [J]. Wood Science and Technology, 2021, 35(05):1-6.

[9] Chen Xi, Zhu Yubo, Yu Riji. Application Research of Virtual Reality Technology in Digital Display of Hanfu [J]. Research on Design Art, 2019, 9 (01): 85-91.

[10] Meng Fanlei. A Brief Analysis of Digital Applications of Virtual Reality Technology in Landscape Planning and Design: A Discussion on Modular Digital Display of Landscape Scenes [J]. Talent and Wisdom, 2010, (27): 78.