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IMPACT OF DIGITAL ART ON DESIGN OF ONLINE MUSEUM: USER-CENTERED DESIGN, NARRATIVE DESIGN, AND INTEGRATION OF TECHNOLOGY

The purpose. This research aims to explore the means by which digital art presented in online museum exhibitions will contribute to an improved visitor experience of the museum exhibition.

Methodology. Theoretical and practical research methods are used, namely, analysis of scientific and professional literature on the impact of digital culture on museum exhibits, analysis of design analogs of online museums.

Results. Based on the research analysis, the influence of digital culture on art museums was established, which allowed them to go beyond physical spaces, display digital art and implement virtual reality technologies. The cases of the Museum of Modern Art, TATE, the Victoria and Albert Museum, as well as China's Palace Museum and Shaanxi History Museum have demonstrated the significant benefits of integrating digital culture into the art world. The use of augmented reality (AR), virtual reality (VR) and mixed reality (MR) in digital museum exhibitions was analyzed. It is substantiated that the impact of digital culture on art museums is evidence of the importance of digital technologies in the design of online museums.

The scientific novelty lies in the fact that the design principles of digital art exhibitions of online museums have been further developed in the work, which allows them to reach a wider audience of visitors and improve the aesthetic perception of museum expositions by viewers.

Practical significance. The results of the study can be used in their introduction into the modern practice of designing museum.

Keywords: digital art; online museum; exhibition design; augmented reality; virtual reality; mixed reality; Chinese culture.

Introduction. In present times, digital culture has impacted every aspect of human existence, ranging from interaction with information, communication and computing, to ways of knowing, thinking, being, and doing. As Nikitenko thinks, this digital state of being is not confined to any specific field or discipline and shares a commonality in terms of the use of digital tools and technology [1]. The change in human behavior is at the core of digital culture, and people from all backgrounds are becoming more accustomed to digital behavior. Even museum visitors are increasingly indulging in digital activity and expect to be an active part of the museum's life. A survey shows that online activity doubled on all social media platforms as from March 2020 when Italy went into lockdown [2]. This digital transformation has prompted museums to go beyond their physical walls and connect with their public on

location, online, in public spaces - real and virtual. Digital technologies are used in all areas of design and design education [3], and museum learning [4].

Analysis of previous researches. The field of museums and digital art is an emerging area that has received limited research attention in terms of the heritage/museum experience and human digital behavior. There is also a lack of research specifically focused on the culture of "digital art" and the division between art and technology within museums remains an ongoing issue. A groundbreaking contribution in this field is the book by Giannini & Bowen [5], which explores the concept of "digital art" rather than solely focusing on the role of digital technology. Only recently, with the onset of the COVID-19 pandemic, has the gap between the real and digital aspects of museums started to be addressed. Museums

are now beginning to adopt an integrative approach, recognizing the dynamic and uncertain nature of the pandemic. This requires heritage institutions to be more flexible and incorporate technologies such as VR, AR, and MR both in physical and online environments.

In April 2021, UNESCO released a follow-up report that revealed a significant decline in revenues for 80% of museums compared to 2019 [6]. In the first quarter of 2021, 43% of museums reported closures. However, the report also highlighted the positive aspects of strengthened community connections and increased intermuseum cooperation. In 50% of countries, public subsidies decreased for national institutions. The report by Bekele [7] estimated the presence of approximately 104,000 museums worldwide, representing a 9% increase from the previous year's report. However, estimating the number of museums on an international scale is challenging. Nevertheless, the global impact of the pandemic has sparked extensive public debate on the future of museums, as activism and protests in the arts sector seek to break down cultural barriers and foster common ground.

The Museum Innovation Barometer 2021 [8], an annual survey conducted by Museum Booster since 2015, provides a comprehensive analysis of technology and innovation in museums. The findings of the extensive survey by Vosinakis et al. [9] demonstrate that COVID-19 has been a key driver for digital transformation in museums, leading to the adoption of new technologies such as AR, VR, and hybrid approaches like MR. The survey confirms that these technologies are becoming increasingly prevalent in museums, aligning with our previous research and the findings of this present study. However, significant challenges remain regarding sustainability and financial feasibility in implementing these technologies.

Statement of the problem. Although digital art has gained recognition and popularity in recent years, its seamless integration within online museum exhibitions is yet to be fully explored. While many museums

have established an online presence to expand their reach, the utilization of digital art in these virtual spaces remains limited. This lack of integration hinders the delivery of a comprehensive and enriching experience for museum visitors, who may not have access to physical exhibitions due to various constraints.

Results of the research and its discussion. User-Centered Design, Narrative Design, and Integration of Technology are indeed key aspects influenced by digital art. Digital art is the use of digital technology and computer programs and other means to analyze, edit and other applications of pictures, audio and video files, and finally get a perfect upgrade work. It mainly includes digital reinvention, 3D modeling, interactive installations, virtual reality, holographic projection, phantom imaging, etc [10]. The digital art context is mainly digital, interactive, and creative features. The mode of communication has changed from one-way communication in the era of traditional media to multi-directional communication. The audience is no longer just a single recipient of the message, but is able to engage with the message communication.

User-Centered Design

The online museum aims to manage physical collection and scientific research information efficiently while ensuring permanent preservation. It provides users with online display, education, and research services through the internet while disseminating knowledge on cultural and natural heritage. Taormina & Baraldi [11] assert that it is an innovative information service system that combines computer science communication and museology. Wu et al. state that the advancement of digital technology allows individuals to browse online museums at their convenience, resulting in a unique viewing experience [12].

The Museum of Modern Art provides an example of how museums are incorporating new mediums such as digital art. The Museum of Modern Art (MoMA) in New York City is

globally recognized as one of the preeminent modern art institutions [13]. Its extensive collection features over 200,000 works of art, including Pablo Picasso, Vincent van Gogh, Salvador Dali, and Andy Warhol, among others. In more recent years, MoMA has concentrated on emerging technologies and has been instrumental in advancing conservation and preservation of digital art (Fig. 1, a). In 2011, MoMA with Google Arts & Culture offers virtual tours of its collections through various digital platforms. This initiative includes web-based galleries, interactive exhibits, and digital replicas of physical art installations. The MoMA website homepage is divided into three sections: "Visit", "Exhibition Online", and "Art and Artists". Each section serves a unique purpose. The "Visit" section provides essential information for individuals intending to visit the museum, such as online ticket sales, transportation options, dining locations, and travel advice. The "Exhibition Online" section showcases past and future exhibitions, screenings, performances, and other events utilizing a calendar-based format. Finally, the "Art and Artists" section fulfills the public education role of online art museums by providing access to their collection of digital works, artists, audio and video recordings, and other art-related content.

TATE (Tate Modern and Tate Britain) which first opened to the public in 1897, boasts a collection of nearly 70,000 works encompassing 1500 years of British art as well as modern and contemporary art from around the world [16]. Its mission is to foster public appreciation of British art from the 16th century to the present and international modern and contemporary art. TATE Online (Fig. 1, b) is a key part of the museum's digital strategy and is utilized by all divisions within the institution. There is a growing emphasis on establishing a dynamic system that encompasses these various aspects and embraces the transformative shift from a traditional nonparticipatory model to one that deeply engages the audience. The website is divided into three main sections: Art & Artists,

Exhibitions & Events, and Tate Children. The Art & Artists section provides visitors with comprehensive explorations of various art forms, allowing them to learn about the artist's life and the stories behind their creations. The Exhibitions & Events section offers over 100 customizable activities, allowing users to tailor their experience according to their needs. The Tate Children section is entirely dedicated to young audiences and offers online craft tutorials, fun games, art history lessons, and a children's gallery.

Narrative Design

Digital art can influence the narrative design of on-site museums by introducing new ways of storytelling and interpretation. Museums can utilize digital technology to create multimedia exhibits that combine visual art with audio, video, or interactive elements. These narratives can provide additional context, historical information, or alternative perspectives on the artworks, enriching the visitor's understanding and appreciation. Digital art can also inspire museums to experiment with non-linear narratives or immersive storytelling techniques.

The official website of the Shaanxi History Museum has been awarded the prestigious 2023 Design Award, showcasing its remarkable performance in design innovation and user experience [17]. This museum website, an immersive platform for cultural exploration, exudes the timeless splendor of cultural heritage with its distinct Eastern aesthetics and meticulous craftsmanship. By seamlessly integrating history and modern electronic information technology, the website offers a captivating digital journey to appreciate the grand achievements of the Chinese civilization from multiple perspectives (Fig. 2). Through its thoughtful design choices, from the harmonious color palette and layout to the visual elements that resonate with the exhibited artifacts, the website encapsulates the rich cultural essence. Every detail, from navigation to font selection and image processing, conveys the designers' dedication, offering an intuitive and engaging

user experience where users can easily uncover new discoveries. Emphasizing user-centricity, the website presents a clear and user-friendly interface, while also serving as a platform of great academic value and social significance. It provides abundant resources for scholars and researchers, disseminates cultural knowledge to

the public, and enables seamless access across devices and browsers. By simply clicking on the website, users can embark on an immersive journey through ancient civilizations, indulging in the treasures of the Shaanxi History Museum and experiencing the unique charm of Chinese civilization.

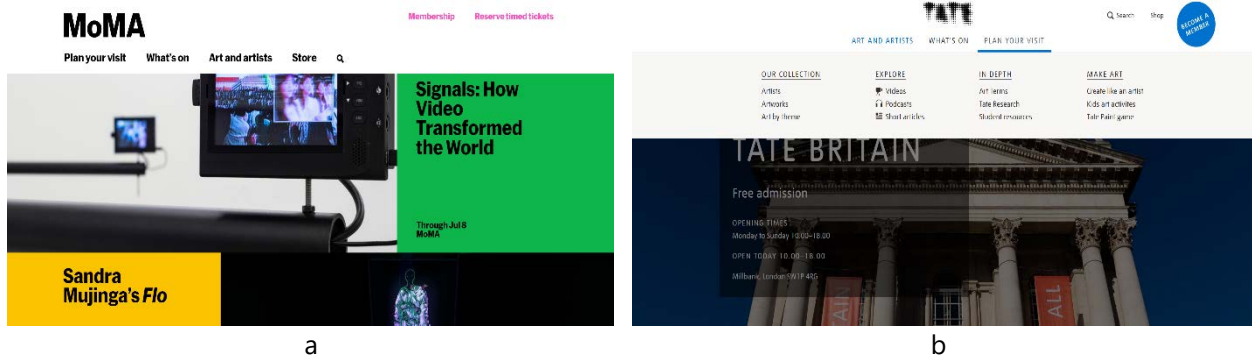


Fig. 1. Digital Art Exhibition: a – MoMA, USA, 2023 [14], b – TATE, United Kingdom, 2023 [15]

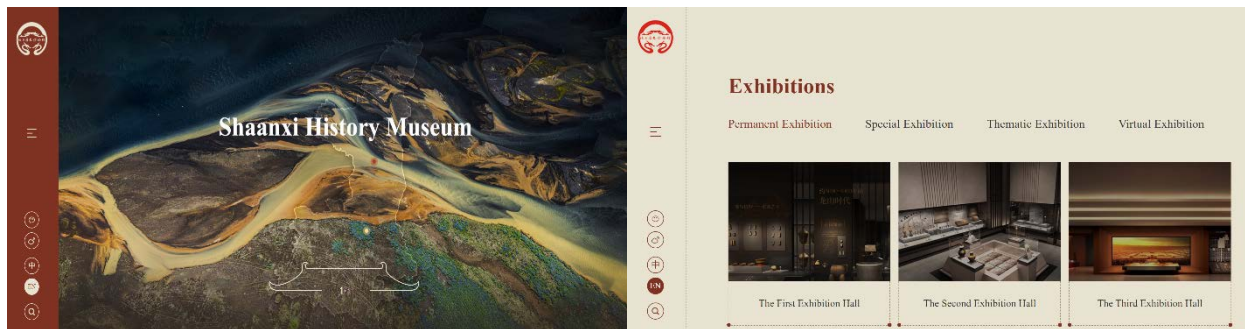


Fig. 2. The Shaanxi History Museum online exhibitions, China, 2023 [17]

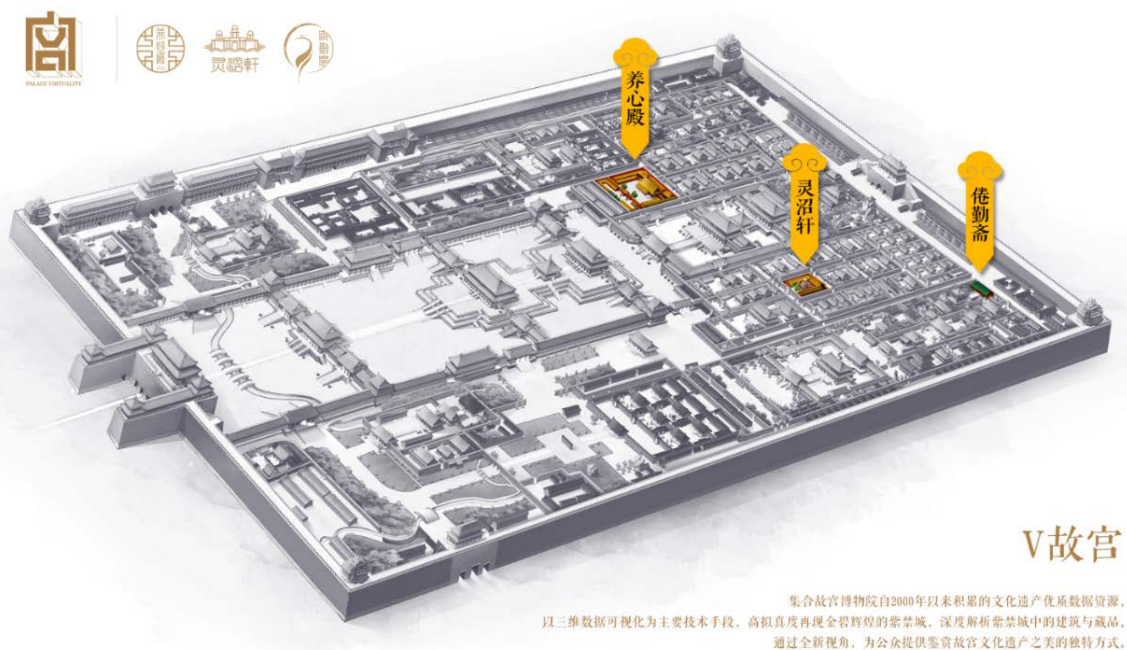


Fig. 3. The Palace Museum online exhibitions, China, 2023 [18]

In response to the temporary closure of the Palace Museum during the COVID-19 pandemic from January 25th to May 1st, 2020, the museum creatively utilized its digital resources to offer a range of online experiences [18]. Through virtual exhibitions, online classes, and virtual tours, the Palace Museum engaged the public and satisfied their desire for cultural exploration from the comfort of their own homes. The museum's innovative initiatives,

such as the "Virtual Tour of the Palace Museum," "Audiovisual Gallery," "Panoramic Palace Museum," "VR Palace Museum," and "Digital Cultural Relic Database," showcased the integration of design features and a compelling narrative. The virtual tour, conducted through live streaming with professional guides, allowed users to select different routes and interact with the guides, creating an immersive and interactive storytelling experience.

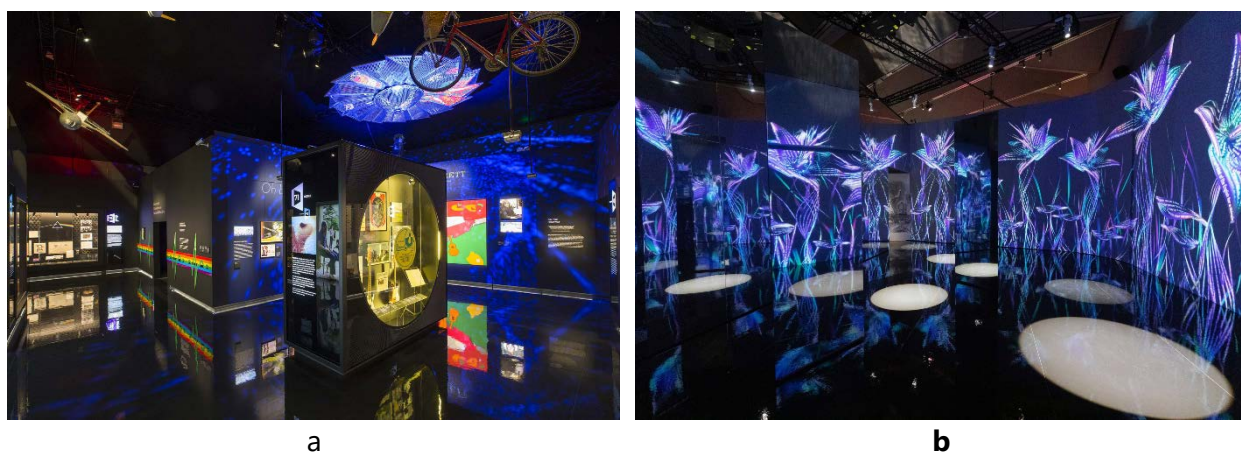


Fig. 4. Presented by the Victoria and Albert Museum exhibitions, United Kingdom, 2023:
a - Pink Floyd, b - Alice in Wonderland [19]



Fig. 5. Presented by Oculus Rift DK2 Virtual Reality Experience, USA, 2023 [21]

Integration of Technology

Digital art can inspire the integration of technology within on-site museums to enhance the presentation and interpretation of artworks. Museums can incorporate digital displays, projectors, or interactive installations to create dynamic and visually captivating exhibitions. Augmented reality (AR) or virtual reality (VR) can be used to provide immersive experiences, allowing visitors to virtually explore art installations or interact with digital representations of artworks. Additionally, technology can enable museums to offer multimedia guides, interactive apps, or online platforms that provide additional information and resources to enhance the visitor's engagement with the art. Online museum designs should embrace emerging technologies, such as VR, AR, and mobile applications, to provide unique and immersive experiences that enhance visitor engagement and extend the reach of art and culture.

This trend was already gaining momentum prior to the pandemic, as seen in exhibitions like the Pink Floyd exhibition at the Victoria and Albert (V&A) Museum in London (Fig. 2, a), where the audience reclined on the floor in a large gallery surrounded by floor-to-ceiling projections. In 2021, the V&A Museum introduced a new venture into VR and integrated digital experiences with their exhibition titled "Alice: Curiouser and Curiouser." (Fig. 2.b) This exhibition featured an AR exhibit showcasing a Madhatter's Tea Party with animated elements on a virtual table and background. Additionally, a VR experience was created in partnership with Vive Arts, offering visitors an immersive encounter with the exhibition's themes. Notably, this VR experience can also be accessed online, further demonstrating the museum's exploration of digital integration.

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According to the article on design guidelines for systematic and theoretically grounded research on virtual exhibitions, Kim concluded that the online museum exhibition has the following characteristics: Interactive, Openness, Dynamic, and Collaborative [20]. In the National Air and Space Museum [21], VR can transport visitors to historic events, such as the moon landing, allowing them to experience the moment firsthand (Fig. 5). AR can superimpose digital information, such as 3D models or interactive elements, onto physical exhibits, providing additional context and detail. VR and AR enable museums to create immersive experiences by providing visitors with virtual environments or overlays that enhance their understanding of artifacts.

Conclusions. Overall, digital art has shaped the design strategies and principles of online museum exhibitions, leading to more visually captivating and immersive experiences. The integration of multimedia elements, user-centered design, storytelling, technology, and accessibility considerations have all been influenced by the possibilities and capabilities brought about by digital art. As a result, online museum exhibitions are evolving into rich and engaging platforms for showcasing and experiencing art. This incorporation of digital art has greatly enhanced museum exhibitions, enabling them to reach a wider audience and offer a more immersive experience. However, despite these successful examples, the broader adoption and regularization of VR, AR, MR, and 3D technologies in art museums and exhibitions are yet to be fully realized. Further exploration and integration of these technologies hold the potential to revolutionize the museum experience and offer visitors new dimensions of interaction with art.

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ВПЛИВ ЦИФРОВОГО МИСТЕЦТВА НА ДИЗАЙН ОНЛАЙН-МУЗЕЮ: ОРІЄНТОВАНИЙ НА КОРИСТУВАЧА ДИЗАЙН, НАРАТИВНИЙ ДИЗАЙН ТА ІНТЕГРАЦІЯ ТЕХНОЛОГІЙ

Мета: дослідження засобів, за допомогою яких цифрове мистецтво, представлене на онлайн-музейних виставках, сприятиме покращенню сприйняття відвідувачами експозиції музею.

Методологія. Використані теоретичні та практичні методи дослідження, а саме, аналіз наукової та фахової літератури щодо впливу цифрової культури на музейні експозиції, аналіз аналогів дизайну онлайн-музеїв.

Результати. Виходячи з аналізу досліджень, встановлено вплив цифрової культури на художні музеї, що дозволило їм виходити за межі фізичних просторів, демонструвати цифрове мистецтво та впроваджувати технології віртуальної реальності. Кейси Музею сучасного мистецтва, TATE, Музею Вікторії та Альберта, а також китайських Музею Палацу та Музею історії Шеньсі продемонстрували значні переваги інтеграції цифрової культури у світ мистецтва. Було проаналізовано використання доповненої реальності (AR), віртуальної реальності (VR) і змішаної реальності (MR) в цифрових музейних виставках. Обґрунтовано, що вплив цифрової культури на художні музеї є свідченням важливості цифрових технологій в дизайні онлайн-музеїв.

Наукова новизна полягає в тому, що в роботі дістали подальшого розвитку принципи дизайну експозицій цифрового мистецтва онлайн-музеїв, що дозволяє їм охопити ширшу аудиторію відвідувачів та покращити естетичне сприйняття глядачами музейної експозиції.

Практичне значення. Результати дослідження можуть бути впроваджені в сучасну практику дизайну онлайн-музеїв.

Ключові слова: цифрове мистецтво; онлайн-музей; дизайн виставки; доповнена реальність; віртуальна реальність; змішана реальність; культура Китаю.

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