

УДК 7.012:
069.02:7

DOI:10.30857/2617-
0272.2024.1.6

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DESIGN OF APPLICATIONS FOR ACCESS TO DIGITAL ART WORKS IN ONLINE MUSEUMS

The purpose. The research aims to explore the integration of digital art with online exhibitions in museums, focusing on the design of application interfaces and museum exhibitions.

Methodology. The study uses a mixed approach that combines theoretical research, analysis of scientific research with analysis of practical examples.

Results. It has been found that the use of digital art has a significant impact on museum online exhibitions, contributing to more interactive, immersive, and inclusive visitor access. The integration of ICT into the museum sector, while primarily focused on digitization, virtual tours, and increasing visitor engagement through augmented reality and virtual reality technologies, also encompasses important design aspects such as color, typography, and interface design, which play an important role in the overall design of an online museum. Examples of the Central American Museum of Art, the Dunhuang Online Museum, the Metropolitan Museum of Art, as well as the Bloomberg Connects application are analyzed. The study highlights the importance of narrative design and user-centered approaches in the design of online museums to access digital cultural heritage.

The scientific novelty lies in the fact that the design principles of the interface of digital applications for visitors' access to the expositions of online museums were further developed in the work.

Practical Significance. The results of the study can be implemented in the modern practice of museum design projects, contributing to innovations in the presentation of cultural heritage artifacts.

Keywords: digital art, online museum, exhibition design, interface design, digital cultural heritage, augmented reality, virtual reality, mixed reality

Introduction. The digital revolution is rapidly changing the cultural and museum landscape by infusing new life into heritage preservation and sharing through Information and Communication Technologies (ICT) [1]. This shift has not only redefined museum operations and visitor engagement but has also created online museums equipped with augmented reality (AR), virtual reality (VR), mixed reality, and interactive archives that provide immersive experiences unaffected by the traditional constraints of time and space. Museums' roles are now expanding into the digital realm, fostering a more immediate, and intimate connection between audiences and cultural artifacts. IT sights from prominent institutions demonstrate that digital tools are enhancing visitor involvement, educational reach, and equitable access to cultural resources [2]. They explored the challenges associated with digital transformation, including the digital divide,

cybersecurity issues, and the need for continuous technological update. It also highlights how digital art and technological advances are revolutionizing online museums by increasing engagement, educational impact and reshaping our interactions with cultural heritage, thus providing an important perspective on the development of museums in the digital age.

Analysis of Previous Researches. The integration of Information and ICTs into the museum sector has been a focal point of academic and professional discourse over the last few decades. This analysis delves into previous researches, shedding light on the evolution, impact, and future trajectory of digital art applications in online museums. Drawing from a wide array of sources, this section synthesizes key findings from the literature, providing a nuanced understanding of how digital innovations are reshaping

museum practices and visitor experiences.

Early research in the domain highlighted the initial forays of museums into the digital realm, primarily focusing on digitization efforts and the creation of virtual tours [3]. The seminal work of Schweibenz on the «virtual museum» laid the groundwork for understanding the potential of the internet as a space for cultural presentation and interaction. These foundational studies underscore the gradual shift from physical to digital, emphasizing the transformative role of ICTs in expanding access to cultural content.

A significant body of research has focused on the impact of digital technologies on visitor engagement. Studies have explored how interactive exhibits, AR, and VR enhance the educational and experiential aspects of museum visits [4]. We also explore the means by which digital art presented in online museum exhibitions will contribute to an improved visitor experience of the museum exhibition [5]. These findings suggest that digital art applications not only facilitate deeper engagement with the content but also cater to diverse learning styles and preferences, thereby broadening the appeal of museums to a wider audience.

The democratization of access to cultural heritage through digital platforms has been another critical area of investigation. Researchers like Giaccardi and Ruggiero et al. have examined the role of online museums in providing educational resources to global audiences [6, 7]. Their studies highlight the use of digital archives, interactive learning tools, and social media as means to overcome geographical barriers and foster a more inclusive approach to cultural education.

Preservation and Presentation of Cultural Heritage. The contribution of digital technologies to the preservation and innovative presentation of cultural heritage has also been a focus of scholarly attention. Cameron and Hou et al., in their work on digital heritage demonstrate how advanced imaging techniques and 3D reconstructions offer new

ways to preserve and interpret cultural artifacts [8, 9]. These technologies not only ensure the longevity of fragile items but also allow for creative storytelling and interpretation, enriching the visitor's understanding of cultural contexts.

Statement of the Problem. The proliferation of digital art applications within online museums heralds a transformative shift in the dissemination and engagement of cultural heritage. However, this evolution is not without its challenges. Firstly, the digital divide poses a significant barrier, limiting equitable access to digital museum resources across various socio-economic and geographic demographics. This disparity undermines the potential of online museums to democratize cultural education and appreciation fully. Furthermore, the authenticity and experiential integrity of digital reproductions of artifacts come into question. As museums increasingly rely on digital replicas to present their collections, there arises a complex debate over the value and impact of these reproductions on the perception of cultural artifacts' authenticity. This scenario complicates the traditional understanding of museum experiences and the role of curatorship in the digital age.

This research endeavors to dissect the synergy between digital art and online museum exhibitions, with a focus on elucidating the manner in which such amalgamation can amplify the caliber and profundity of visitor interactions. Central to this investigation is the examination of design aesthetics, including color schemes, typography, and user interfaces, and their integral roles in crafting immersive, educational, and accessible digital environments. Through a comprehensive analysis of these design elements, the study aims to offer insights into optimizing online museum experiences, thereby enhancing visitor engagement and broadening the spectrum of cultural accessibility. This nuanced approach underscores the potential of digital art in redefining the parameters of museum exhibitions and visitor experiences in the digital

age.

This research aims to explore the integration of digital art with online museum exhibitions, aiming to reveal how such fusion can elevate the quality and depth of visitor experiences.

Results of the research and its discussion. The expanded analysis of these case studies highlights the transformative potential of digital art applications in online museums and the nuanced challenges they present. Balancing accessibility and authenticity, enhancing engagement and educational outcomes, and expanding museum reach against sustainability concerns are central to museums' ongoing evolution in the digital age. These findings underscore the need for strategic approaches to digital integration that respect curatorship traditions and cultural artifacts' intrinsic value. Future research should focus on developing comprehensive strategies to address the digital divide, exploring the balance between digital and physical experiences, and innovating sustainable models for digital content provision.

Overcoming the Digital Divide

The digital divide poses a significant challenge to the universal accessibility of cultural heritage, perpetuating disparities in digital literacy and access. However, initiatives like the Google Arts & Culture project have emerged as pioneers in leveraging technology to bridge this gap. By partnering with over 2,000 institutions worldwide, this project has revolutionized access to cultural heritage through virtual tours and high-resolution imaging of artworks, particularly benefiting marginalized regions [10]. This underscores the transformative potential of digital platforms in democratizing access to cultural resources. Despite progress, disparities in access persist, especially in rural and low-income areas with limited internet connectivity. Innovative solutions, such as offline access options and mobile exhibition units, are essential to ensuring universal access to cultural heritage regardless of digital connectivity. These efforts

align with the call for comprehensive strategies to address the digital divide and equitably distribute the benefits of digital cultural resources.

During International Museum Day, the Central Academy of Fine Arts (CAFA) Art Museum collaborated with Google Arts & Culture to launch a 3D virtual art gallery using AR, marking a significant milestone in China's cultural landscape. This virtual space, known as the Pocket Gallery (Fig.1), features nearly 40 labor-themed artworks from the 1930s to the 1970s, providing a unique and immersive viewing experience accessible via desktop and mobile web browsers. The user-friendly platform empowers museums to create personalized virtual exhibitions effortlessly, inviting a global audience to explore their collections. Google Arts & Culture's Pocket Gallery not only expands access to cultural heritage but also revolutionizes curatorial practices and exhibition planning. The incorporation of virtual curation courses into academic curricula, as demonstrated by CAFA, highlights the transformative potential of digital technologies in enhancing educational experiences and preparing future curators. The 360-degree digital technology not only enhances exhibition planning but also allows for more comprehensive and strategic curatorial decisions, ultimately enriching the viewing experience for audiences worldwide.

The collaboration between the CAFA Art Museum and Google Arts & Culture exemplifies the transformative impact of digital technologies in overcoming the digital divide and advancing cultural accessibility. By leveraging AR and innovative digital platforms, museums can broaden their reach, enhance educational experiences, and revolutionize curatorial practices, ultimately democratizing access to cultural heritage for audiences worldwide. As technology continues to evolve, initiatives like the Pocket Gallery offer new possibilities for museums to engage with diverse audiences and enrich cultural experiences in the digital age [11].

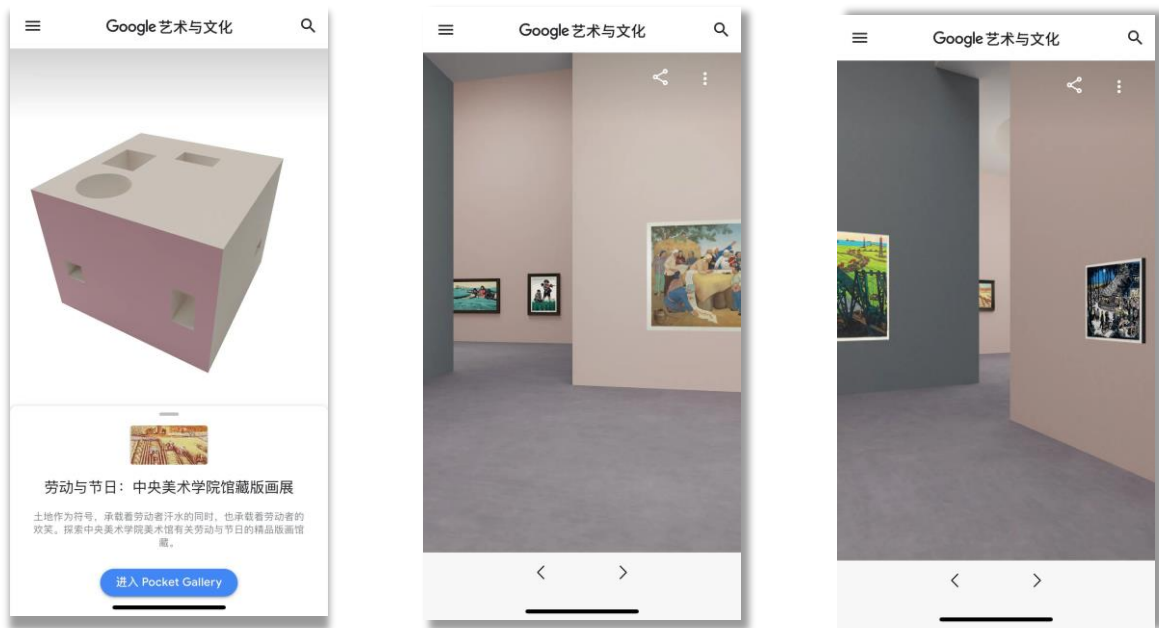
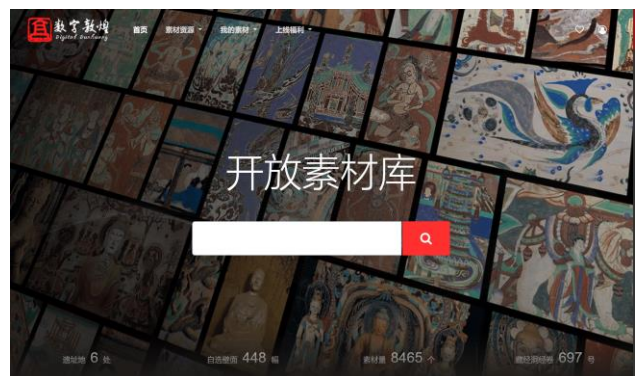


Fig.1. Pocket Gallery is an online exhibition project in collaboration with Google Art & Culture and the Central American Museum of Art [11].



a



b



c

Fig. 2. Digital Dunhuang Online Museum, China, 2024: a - Resource library, b - Open material library, c - Display of the Sutra cave based on VR technology [12].

Authenticity and Engagement in the Age of Digital Replicas

In the age of digital replicas, initiatives like Digital Dunhuang exemplify innovative approaches to preserving and presenting ancient cultural artifacts. By leveraging high-resolution digital scans and VR experiences, Digital Dunhuang not only safeguards fragile murals but also extends their accessibility to a global audience. However, this digital engagement raises questions about authenticity in cultural experiences, prompting a nuanced exploration of the relationship between technological advancements and traditional notions of cultural heritage.

Since the late 1980s, the Dunhuang Research Academy has spearheaded the «Digital Dunhuang» project, utilizing advanced computer and digital imaging technologies to preserve the cultural relics of the grottoes. The launch of the Digital Dunhuang online resource library in 2016 marked a significant milestone, integrating VR, AR, and interactive experiences to provide visitors with an immersive platform for exploring Dunhuang's culture (Fig. 2, a). In 2022, a collaboration with Tencent led to the introduction of the «Digital Dunhuang Open Material Repository» (Fig. 2, b), a blockchain-based platform offering access to over 6,500 high-definition digital resources, including archives from the Mogao Grottoes and the Dunhuang Manuscript Caves, facilitating sharing and innovation among scholars and cultural enthusiasts worldwide.

Digital Dunhuang harnesses VR technologies to offer an interactive cultural experience of Dunhuang, transcending geographical limitations and fostering global engagement with its rich heritage. By granting access to the intricate murals and vast caves of the Mogao Grottoes (Fig. 2, c), Digital Dunhuang enhances the social openness of cultural artifacts and ensures the modern inheritance of Dunhuang's intangible cultural legacy. Through these digital initiatives, Dunhuang's precious culture is disseminated and preserved for future generations,

underscoring the profound significance of integrating traditional culture with modern technology.

Digital Dunhuang exemplifies the transformative potential of digital technologies in preserving and presenting cultural heritage. While digital replicas expand accessibility and foster engagement, they also prompt reflections on the authenticity of cultural experiences in the digital realm. Nonetheless, initiatives like Digital Dunhuang demonstrate the power of technology to protect tangible heritage, enhance cultural engagement, and ensure the long-term preservation of invaluable cultural legacies [12].

The Role of Digital Platforms in Expanding Museum Reach

The Metropolitan Museum of Art's bold initiative to release over 400,000 high-resolution images of its collection under a Creative Commons Zero license exemplifies the pivotal role of digital platforms in extending the reach and impact of museums. This open-access approach has facilitated diverse engagements, from scholarly research to creative endeavors, significantly amplifying digital interactions with the museum's vast collection (Fig.3) [13]. Notably, the initiative has spurred a remarkable surge in website traffic and social media interactions, highlighting the transformative potential of digital platforms in transcending physical boundaries and fostering a more inclusive cultural dialogue. However, the sustainability of providing free digital content raises valid concerns, necessitating innovative revenue models to sustain the ongoing digitization and accessibility of museum collections [14].

Bloomberg Connects, an innovative application developed by Bloomberg, redefines the museum experience by offering a comprehensive suite of features. Through its digital guides, expert commentary, diverse tours, and global exploration opportunities, Bloomberg Connects revolutionizes the way visitors engage with cultural institutions.

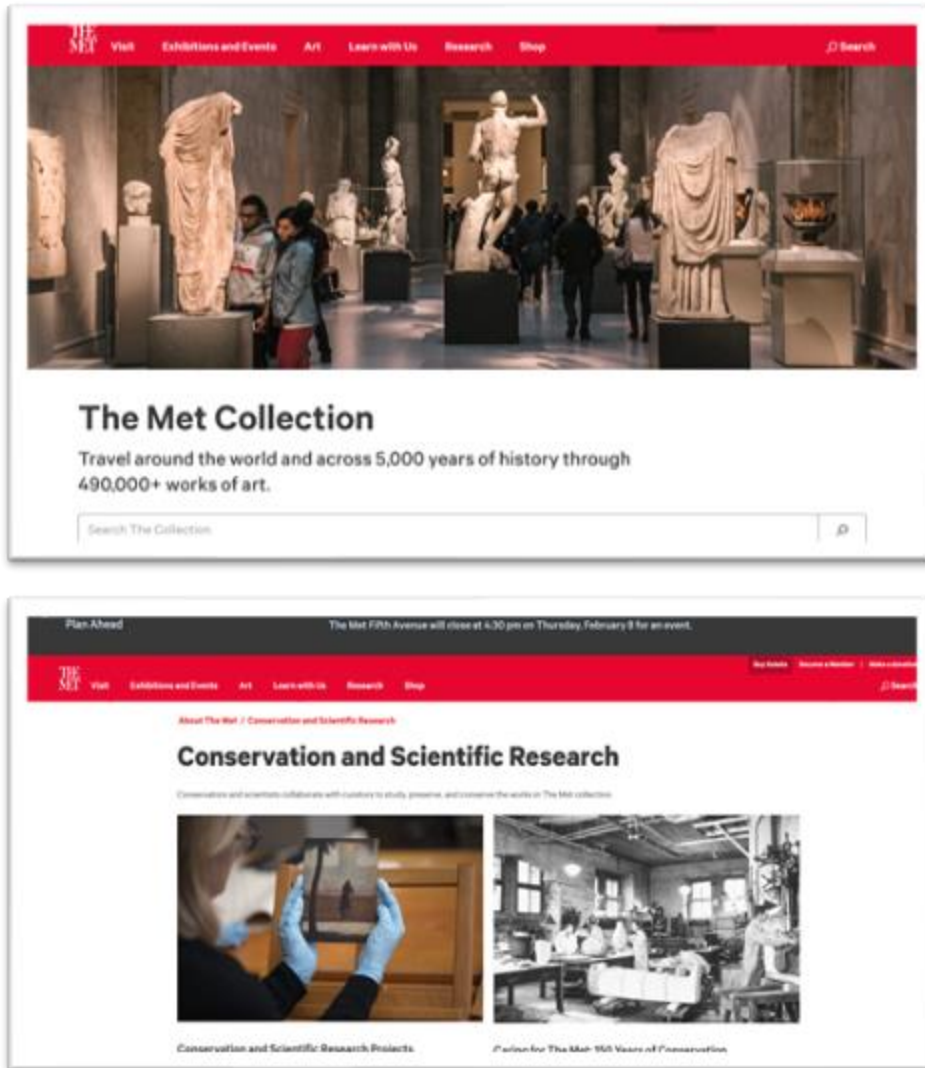


Fig. 3. Metropolitan Museum of Art open access, USA, 2024 [13].

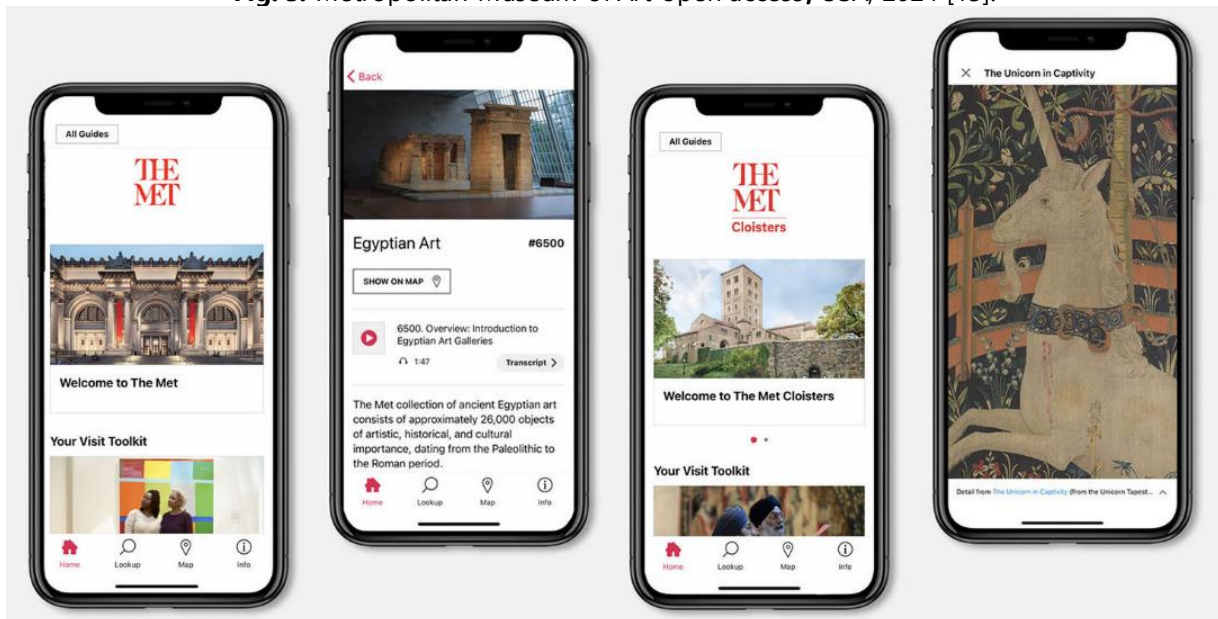


Fig. 4. Bloomberg Connects at The Met, USA, 2024 [15].

Seamlessly facilitating access to both The Met Fifth Avenue and The Met Cloisters (Fig. 4) [15], the app empowers visitors to plan their visits with ease, eliminating the need for cumbersome physical guidebooks and enhancing overall visitor preparedness and convenience. A key highlight of Bloomberg Connects lies in its expert commentary, which enhances visitors' understanding and appreciation of artworks. The audio guides delve deep into the significance and context of exhibits, providing a personalized and enriching educational experience for visitors. Catering to diverse interests, the app offers a range of audio tours, from general highlights tours to specialized options tailored for families and music enthusiasts. Multilingual support further enhances accessibility and inclusivity, ensuring that visitors from all backgrounds can fully immerse themselves in the museum experience.

Beyond the confines of The Met, Bloomberg Connects serves as a gateway to cultural institutions worldwide, providing access to over a hundred museums and galleries. This global connectivity promotes cultural exchange and fosters a sense of interconnectedness among audiences worldwide. By leveraging digital resources and identifying artworks featuring Audio Guide content, visitors can maximize their museum experience, delving deeper into exhibits and enriching their overall visit.

As museums continue to embrace digital innovation, Bloomberg Connects emerges as a trailblazer, reshaping cultural experiences in profound ways. Through its seamless accessibility, expert commentary, diverse tour offerings, and global connections, the app elevates visitor engagement and heralds a new era in museum visits, reaffirming the transformative power of digital platforms in the realm of cultural institutions.

Analyzing the Design Features of Online Museum Exhibitions

The integration of Information and ICTs into the museum sector, while primarily focused on digitization, virtual tours, and enhancing

visitor engagement through AR and VR technologies, also encompasses crucial design aspects such as color, typography, and interface design, which play a vital role in the overall online museum experience. The evolution of digital museums has not only been about shifting from physical to digital but also about how these digital spaces are designed to appeal to and engage audiences.

Color Usage in Online Museum Design

The use of color in online museum exhibitions is pivotal for creating visually appealing and emotionally resonant experiences. For instance, the Digital Dunhuang project leverages color palettes that reflect the historical and cultural significance of the artifacts, employing warm earth tones to echo the natural pigments of the ancient murals. This thoughtful application of color not only enhances aesthetic appeal but also aids in storytelling, guiding visitors through the virtual exhibition in a way that is both informative and evocative.

Graphics and Visual Elements

Graphics and visual elements are integral to the digital representation of artifacts and exhibitions. High-resolution images, 3D models, and interactive graphics are utilized to offer detailed views of objects that might not be as accessible in physical exhibitions. The Metropolitan Museum of Art's initiative to release over 400,000 high-resolution images under a Creative Commons Zero license exemplifies the importance of graphics in making art universally accessible and engaging. These visual elements are designed to be both informative and immersive, allowing users to explore artifacts in unprecedented detail.

Patterns and Textures

Patterns and textures in online museum designs contribute to the depth and authenticity of the digital experience. In the case of Digital Dunhuang, the intricate patterns and textures of the murals and manuscripts are meticulously recreated digitally, providing a tactile sense of the artifacts. This attention to detail not only enriches the visual experience but also serves an

educational purpose by highlighting the craftsmanship and artistic techniques of ancient cultures.

Layout and Typography

The layout and typography of online exhibitions are critical for ensuring a seamless and intuitive user experience. Effective layout designs facilitate easy navigation through the exhibition, with clear hierarchies and logical flows that guide the visitor from one section to another. Typography is equally important, with readable fonts and carefully considered text placement enhancing the accessibility and comprehension of information. For example, Google Arts & Culture's platform showcases exemplary use of layout and typography, with clean lines, ample white space, and legible fonts that make vast amounts of information easily digestible.

Conclusions. This study synthesizes the imperative role of design elements like color,

graphics, patterns, and layout in enhancing digital museum exhibitions. Recognizing their influence on creating immersive, educational digital spaces, this research underlines the significance of strategic design in offering global access to cultural heritage, urging continued exploration of design principles for future digital exhibition innovation. Additionally, the research delves into the transformative effects of digital art in online museums, tackling challenges of cultural heritage democratization and authenticity preservation. It advocates for future strategies to maintain museums as vibrant cultural, educational platforms, contributing to discussions on digital technology's role in cultural heritage. This work marks a step towards understanding the interplay between digital art, online museums design, and audience engagement, setting the stage for further inquiry into this dynamic relationship.

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ДИЗАЙН ДОДАТКІВ ДЛЯ ДОСТУПУ ДО ТВОРІВ ЦИФРОВОГО МИСТЕЦТВА ОНЛАЙН-МУЗЕЇВ

Мета. Дослідження спрямоване на вивчення інтеграції цифрового мистецтва з онлайн-виставками в музеях, фокусуючись на дизайні інтерфейсів додатків та музейних експозицій.

Методологія. У дослідженні використовується змішаний підхід, що поєднує теоретичні дослідження, аналіз наукових досліджень з аналізом практичних прикладів.

Результати. Встановлено, що застосування цифрового мистецтва значно впливає на музейні онлайн-виставки, сприяючи більш інтерактивному, імерсивному та інклюзивному доступу відвідувачів. Інтеграція ІКТ у музейний сектор, хоча в першу чергу зосереджена на оцифруванні, віртуальних турах та підвищенні залученості відвідувачів за допомогою технологій доповненої реальності та віртуальної реальності, також охоплює важливі аспекти дизайну, такі як колір, типографіка та дизайн інтерфейсу, які відіграють важливу роль у загальному дизайні онлайн-музею. Проаналізовано приклади Центральноамериканського музею мистецтв, Онлайн-музею Дуньхуан, Метрополітен-музею, а також додатку Bloomberg Connects. Дослідження підкреслює важливість нарративного дизайну та підходів, орієнтованих на користувача, у дизайні онлайн музеїв для доступу до цифрової культурної спадщини.

Наукова новизна полягає в тому, що в роботі дістали подальшого розвитку принципи дизайну інтерфейсу цифрових додатків для доступу відвідувачів до експозицій онлайн-музеїв.

Практичне значення. Результати дослідження можуть бути впроваджені в сучасну практику проєктів музейного дизайну, сприяючи інноваціям у презентації артефактів культурної спадщини.

Ключові слова: цифрове мистецтво, онлайн-музей, дизайн виставки, дизайн інтерфейсу, цифрова культурна спадщина, доповнена реальність, віртуальна реальність, змішана реальність

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Цитування за ДСТУ: Zhao J., Yezhova O. Design of Applications for Access to Digital Art Works in Online Museums. *Art and design*. 2024. №1(25). С. 68–77.

[https://doi.org/
10.30857/2617-
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Citation APA: Zhao, J., Yezhova, O. (2024). Design of Applications for Access to Digital Art Works in Online Museums. *Art and design*, 1(25), 68–77.