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THE IMPACT OF AIGC TECHNOLOGY ON SMART MUSEUM DEVELOPMENT AND CULTURAL HERITAGE TRANSMISSION

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Abstract: The rapid advancement of artificial intelligence (AI) technology has significantly accelerated the development of smart museums, enhancing their capabilities in cultural preservation and inheritance. However, researchers have identified numerous challenges in integrating AI technology into traditional museum frameworks, particularly in advancing smart museum construction. This study employs a narrative review methodology and adopts the Diffusion of Innovations Theory as its theoretical framework to analyze the current state of digitalization and smart development in museums. It explores the application of Artificial Intelligence Generated Content (AIGC) technology in building smart museums, emphasizing its critical role in cultural heritage preservation, transmission, and interactive cultural education. This study aims to provide new perspectives and innovative strategies for smart museum construction to support museums' sustainable development in the digital era as there is limited financial support from governments.

Keywords:
Artificial Intelligence, AIGC Technology, Smart Museum, Cultural Heritage Transmission

1. INTRODUCTION

1.1. Each Word in the Subheadings Should be Capitalized

Your introduction should include a definition of your paper's topic and an explanation of its relevance to the International Journal of Applied and Creative Arts' (IJACA) theme. The introduction should clearly reflect the central concern of your paper or the main argument of the paper.

1. INTRODUCTION

Museums serve as a bridge that connects the ancient with the modern and links the present with the future. It was stated by Chen Qian (2013) that museums are not only repositories for traditional tangible cultural heritage, but also play a crucial role in the preservation of intangible cultural heritage and play a key role in this. While museums play an essential role in preserving the memory of nature and human society, its also transmitting culture, educating the public, inspiring wisdom, cultivating feelings, and providing leisure and entertainment (Wang, 2022). According to Hong Lihua (2022), the diversity of display forms of museum artifacts has promoted the influence and spread of traditional Chinese culture. In fact, museums have a concentrated expression of national culture and world civilization.

With rise of social media has an impact to the way museums communicate with public in which these platforms are becoming the ideal, cost-effective, and interactive communication tools for museums given the high consumer participation through electronic word of mouth (eWOM). Further to this, the AIGC technology has become a core discussion in many organizations including museums as a cultural institution. Discussion on AIGC focusing on how it can significantly improve the connection between museums, visitors and public and contribute to the sustainability and management of the organization. Ciolfi & Bannon (2007) indicated that the core of AIGC technology lies in utilizing AI algorithms to generate creative and high-quality content, encompassing audio, text, image, video generation, and cross-modal generation. Brown (2020) noted that AIGC is a content-generating technology based on AI methods such as Generative Adversarial Networks (GAN) and large pre-trained models. Goodfellow (2020) discovered deep learning algorithms, represented by GANs, that provide strong technical support for AIGC. In 2018, NVIDIA released StyleGAN-XL, a model for automatic image generation (Sauer et al., 2022). In 2019, DeepMind introduced the DVD-GAN model (Clark et al., 2019), which can learn and understand human language for conversation and interactive chat. Open AI launched DALL-E in 2021 (Ramesh et al., 2021) and DALL-E-2 in 2022 (Marcus et al., 2022),

enabling secondary creations based on original images, marking the maturity of AIGC technology.

This paper primarily explores how AI-powered AIGC technology enhances smart museum development while contributing to the sustainability and management of the organization. The application of this technology not only better meets public demand but also significantly improves museum service quality and operational efficiency (Hao & Wu, 2024). AI technology provides new approaches and methods for the digital and smart development of museums, offering novel means and channels for the preservation and transmission of traditional culture while also fostering innovation in cultural dissemination and promoting the prosperity of the cultural industry.

2. LITERATURE REVIEW

2.1 Transformation Of Museums

In 2021, the National Development and Reform Commission of China, the CPC Central Committee Publicity Department, the State Administration of Cultural Heritage, and nine other ministries issued the "Guiding Opinions on Promoting the Reform and Development of Museums." This document clearly outlined two main development directions: first, vigorously develop smart museums, gradually achieving smart services, protection, and management; second, vigorously develop museum cloud exhibitions and cloud education, building an integrated online and offline museum communication system. Many researcher have defined smart museums from different perspectives. Song Xinchao (2015) and Wei Jun (2019) consider brilliant museums as an ecosystem from the standpoint of core business. Further explanation stated that smart museum as "an intelligent application ecosystem based on physical museum resources, utilizing next-generation network communication technologies such as the Internet of Things, cloud computing, mobile internet, and big data to serve the core business functions of museums (such as display, protection, service, and communication)." From the perspective of serving the public, Shi Chuankun (2018) views a smart museum as an innovative service model. He describes a smart museum as "a new model of museum development that is guided by the service needs of the public, led by the core business of physical museums, and enhanced through the application of new technologies to provide integrated, intelligent public cultural resources, offering menu-based, customized, and convenient services to the public. "From the perspective of technological iteration, Chen Gang (2013) and Shao Xiaolong (2015) believe that a smart museum can be expressed with a formula. They mathematically define a smart museum as "Smart Museum = Physical Museum + Digital Museum + Intelligent Museum + Internet Thinking," where the physical museum is responsible for the research, display, and visitor experience of cultural relics; the digital museum is responsible for the data processing, storage,

analysis, and expression of all museum components; and internet thinking is responsible for the collection and sharing of public wisdom. Although those researchers define smart museums from different perspectives, these definitions share some five common characteristics. Firstly, they are based on physical museums; second, they use network science and technology as tools; third, they aim to intelligent various types of data; fourth, they focus on the connection between people and objects; and finally, they aim for a user-centered service concept. By adapting the industrial sector that the concept of "Museum 4.0" has emerged.

This innovative classification reflects different stages in the development of museums. As stated by Zhang Zixin (2014) that Industry 4.0 represents a new industrial revolution era led by informatization and intelligent technologies. Similarly, Museum 4.0 signifies that the museum industry is entering a new development stage, characterized by a highly integrated, dynamic, collaborative network of "people-objects-environment-data." The current era we live in is the backdrop for Museum 4.0. Another study by Lin Shaoxiong (2018) shows that the development of museums and identified three important stages or forms of museum evolution. In the Museum 1.0 era, museum space design mainly exhibited a "container-like" characteristic, focusing on basic functionality. With the advent of Museum 2.0, exhibition space design significantly improved, with designers creating dedicated spaces for each exhibit and striving to make the museum architecture an artwork. Interestingly in the Museum 3.0 era, the artistic value of the architecture and the display value of the space were given equal importance, transforming museums into comprehensive venues for various cultural experiences. Although the formation of Museums 1.0, 2.0, or 3.0 demonstrate the evolution by years, however it was considered under the category of traditional museums.

Following the rapid development of digital technology around 1987, museums entered the 4.0 era (the digital museum era). In this era, the narrative approach of museums underwent a fundamental change, no longer confined to traditional single-narrative modes but evolving towards more diversified and immersive directions. According to Fang Ling (2023), he believes that Museum 4.0 utilizes the most advanced technological means to enrich exhibition content and forms while enhancing audience interaction experiences. By engaging the multiple cognitive senses of the audience, it aims to achieve "multi-sensory cognition." Smart museums, on the other hand, are new types of museums formed by continuously evolving and developing technologies based on the digitalization of traditional museums. The transformation of museums in China has promoted the upgrading of traditional museums. This extension of digital museums allows cultural relics to transcend time and space, presenting themselves in richer forms and with deeper content.

2.2 Current Status of Museum Development under the Background of AI

As AI technology is becoming increasingly important in various industries, modern museums have also begun to gradually apply this technology to play its multifaceted role. Some forward-looking museums have already introduced AI technology in corporate research and visitor services [Gong, 2023]. For example, the National Museum of American History held an exhibit, "Defense Innovation: Artificial Intelligence and Cybersecurity Challenges," in September 2017, which featured a specially designed AI network defense system designed to protect increasingly vulnerable devices from hacking. In 2018, the National Museum of Maritime Affairs of China introduced AI technology for information release verification and augmented reality large-scale construction. The guide screen of the exhibition hall is based on AI technology and enables a variety of functions such as personalized member services and intelligent questions and answers.

2.2.1 Digital Construction of Museums and Its Characteristics

At the end of the 20th century, with the development of digital technology, a new form of museum emerged - the digital museum. The digital construction of museums refers to the use of advanced information technology to comprehensively upgrade the transformation of traditional museums to improve display effects, management efficiency, and service quality. Museums are digitizing their collections and creating digital exhibition databases through high-resolution photography, three-dimensional scanning, and other technologies. After 2010, with the popularization of mobile devices, museums have developed mobile applications to provide guided tours, explanations, and interactive functions, promoting the development of museums towards intelligence (Gui, 2022). Visitors can receive exhibition maps, introductions, and descriptions of the exhibits through cell phone applications or devices for guided tours, and they can even use indoor navigation positioning technology to find exhibits of interest. Through the digital management system, museums can efficiently manage collections, dynamically adjust and update exhibitions, improve the accuracy and safety of cultural relics protection, and use data analysis and statistics to provide a scientific basis for decision-making (Zhang, 2023).

Combined with the existing digital museum constructions, digital museums have two display functions: the first is to realize the integration of exhibition information and guided tour information. The museum uses digital technology to establish a comprehensive service system that contains information on all cultural relics. Visitors can freely browse the information on cultural relics and change their way of visiting. For example, the map on the website of the Chinese Palace Museum **(Figure 1)** integrates the information on the exhibits and the guides. Visitors can choose the place they want to visit according to their needs. The pictures of various cultural relics

and collected artworks can be viewed and downloaded online. The visitors can freely navigate through the museum with high image clarity.

Figure 1. Chinese Palace Museum Website Guide Map

Secondly, virtual space exhibitions allow digital museums to integrate virtual displays with physical exhibits, enabling people to explore the real stories behind cultural relics and interact with them by entering the virtual space, thus establishing an emotional connection. This approach is widely used in cultural heritage preservation, and its effectiveness has been widely recognized. For example, at the 2010 Shanghai World Expo, the China Pavilion featured a large-scale dynamic version of “Along the River During the Qingming Festival” (see **Figure 2**), which combined the classic Chinese painting with 3D animation technology and giant screen projection to showcase the customs and life of the Song Dynasty (Liu, 2019).

Figure 2. Digital Display Chinese “Along the River During the Qingming Festival”

Another example is Digital Dunhuang, a digital project launched by the Dunhuang Museum (see Figure 3), which uses MR technology to digitize the treasures of Dunhuang, overcoming the limitations of time and space to meet people's interest in Dunhuang culture.

Figure 3. Digital Dunhuang Home Page Notes
Source: https://www.e-dunhuang.com

It can be seen that the process of museum digital construction is from simple exhibition and dissemination through interaction and participation to protection and research. It should be noted that different museums have differences in the process of digitization and intelligence. Some museums adopt these technologies earlier, while others start relatively late. With the continuous development and innovation of technology, the digital construction of museums has brought new development opportunities and challenges.

2.2.2 Intelligent Construction of Museums

Smart museums use advanced technology and digital means to combine traditional museums with digital technology to provide a richer, more interactive, and personalized visitor experience (Fang, 2023). The construction of smart museums includes the construction of museum infrastructure and the construction of AI systems for museums.

The first task of a smart museum is to complete the infrastructure build, including integrating management, service, control, and decision-making modules into a single system. With the help of 5G communication technology and artificial intelligence, these modules can be efficiently connected in series to improve the system's transmission efficiency and response speed (Yang, 2021). In this process, big data technology is the core, and the efficient connection is achieved through 5G, while the intelligent connection is done with artificial intelligence. Environmental data such as

temperature, humidity, and light collected by sensors and data on traffic flow and cultural relics monitoring are analyzed and processed by artificial intelligence to achieve intelligent management and optimization. In 2018, for example, the Beijing Palace Museum developed the "Play the Forbidden City" applet. In 2021, the project was upgraded to the "Smart Open" project. In order to achieve efficient data transmission, the project integrates 5G technology, uses big data to collect and analyze environmental data and visitor behavior accurately, integrates management, service, control, decision-making and other functions into one system, optimizes the museum's operation and resource allocation, and adds new functions such as online ticket purchase, exhibition reservation and online shopping, integrating the concepts of "zero waste," "age-friendly" and "barrier-free" to provide tourists with convenient inquiries, visits, and other services. The project also explored AR navigation capabilities in the Forbidden City, providing tourists a realistic experience.

The construction of an AI-integrated system in museums primarily refers to using intelligent systems to collect large amounts of data, analyze it to identify patterns and correlations, and then classify, clean, and integrate it to build a comprehensive database. This intelligent management and service approach enhances museum operational efficiency and drives the modernization of museum development. For example, the Los Angeles Natural History Museum installed hundreds of sensors to monitor temperature, humidity, light intensity, and visitor flow within the museum. The data collected by these sensors is analyzed by an AI system, helping the museum adjust environmental controls in real time to ensure optimal preservation conditions for artifacts (Los Angeles Natural History Museum, 2021). Similarly, the Metropolitan Museum of Art uses AI technology to analyze visitor behavior data. By assessing the popularity of different galleries and visitor interests, the museum optimizes exhibition layouts, adjusts the order of exhibits, and provides personalized recommendations to enhance the visitor experience (The Metropolitan Museum of Art, 2020).

The construction of AI application systems in museums primarily involves integrating systems for collections management, storage management, exhibitions, artifact conservation, public services, cultural product management, ticketing, and visitor flow monitoring and alerts (Gui, 2022). When designing these systems, it is essential to consider both current and future needs for intelligent development and extract relevant equipment and technical requirements (Zhang, 2023). The information systems in smart museums must also meet the needs of public areas, such as information inquiry terminals, multimedia displays, and smart navigation, supporting intelligent sensing, digital on-demand services, and automated responses. Museums can use relevant technologies to design electronic tags for artifacts, establish an intelligent integrated management platform for real-time tracking and remote

management, and create an audio service system and intelligent voice guidance network.

For example, on May 3, 2018, the Shanghai Museum completed the construction of an entirely data-driven digital management platform, transforming its management approach from “experience-driven” to “data-driven.” This system enables data interaction and collaborative work, allowing for real-time tracking and remote management of the museum’s collections, thus ensuring the safety and efficiency of artifact management. The Shanghai Museum has introduced the latest machine-learning technologies to analyze elements and features of ancient Chinese paintings using high-definition image data. By employing deep convolutional neural networks (CNN), the system extracts deep visual features through multi-level convolution and pooling operations at various scales, followed by object classification using Softmax. Position regression calculations were also performed to recognize object locations. After algorithm optimization, the machine learning model has stabilized, successfully extracting thousands of samples from dozens of feature elements, including mountains, trees, houses, pavilions, rocks, and boats. This provides a quantitative foundation for further applications such as clustering analysis, similarity matching, feature discovery, recreation of paintings, and machine learning-based curation, pioneering new methods for research on Chinese paintings (Liu, 2019). The AI application system must support various museum services, ensuring the foundational infrastructure's scientific and rational development.

3. METHODOLOGY

This paper adopts a narrative review method for research. Narrative reviews aim to identify and summarize what has previously been published, avoid duplications, and seek new areas for study that have not yet been addressed (Ferrari, R. 2015). Narrative literature review articles describe and discuss the state of the science of a specific topic or theme from a theoretical and contextual perspective. Such review articles do not typically list the types of databases and methodological approaches used to conduct the review nor the evaluation criteria for including articles retrieved during the database search (Bernardo et al., 2004). A narrative review critically analyzes the literature published in books and electronic or paper-based journal articles (Rother, 2007). Through a synthesis and qualitative analysis of the existing literature, this paper provides an in-depth understanding of the development status of AIGC technology in the process of smart museum construction.

Initially, relevant literature was searched in databases such as China National Knowledge Infrastructure (CNKI), Google Scholar, and Web of Science using

keywords like “AIGC,” “smart museum,” “digital museum,” “AI and cultural heritage,” and “generative AI.” The search covered articles, industry reports, and foundational literature on AI integration in museum practices from the past decade to build the theoretical foundation of this research. Key literature from the last ten years on topics such as digital museum construction, museum cultural preservation and transmission, and AIGC technology applications in museums was selected, while articles outside these topics or the defined timeframe were excluded. Finally, a thematic analysis was conducted to systematically summarize the role of AIGC technology in cultural heritage preservation, transmission, and educational interactions.

This paper applied the Diffusion of Innovation (DoI) theory (Figure 4) to explain the application and dissemination of AIGC technology within smart museums. The Diffusion of Innovation theory is a social process in which subjectively perceived information about a new idea is communicated. It is based on the premise that a new idea, practice, or object has observable channels, a timeline, and an adoption mode by individuals or organizations (Rogers, 1983). Diffusion is a specific “communication process by which an innovation, in the form of new ideas, practices, or products, is spread through certain channels, over time, among the members of a social system” (Rogers & Scott, 1997). From this definition, four main concepts arise—innovation, communication channel, time, and social system—which form the four core elements of the diffusion process (Minishi-Majanja et al., 2005). An innovation is defined as an idea, practice, or object perceived as new by members of a social system (Rogers & Scott, 1997). In other words, diffusion of innovation explains the speed at which new ideas and technologies spread. Marketers widely use the theory to understand how quickly consumers adopt new products or services (CFI Team, 2024).

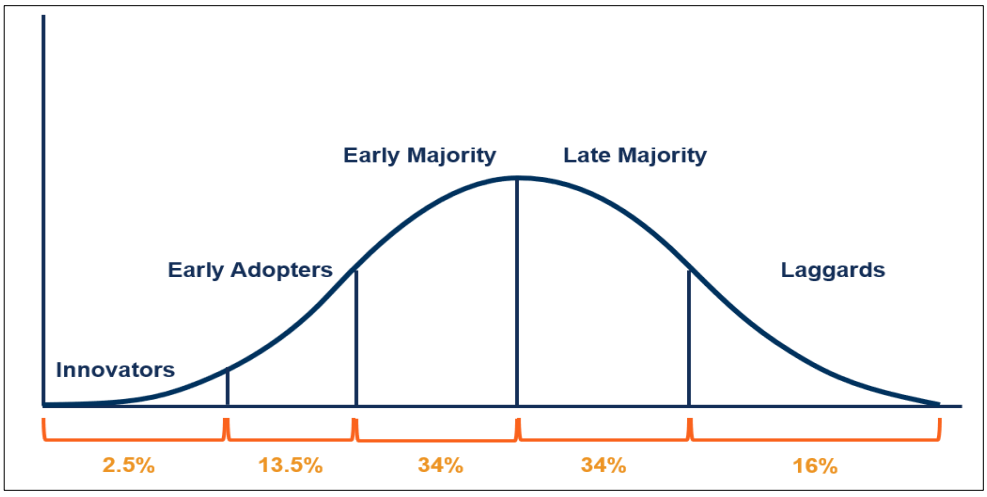

Figure 4. The Diffusion of Innovation Theory

In this paper, the Diffusion of Innovation theory helps analyze the innovative features of AIGC technology within museums, explaining the factors influencing its diffusion and guiding large museums to drive industry-wide adoption through a demonstration effect. Throughout the diffusion process, AIGC technology can showcase its substantial potential in areas such as cultural heritage digitization, personalized education, and interactive exhibits. Thus, by leveraging this theory, the paper can deeply explore the impact of AIGC technology on smart museum development and cultural heritage transmission.

4. DATA FINDINGS AND ANALYSIS

The above content introduces the development status of museums and the construction of museum intelligence under the background of artificial intelligence. In this section, we mainly analyze two aspects: one is the application of AIGC technology in smart museums, and the other is how AIGC technology can help museums inherit culture.

4.1 Application of AIGC technology in smart museums

The application of AIGC technology in smart museums is mainly explained from four aspects: the generation of personalized content, virtual exhibitions and immersive experiences, intelligent guides and services, and data analysis and management optimization.

4.1.1 Personalized Content Generation

When tourists visit a museum, their needs are different. AIGC technology uses big data to generate personalized tours based on tourists' needs and interests, recommend interesting exhibits, provide detailed background information about the exhibits, and optimize their visit experience. AIGC technology can generate and update dynamic exhibition content. For example, the history of the exhibition is dynamic, the background information is simplified, and the interactive games are lively. This not only enhances the cultural understanding of the exhibits but also enhances the educational value of the exhibitions. AIGC has powerful functions and can customize cultural and educational materials for tourists of different ages, including text explanations, video content, and interactive questions and answers, significantly enhancing the museum's educational value (Hao, M., & Wu, D., 2024). The content generation of AIGC technology improves tourists' interactive experience. Tourists can generate personalized responses through voice or AI interaction, create content (text, images, and videos) that is more suitable for social media, and dynamically adapt to the exhibition and visitors' feedback to attract more attention and participation.

4.1.2 Virtual Exhibitions and Immersive Experiences

Nowadays, museums are using AI technology to build digital platforms. Museums use 3D modeling and virtual reality (VR) technology to show realistic virtual exhibitions on digital platforms. Virtual exhibitions break geographical limitations, provide more diverse options for museum cultural relics display, and make exhibition content more prosperous and interactive (Kenderdine, 2016). AR technology overlays virtual content with the natural environment. Visitors can use smartphones or AR glasses to view augmented reality displays, enter an entirely virtual exhibition space, and experience historical events, cultural scenes, etc. This immersive experience allows visitors to experience a more accurate and interactive exhibition.

AIGC technology can digitize exhibits, build virtual exhibition spaces, and share data globally, allowing visitors to experience cultural relics and artworks in an immersive way. This makes it easier to understand the historical background and production process of museum exhibits. Visitors can get more information about the historical background, production process, etc., by clicking on the digital platform exhibits and watching related videos and animations (Smith, 2021). For example, in May 2017, the China Garden Museum held the "Seeing the 'Old Summer Palace'" digital experience exhibition, which selected 26 scenic spots such as the "Western Mansions," "Great Light," and "Diligent Government and Love for the People" from the Old Summer Palace. Modern digital technology was used to recreate the overall layout of the Old Summer Palace, providing audiences with a more intuitive and profound experience. In 2018, Baidu launched an AI project to present rich cultural heritage more intuitively and vividly to the audience; at the Mausoleum of the First Qin Emperor, users could use AI technology to photograph artifacts, making the Terracotta Warriors "speak" and allowing viewers to see the details of the armor from 100 meters away. In 2018, Google used AI technology to automatically identify 30,000 images for the Museum of Modern Art in New York and create interactive archives for the museum exhibition. These innovations not only enhance the visitor experience but also promote cultural dissemination and the realization of educational functions (Jiang, Zhao, & Zhang, 2023).

4.1.3 Intelligent Guide and Services

AIGC technology can generate personalized tour routes based on visitors' interests and history. By analyzing visitor preferences, the system can recommend exhibits they might find interesting and provide detailed background introductions and interactive content. For example, with the widespread use of smartphones, the rapid development of app software has significantly improved convenience. Apps can deliver information instantly and quickly, utilizing users' fragmented time and

increasing customer engagement during use, greatly enhancing visitor satisfaction (Yang, 2021).

In May 2019, the "5G Museum" was established at the Hubei Provincial Museum, achieving full 5G network coverage. The Smart Museum App transforms the traditional methods of disseminating text and images, enabling a "millimeter-level" display of a batch of precious artifacts such as the Zeng Houyi chime bells and the Sword of Goujian. The Zeng Houyi chime bells, over 2400 years old, are grand and resonant. However, since their excavation in 1978, the chime bells have only been struck three times, making the music they produce a curiosity for visitors. Through the Hubei Provincial Museum App, combined with VR gaming technology, visitors can wear VR equipment and use 5G to virtually strike the chime bells, experiencing the music-playing process as if they were there.

4.1.4 Data Analysis and Management Optimization

AIGC technology can collect real-time data through various sensors and devices within the museum, gathering information such as visitor behavior patterns, dwell times, and interaction frequencies. By analyzing this data, museums can better understand visitor interests and preferences, allowing for optimized exhibition content and layout. With advancements in machine algorithms, AIGC technology enables the optimization of big data and management in museums. For instance, when a large number of visitors are present, the museum can analyze visitor flow to efficiently position staff and security personnel and adjust environmental systems (e.g., lighting, air conditioning) through intelligent control systems, thereby optimizing resource utilization and reducing operational costs (Chen, 2023).

For example, the Data Center of the Shanghai Museum is a data analysis and management information system that relies on digital technology and is deeply rooted in museological principles. This system focuses on museum management by categorizing detailed information on personnel, venues, and exhibits to streamline process management. In terms of data collection, the center comprehensively covers collection information, visitor flow, social media influence, audience behavior patterns in exhibition areas, and sales records of cultural and creative products, providing a complete picture of the museum's core functions in collection care, academic research, and cultural dissemination. As for data application and analysis, the system delves into museum operational data, performs precise analysis, and vividly presents results through intuitive visualizations.

In summary, AIGC technology enables museums to achieve significant progress and innovation across multiple dimensions. With the evolution of robotics, deep learning,

and artificial intelligence, museums rapidly advance toward a new phase of comprehensive intelligent transformation.

4.2 AIGC Technology Assisting Museum Cultural Heritage Preservation

4.2.1 Cultural Heritage Preservation and Transmission

At the 2024 World Artificial Intelligence Conference, the capabilities of AIGC technology in ancient manuscript restoration were fully demonstrated. With high-precision scanning and intelligent analysis, this technology accurately captures details such as stains, missing strokes, and blurred characters on ancient manuscripts, enabling highly detailed restoration work. This allows damaged portions of precious manuscripts, like the Dunhuang manuscripts, to be meticulously revived, paving a new path for the long-term preservation and transmission of ancient texts (Hao & Wu, 2024). Compared to traditional artifact preservation methods, which may lead to accelerated aging and damage due to frequent displays, AIGC technology presents unparalleled advantages.

Firstly, this technology seamlessly combines digitalization with virtual reality to create intricate 3D digital models and virtual exhibition platforms for artifacts. This innovation ensures that artifacts can be preserved indefinitely without physical deterioration, significantly reducing the need for physical displays and effectively lowering the risk of damage due to human intervention. Moreover, it allows global audiences to appreciate the unique charm of these artifacts up close, regardless of geographic or temporal limitations. Secondly, AIGC technology's powerful data analysis capabilities enable continuous monitoring and assessment of preservation environments, including critical factors like temperature, humidity, and vibrations. This allows for precise predictions of potential aging trends and risks to artifacts, providing preservation personnel with timely scientific alerts and decision support to ensure artifacts are maintained in optimal conditions. Finally, AIGC technology also demonstrates irreplaceable value in the field of artifact restoration. Advanced image processing and simulation techniques aid in formulating more precise and efficient restoration plans, providing robust technical support for restoration work. This not only significantly enhances restoration efficiency but also ensures the accuracy of restoration and the authenticity of artifacts, revolutionizing the field of artifact restoration.

4.2.2 Cultural Education and Interaction

AIGC technology also plays a crucial role in advancing cultural research and education. As vital carriers of cultural heritage, museums hold a wealth of historical and cultural treasures; however, these valuable resources are often challenging to disseminate widely due to the high threshold for expert interpretation. Through in-depth digital methods, AIGC technology organizes and analyzes vast amounts of

historical documents, artworks, and artifact data, creating a more comprehensive and detailed knowledge repository for researchers and learners, significantly expanding the boundaries of knowledge accessibility. Furthermore, AIGC technology has transformed traditional cultural education by breaking free from static displays and conventional explanations, introducing more engaging and interactive educational experiences. Students can "travel through time and space" to experience the grandeur of ancient architecture, participate in re-enactments of historical events, and even engage in dialogues with virtual historical figures. This immersive learning approach greatly enhances students' enthusiasm and interest in learning, allowing the essence and value of cultural knowledge to be displayed in a more vivid and intuitive manner.

Additionally, AIGC technology has led to the development of interactive educational tools and gamified learning platforms, encouraging students to explore the cultural world more actively and passively. These innovative tools and games not only deepen students' understanding and retention of cultural knowledge but also inspire their creativity and critical thinking, breathing new life into cultural education through entertainment and exploration.

5. DISCUSSION

With the advancement and rapid updating of technology, museums' digitalization and intelligent transformation have accelerated. AIGC technology drives this transformation, enhancing smart museum construction, cultural preservation, and educational outreach. Firstly, AIGC technology can analyze visitor preferences to generate personalized tour routes, customized guide information, and immersive exhibitions, enhancing visitor interaction and making museum visits more enjoyable. For example, the British Museum uses VR and AR technology to offer virtual tours, allowing visitors to view recreated historical scenes through mobile and tablet devices, immersing them in the ancient world (British Museum, 2020). Similarly, the National Air and Space Museum in the United States uses motion-sensing interactive devices to let visitors simulate astronaut training, increasing engagement and interest (National Air and Space Museum, 2019). The Louvre in France has also implemented smart guidance systems that recommend exhibits based on visitor preferences (Louvre Museum, 2023). Secondly, as a "second classroom," museums can leverage AIGC technology to innovate educational models, generating interactive courses, themed games, and diverse learning experiences for children and visitors of all ages. Thus, AIGC technology supports museum visitor experiences and education, accelerating the transformation of museums. As discussed in the second section of this paper, AIGC technology promotes smart museum construction. Traditional in-

person museum exhibits are often limited by physical space and display format. Still, intelligent technology has opened up new formats, including online virtual exhibitions and digital artifact displays, alongside in-person personalized services and immersive experiences, enhancing online and offline visitor engagement. Moreover, based on big data, AIGC technology can generate personalized content, optimize resource management, and improve museum operational efficiency. AIGC technology can also digitize artifacts, create 3D models, and form virtual exhibitions, converting artifacts and historical scenes into high-precision digital representations. This digital transmission is not limited by time and space, allowing artifacts to be displayed and preserved in new formats, significantly expanding the scope and depth of cultural dissemination. This promotes a deeper understanding and resonance with culture, advancing digital construction and supporting smart museum development, cultural preservation, educational outreach, and intelligent management.

6. CONCLUSION

Artificial intelligence technology plays a crucial role in museum construction and cultural heritage transmission. Through digital and smart development, museums have enhanced service quality and operational efficiency and provided more prosperous and interactive visitor experiences. The application of AIGC technology, in particular, has opened new pathways for cultural heritage preservation and transmission, revolutionizing cultural education and interaction and promoting the modernization of the museum industry. Future research should focus on the following areas: first, further developing and improving AI technology to enhance its efficiency and effectiveness in smart museum development; second, exploring and documenting best practices of AI applications across different museum contexts to build a collection of successful case studies; and finally, strengthening interdisciplinary collaboration to foster more profound integration of AI with museology and cultural heritage preservation. Through these efforts, the goal of smart museum construction will be better realized, advancing cultural heritage preservation and transmission and providing new insights and methods for museum development in the digital age.

REFERENCES

Bernardo, W. M., Nobre, M. R. C., & Jatene, F. B. (2004). Evidence-based clinical practice. Part II: Searching for evidence in information sources. Revista da Associação Médica Brasileira, 50(1), 1-9. British Museum. (2020). Augmented Reality Tour. Retrieved from https://www.britishmuseum.org

Brown, T., Mann, B., Ryder, N., Subbiah, M., Kaplan, J. D., Dhariwal, P., ... &

Amodei, D. (2020). Language models are few-shot learners. arXiv preprint arXiv:2005.14165. CFI Team. (2024). Diffusion of innovation: The rate at which new ideas and technology spread. Retrieved from https://corporatefinanceinstitute.com/resources/economics/diffusion-of-innovation/

Chen, G. (2013). Trends and challenges in the development from digital museums to smart museums. In Fusion, Innovation, and Development: Digital Museums and Cultural Strength Construction – Proceedings of the 2013 Beijing Digital Museum Symposium, 281-287. China Communication University Press.

Chen, Q. (2013). The role of museums in the protection of intangible cultural heritage (Master's thesis). Zhengzhou University, Zhengzhou.

Chen, X. (2023). Research on smart museum construction under digital。empowerment. Information System Engineering, (12), 94-97.

Ciolfi, L., & Bannon, L. J. (2007). Designing hybrid places: merging interaction design, ubiquitous technologies and geographies of the museum space. CoDesign, 3(sup1), 159-180.

Clark, A., Donahue, J., & Simonyan, K. (2019). Adversarial video generation on complex datasets. arXiv preprint arXiv:1907.06571.

Colby, C., & Parasuraman, A. (2016). The future of consumer decision making. Journal of Service Research, 20(1), 120-138.

Dai, T. (2023). Review of the development of smart museums. Museum Management, (2), 83-84.

Fang, H. (2023). Innovation paths of interactive cultural product design from the perspective of smart museums. Journal of Anshan Normal University, 25(4), 93-98.

Fang, L. (2023). Interaction design of knowledge graphs in smart museums (Master's thesis). Nanjing Academy of Art.

Ferrari, R. (2015). Writing narrative style literature reviews. Medical Writing, 24(4), 230-235.

Gong, Y. W. (2023). Attempts and thoughts on the application of AI scenarios in museums – A case study of the Shanghai Museum. Museum Research, (3), 30-36.

Goodfellow, I., Pouget-Abadie, J., & Mirza, M., et al. (2020). Generative adversarial networks. Communications of the ACM, 63(11), 139-144.

Hao, M., & Wu, D. (2024). Exploration of the construction and cultural heritage development of smart museums based on AIGC technology. Cultural Relics Identification and Appreciation, (02), 76-79. https://doi.org/10.20005/j.cnki.issn.1674-8697.2024.02.019.

Hong, L. H. (2022). Analysis of the problems and solutions in museum cultural product innovation. China Nationalities Expo, 07(14), 211-213.

Hu, H. Y. (2020). Development trends from smart museums to AI museums – A case study of Hunan Provincial Museum. Beauty and Times (Urban Edition), (5), 89-91.

Jiang, S., Zhao, M., & Zhang, G. (2023). Analysis of the application progress of artificial intelligence generated content. Mobile Communications, 47(12), 71-78.

Kang, S., & Gretzel, U. (2012). Perceptions of museum experiences: A study of museum adoption of social media. Journal of Travel & Tourism Marketing, 29(1), 69-82.

Karras, T., Laine, S., & Aittala, M., et al. (2020). Analyzing and improving the image quality of StyleGAN. Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition, 8110-8119.

Kenderdine, S. (2016). Embodiment, entanglement, and immersion in digital cultural heritage. Journal of Cultural Heritage, 23, 326-331.

Lin, S. X. (2018). Material narrative and spatial integration in the Museum 4.0 era. Aesthetics Journal, 9(4), 18-23.

Liu, J. (2019). Exploration and practice of museum data visualization – A case study of the Shanghai Museum's digital construction. Museum Research, (2), 91-97.

Los Angeles Natural History Museum. (2021). Smart Sensor System for Environmental Monitoring. Retrieved from https://www.nhm.org

Louvre Museum. (2023). Smart Guide System. Retrieved from https://www.louvre.fr

Marcus, G., Davis, E., & Aaronson, S. (2022). A very preliminary analysis of DALL-E 2. arXiv preprint arXiv:2204.13807.

Minishi-Majanja, M. K., & Kiplang'at, J. (2005). The diffusion of innovations theory as a theoretical framework in library and information science research. South African Journal of Libraries and Information Science, 71(3), 211-224.

Museum of Modern Art. (2020). Digital Art Exhibition. Retrieved from https://www.moma.org

National Air and Space Museum. (2019). Interactive Astronaut Training Exhibit. Retrieved from https://airandspace.si.edu

Ramesh, A., Pavlov, M., & Goh, G., et al. (2021). Zero-shot text-to-image generation. International Conference on Machine Learning, 8821-8831.

Rogers, E. M. (1983). Diffusion of innovations (3rd ed.). New York: Free Press.

Rogers, E. M., & Scott, K. L. (1997). The diffusion of innovations model and outreach from the National Network of Libraries of Medicine to Native American communities: Draft paper. Retrieved from http://nnlm.gov/pnr/eval/rogers.html

Rother, E. T. (2007). Systematic literature review X narrative review. Acta Paulista de Enfermagem, 20, v-vi.

Sauer, A., Schwarz, K., & Geiger, A. (2022). StyleGAN-XL: Scaling StyleGAN to large diverse datasets. ACM SIGGRAPH 2022 Conference Proceedings, 1-10.

Shao, X. L. (2015). Advancing smart museum construction with an Internet mindset. Chinese Museums, (3).

Smith, J. (2021). Virtual exhibitions in modern museums. Journal of Museum Technology, 15(3), 45-58.

Song, X. C. (2015). Thoughts on the construction of smart museum systems. Chinese Museums, 32(2), 12-15.

The Metropolitan Museum of Art. (2020). AI-Driven Visitor Behavior Analysis. Retrieved from https://www.metmuseum.org

Wang, X. (2022). Investigation of museum audience preferences and influencing factors for cultural and creative products. Cultural Innovation Comparative Study.

Wei, J. (2019). New directions in the development of Chinese museums. Southeast Culture, (2).

Yang, Z. (2021). The informatization construction of museums in the era of big data – A case study of the information platform at the Palace Museum. Beijing Cultural Heritage Series, (3), 101-106.

Zhang, C. (2023). Brief discussion on digitalization and smart construction of museums. Smart China, (12), 72-73.

Zhang, Z. X. (2014). Wisdom in museum cultural products – Reflections based on 21st-century information technology and Industry 4.0. Museum Development Anthology, (0), 3-13.

Zhang, W., & Fan, K. X. (2019). Deciphering “homogenization” and exploring “new design”: Intelligent development and research of museum cultural products in the AI era. New Art, 40(4), 117-120.