

Research on the Digital Application of Museums under AIGC Technology

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Abstract: *With the rapid development of artificial intelligence technology, AIGC technology has become an important force in promoting the digital transformation of museums. This article explores the practice and impact of AIGC (Artificial Intelligence Generated Content) technology in the digital application of museums. Analyze the current application status of AIGC technology in museums, including cultural relic identification and appreciation, smart museum construction, and cultural and creative product design. Identify the issues in the application of AIGC technology, such as data quality and bias, balance between cultural heritage and innovation, and ethical and legal risks. In response to these issues, this article further explores corresponding countermeasures, including improving data quality, promoting cultural inheritance and innovation, and strategies to address ethical and legal risks. It emphasizes that while enjoying the convenience brought by technology, attention should also be paid to the depth and breadth of technological applications to realize the core values of museum research and inheritance.*

Keywords: AIGC technology; Museum; Digitize.

1. INTRODUCTION

With the explosive development of artificial intelligence technology, AIGC technology has become a key force in promoting the digital construction of museums. It is widely used in fields such as audio, text, image, video, and cross modal generation through the production of automatically generated content. The core of AIGC technology lies in using algorithms to generate creative and high-quality content, which provides museums with personalized and rich exhibition experiences, while also promoting audiences to better understand and learn cultural knowledge. As an important place for cultural heritage, museums can not only improve their management efficiency and service quality through the application of AIGC technology in the process of digitization, but also expand their influence and popularity, enrich the cultural experience of visitors, and promote cross-border cooperation and innovation between museums and other fields. Deng et al. [1] proposed a transformer-based financial fraud detection model with cloud-optimized real-time streaming, which enhances the efficiency and accuracy of fraud detection. Zhou et al. [2] optimized an automated garbage recognition model using ResNet-50 and weakly supervised CNN for sustainable urban development. Lyu et al. [3] introduced optimized CNNs for rapid 3D point cloud object recognition, improving recognition speed and accuracy. Wang and Liang [4] applied reinforcement learning methods combining graph neural networks and self-attention mechanisms in supply chain route optimization, achieving better optimization results. Zhao et al. [5] developed a CNN-Bi-GRU model for short and long-term renewable electricity demand forecasting, providing valuable insights into energy planning. Liu et al. [6] presented MiM-UNet, an efficient building image segmentation network integrating state space models, which significantly improves segmentation accuracy. Tian et al. [7] proposed an improved UNet for brain tumor image segmentation based on the GSConv module and ECA attention mechanism, enhancing segmentation performance. Shen et al. [8] explored the clinical application of an AI system incorporating the LSTM algorithm for anesthetic dose management in cancer surgery, demonstrating its potential in improving surgical outcomes. Xu et al. [9] discussed adversarial machine learning in cybersecurity, focusing on attacks and defenses. Shen et al. [10] analyzed a data-driven wealth management model powered by AI for robo-advisors, highlighting its advantages in personalized investment advice. Chew et al. [11] demonstrated how AI optimizes the accounting data integration and financial risk assessment model of e-commerce platforms, contributing to more accurate risk management.

2. AIGC TECHNOLOGY MUSEUM DIGITALIZATION RELATED CONCEPTS

2.1 Development of AIGC Technology

AIGC, The full name is AI Generative Content, translated as Generative Artificial Intelligence. AIGC technology has a wide range of applications in media, film and television, gaming, music, art, and other fields, creating new forms of digital content generation and interaction. The traditional design approach involves the logical thinking process of designers, from creative inspiration to the use of tools and the final presentation of the work. However,

the design approach based on AIGC technology can be divided into two aspects: on the one hand, designers provide semantic scenario conceptualization and data collection; On the other hand, artificial intelligence provides computation and generates candidate works, and the final obtained works are the joint product of humans and machines. The main applications of generative AI are text generation, audio generation, and image generation. Designers can use AIGC to assist in literary creation, music creation, painting creation, and drama creation to expand existing dimensions. AIGC technology continuously improves through deep learning and pre training, applying generative AI (such as Stable Diffusion, GANs, etc.) to the field of museum cultural and creative product design, bringing infinite possibilities.

2.2 Digital Construction of Museums

The digital construction of museums refers to the use of advanced information technology to comprehensively upgrade and transform traditional museum exhibitions, management, and services, in order to enhance the exhibition effectiveness, management efficiency, and service quality of museums. At this stage, museums utilize digital technology to record and store exhibit information. Through high-definition photography, 3D scanning and other technological means, the museum's collections are presented in a digital way, and a digital exhibit database is established. At the same time, the museum has introduced an intelligent navigation system to provide visitors with more convenient and personalized visiting services. Viewers can obtain exhibition maps, exhibit introductions, and explanations through mobile applications or navigation devices. In addition, the navigation system can also utilize positioning technology to provide indoor navigation for the audience, helping them find the exhibits they are interested in more conveniently.

Museums introduce digital management systems to achieve digital management of various aspects of the museum, including collection management, exhibition planning, cultural relic protection, ticketing management, security monitoring planning, cultural relic protection, ticketing management, security monitoring, etc. Through digital management systems, museums can manage their collections more efficiently, achieve dynamic adjustments and updates to exhibitions, and improve the accuracy and safety of cultural relic protection. Digital management systems can also assist museums in data analysis and statistics, providing scientific basis for museum decision-making.

The process of digital construction in museums can be summarized as follows: from simple display and dissemination, to interaction and participation, and then to protection and research. It should be noted that there may be differences in the process of digitization and intelligence among different museums, with some museums adopting these technologies earlier in certain aspects and others relatively later. With the continuous advancement and innovation of technology, the digital construction of museums has ushered in new development opportunities and challenges.

3. APPLICATION OF AIGC TECHNOLOGY IN MUSEUM DIGITIZATION

3.1 Data Analysis and Image Processing

Using AIGC technology for data analysis and image processing of museum collections can efficiently and conveniently assist museums in better understanding audience needs, improving exhibition planning, and optimizing cultural and creative product design. Through AI image processing technology, museums can automatically process the collection images required for cultural and creative product design, perform virtual restoration, and extract key cultural features and elements. For example, it can automatically recognize patterns, colors, textures, etc. with artistic value, as well as symbols and images related to historical culture. These restored images can provide reference for designers to better understand and utilize museum collections. After the fire, Notre Dame Cathedral in Paris can be 3D modeled using AIGC technology to better accurately restore its historical appearance. Museums can use the data analysis capabilities of AIGC technology to uncover potential creative and design elements in museum collections. By conducting in-depth analysis of a large amount of collection data, including information on the types, ages, and regions of artworks, as well as the styles and creative backgrounds of artists, museums can discover hidden associations and patterns.

3.2 Personalized Customization

Using AIGC technology, users can customize personalized artworks based on museum collections. This customized design approach can meet the needs of different audiences and enhance their sense of participation and

experience in museum culture. Technologies such as the Internet of Things, 3D printing, and additive manufacturing provide museums with personalized service buckets for flexible production. Museums can generate personalized product designs based on user needs and preferences, providing unique and customized solutions that meet user tastes.

3.3 Virtual Display and Interactive Experience

Through AIGC technology, museums can utilize technologies such as virtual reality (VR) and augmented reality (AR) to create immersive virtual exhibitions and interactive experiences, allowing visitors to gain a deeper understanding of cultural relics and artworks. On May 18, 2023, the Palace Museum collaborated with Tencent to develop a cultural and creative product called "Digital Palace Museum" to digitize cultural relics. This product is based on deep learning and image recognition technology. By scanning the cultural relics of the Forbidden City, it provides visitors with immersive experiences such as virtual exhibitions and holographic projections. Tourists can experience the tour visually and tactilely, showcasing a digital museum.

3.4 Social media promotion

Museums can utilize technologies such as intelligent algorithms and natural language processing to optimize social media promotion, thereby attracting more visitors to the museum. Social media platforms can use machine learning algorithms to predict topics, themes, and accounts that users may be interested in, in order to more accurately convey promotional activities to target audiences and provide personalized recommended content. Similarly, AIGC technology can be used for precise advertising on social media, and museums can use AIGC technology to analyze the profile characteristics of social media users, such as age, gender, interests, etc., and target advertising push accordingly.

4. THE HIDDEN DANGERS OF AIGC TECHNOLOGY IN MUSEUM DIGITIZATION

4.1 Beware of Data Quality and Bias

The performance of AIGC technology directly depends on the quality of the training data. If there is misleading or erroneous information in the training data, it may not only mislead the audience, but also damage the credibility of museums as knowledge dissemination and cultural heritage institutions. Therefore, ensuring the accuracy of training data is the primary prerequisite for applying generative artificial intelligence technology to museum storytelling. Data bias is another issue that cannot be ignored. The biases that may be hidden in the training data, such as social, racial, and gender biases, will be reflected in the content generated by AI, thereby exacerbating social inequality and misunderstandings. Museums, as public educational institutions, have a responsibility to ensure that the cultural information they disseminate is fair, objective, and unbiased. Therefore, effective measures must be taken to identify and eliminate data bias when applying generative artificial intelligence technology. The integrity of data is crucial for generating comprehensive and accurate historical narratives. If the training data is incomplete, the content of generative artificial intelligence technology may miss key historical events or details, leading to a one-sided understanding of history by the audience. Museums should ensure comprehensive coverage of training data in order to generate complete and coherent content.

4.2 Balancing cultural inheritance and innovation

The transfer of human autonomy and control can lead to a poverty of cultural innovation and creation. The traditional cultural dissemination content produced in batches will have a negative impact on key dimensions such as artistic and original quality of works or products. With the patterned setting of voice features and facial expressions, it can shape characters such as "digital human interpreters". However, it is necessary to maintain a clear understanding that traditional cultural AIGC itself has significant limitations due to its sequential data architecture and lack of discriminative information processing. In this operation process that follows the inherent pattern, it is inevitable to create a homogeneous perception among people. For example, a digital human guide, although following certain standards in appearance and movement, appears rigid and lacks depth in the vividness and infectiousness of the explanation, making it difficult to truly resonate with the audience's innermost feelings.

4.3 Examining ethical and legal risks

While AIGC technology promotes innovation in museum content creation and display, it also comes with a series of potential legal and ethical risks, the most prominent of which is the risk of infringement. Generative technology heavily relies on a large amount of training data to learn and generate content. However, these data are likely to contain copyrighted content, and if used without authorization, it may constitute an infringement of the intellectual property rights of the copyright holder. Therefore, when introducing technology, it is necessary to strictly comply with intellectual property laws and regulations, ensure that all training data used comes from legal and reliable sources, and obtain full authorization or permission from copyright holders before use. In addition, museums need to establish a sound content review mechanism to strictly control the generated content and ensure that it does not contain any elements that infringe on third-party intellectual property rights. Once potential infringement issues are discovered, the use of relevant content should be immediately stopped, and solutions should be negotiated with copyright holders proactively to maintain legal compliance.

5. CONCLUSION

AIGC technology is a powerful tool that can digitize museums into rich, engaging, and meaningful journeys. By weaving stories around objects, cultivating critical thinking, utilizing technology, attracting communities, and inspiring creativity, museums can create experiences that resonate deeply with audiences.

As an important cultural institution, one of the core tasks of museums is to study and inherit the rich value contained in cultural relics. AIGC technology can achieve multimodal content generation, create museums that meet the needs of the audience based on their instructions, and improve audience participation and satisfaction with museum resources. However, technological applications are not omnipotent. Overreliance on technology may also weaken the audience's ability to explore and learn independently, affecting their perception and understanding of the deep-seated value of cultural relics. Therefore, while using AIGC technology to enhance the experience, museums should strike a balance between technology and humanities, guiding visitors to explore the history and culture behind cultural relics while enjoying personalized services, and truly realizing the core values of museum research and inheritance.

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