

Research on AI-Driven Digital Protection and Artistic Re-Creation of Cultural Heritage

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Abstract: With the development of AI technology, it has been gradually applied in various industries. Its application in cultural heritage protection brings new opportunities and challenges. In the process of digital protection and artistic re-creation of cultural heritage, it is necessary to attach importance to giving play to the driving role of AI, break the limitations of traditional creation, and improve the quality of creation. From the perspective of cultural heritage, this paper analyzes the application of AI technology and puts forward specific practices of artistic re-creation, aiming to promote the digital protection and artistic re-creation of cultural heritage and provide references for the subsequent development of cultural heritage.

Keywords: AI-driven; Digital protection of cultural heritage; Artistic re-creation

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1. Introduction

In the development of human civilization, cultural heritage plays an important role as a carrier. It bears national memories, values and aesthetic tastes, and exists in various forms. However, it is easily affected by many factors, such as changes in the natural environment. The protection of traditional cultural heritage usually relies on methods like manual restoration and written records, which are generally inefficient and have incomplete information storage, making it difficult to meet the needs of cultural heritage protection in the new era. AI technology, with its excellent data processing capabilities, is widely used in various industries and provides new ideas for cultural heritage protection. AI-driven digital protection of cultural heritage can effectively collect data and conduct digital modeling, thus realizing the effective preservation and utilization of cultural heritage information. At the same time, AI technology empowers the artistic re-creation of cultural heritage, which can effectively break through the boundaries of traditional creation, endow cultural heritage with novel and diversified forms, and effectively stimulate the vitality of cultural heritage in the contemporary era.

2. Application of AI technology in digital protection of cultural heritage

2.1. Data collection and collation

In the digital protection of cultural heritage, data collection plays a fundamental role, and its accuracy and completeness

are related to the quality of subsequent protection work. Traditional data collection usually relies on manual measurement and hand-drawing, which not only consumes time and energy but also is easily affected by human factors, resulting in problems such as large data errors and information omissions^[1]. The integration of AI technology can address these issues and truly realize the automation and high precision of cultural heritage data collection.

For example, in the data collection of ancient buildings, AI technology can be integrated with 3D laser scanning, unmanned aerial vehicles (UAVs) and other technologies to quickly obtain 3D spatial data of buildings. AI algorithms can automatically identify building components in images, effectively eliminate redundant images and interference information, and adjust the shooting angle and distance in real time to ensure the completeness and clarity of image data. 3D laser scanning equipment can quickly locate the 3D coordinate data of ancient buildings, while AI technology can process the relevant data in real time, remove noise points on time, repair data gaps, and construct high-precision 3D building models^[2].

The application of the above methods not only helps to record the appearance of ancient buildings, but also can effectively capture relevant components and clarify specific detailed features, such as carved patterns and wood textures, providing accurate data support for the subsequent restoration of ancient buildings.

2.2. Data storage and management

Digital collection of cultural heritage involves a large amount of data, including images and 3D models. The data has high precision and fast update speed, which poses challenges to traditional data storage and management. Traditional storage usually relies on local servers, which have limited storage capacity and poor data security and reliability. They are easily affected by factors such as network failures and natural disasters, leading to data loss and damage^[3]. At the same time, traditional data management relies on manual work, making it difficult to retrieve and update data efficiently, thus affecting the utilization rate of cultural heritage data.

The effective application of AI technology can smoothly carry out cultural heritage data storage and management activities, solve the problems existing in traditional data storage, promote the intelligent and secure development of data storage, and effectively improve management efficiency. In terms of data storage, AI combines cloud computing technology to build a distributed cultural heritage data storage system^[4]. This system uses AI algorithms to intelligently analyze and classify cultural heritage data, and distributes data to different storage nodes for storage according to factors such as data importance, access frequency and data type.

For instance, cultural heritage data with high access frequency (such as photos of popular cultural relics and preview images of 3D models of ancient buildings) is stored in high-performance storage nodes to improve data access speed; data with high importance but low access frequency (such as original scanned copies of ancient books and documents and detailed detection data of cultural relics) is stored in storage nodes with high security and low storage costs, and multiple backups are made.

At the same time, AI technology can monitor the operation status of the storage system in real time. By analyzing data such as the load status of storage nodes, hardware performance and network bandwidth, it can predict potential failures and take timely measures such as data migration and hardware repair to ensure data security and reliability^[5]. For example, when a storage node shows signs of hardware failure, the AI system can automatically migrate the data on that node to other normal storage nodes and send an alarm to notify staff to carry out hardware maintenance, avoiding data loss.

3. Practice of AI-driven digital protection and artistic re-creation of cultural heritage

3.1. Practical case in the field of ancient buildings: The Palace Museum's "Digital Palace Museum" and AI cultural and creative design

The Palace Museum, once the imperial palace of the Ming and Qing dynasties, is one of the largest and best-preserved wooden ancient buildings in the world. It contains rich architectural art and has profound cultural connotations. To better

inherit the cultural heritage of the Palace Museum, it is necessary to attach importance to the implementation of digital protection. The “Digital Palace Museum” project flexibly uses technologies such as AI and virtual reality to conduct a comprehensive digital collection and modeling of the ancient buildings in the Palace Museum and create a corresponding 3D virtual space ^[6].

Based on the foundation of digital protection, the Palace Museum has strengthened cooperation with technology companies, flexibly used AI technology, and carried out artistic re-creation activities related to ancient architectural culture. In the process of artistic re-creation, AI technology can conduct in-depth analysis based on the 3D model of the “Digital Palace Museum” to grasp the typical artistic features of ancient buildings, such as the overhanging eaves and bucket arches of palaces. By grasping these artistic features and carrying out learning and modeling activities, AI can construct an artistic creation model with the architectural style of the Palace Museum’s ancient buildings.

Designers can input creative requirements (e.g., taking the Palace Museum as the theme to produce cultural and creative products), and AI can understand the creative needs and automatically generate design plans that conform to the artistic style of the Palace Museum’s ancient buildings ^[7]. For example, in the design of cultural and creative products for the Palace Museum, AI tools can extract the colored drawing patterns of ancient buildings, appropriately combine the needs of modern daily necessities, and automatically generate design drawings of cultural and creative products, such as porcelain, bookmarks and throw pillows. In the specific design process, AI can appropriately adjust the color and proportion of patterns to truly adapt to different product uses.

At the same time, AI technology can analyze consumer preferences and needs based on market feedback data, thereby effectively improving the design strategy. For example, AI tools analyze consumer data to understand the impact of the color of silk scarves on consumer preferences, and thus appropriately increase the colors favored by consumers in the subsequent design process, effectively improving the market recognition of cultural and creative products.

In addition, the integration of AI and virtual reality technology helps to create an immersive experience of the Palace Museum’s ancient buildings. Users can use VR equipment to enter the “Digital Palace Museum” space, not only to visit the buildings in the Palace Museum freely, but also to interact with the virtual scenes generated by AI ^[8]. For example, AI tools can capture the seasonal changes of the Palace Museum’s ancient buildings, generate virtual scenes of different forms in spring, summer, autumn and winter based on their specific characteristics, and users can participate in the virtual space to experience the beauty of the Palace Museum in different seasons. At the same time, users can use AI tools to carry out secondary creation of virtual ancient building elements, such as adding modern elements and adjusting the color of buildings, truly integrating cultural heritage with modern art.

3.2. Practical case in the field of traditional painting: AI-assisted artistic re-creation of Dunhuang Murals

The murals in Dunhuang Mogao Grottoes are one of the important treasures in ancient Chinese painting art, which contain excellent artistic and historical values. However, affected by the natural environment and the number of tourists, the Dunhuang murals are facing severe protection pressure. To better protect and inherit Dunhuang murals, the Dunhuang Academy has actively carried out digital protection projects, strengthened the application of advanced technologies such as AI, conducted digital collection and restoration of murals, and built a digital resource database of murals.

Based on this, the Dunhuang Academy has strengthened cooperation with universities and technology companies, flexibly used AI technology, and carried out artistic re-creation activities of murals. AI technology can mine the mural data in the digital resource database of Dunhuang murals, effectively carry out in-depth learning, and objectively analyze the themes, lines and composition characteristics of the murals. For example, AI tools can learn the Feitian (flying apsaras) images in Dunhuang murals and objectively summarize the characteristics of Feitian images, such as flexible postures and elegant dresses. At the same time, AI can identify the artistic styles of different Dunhuang murals and objectively grasp their differences, such as the elegant and delicate style of murals in the Song Dynasty and the bright and colorful style of murals in the Tang Dynasty.

In terms of artistic re-creation, AI can create works that contain the artistic style of Dunhuang murals according to different creative needs. For example, in the field of animation creation, AI can effectively extract the artistic characteristics of Dunhuang murals and use modern animation creation technology to produce animated short films with Dunhuang murals as the theme. In the specific animation production process, AI can generate characters and scenes that conform to Dunhuang murals, effectively improving the effectiveness of animation production. For example, the animated short film *Dunhuang Feitian* effectively restores the flexible beauty contained in Dunhuang murals with the help of AI technology, promoting the integration of traditional murals and modern animation.

3.3. Practical case in the field of folk literature: AI-enabled digital transformation and innovative dissemination of folk stories

Folk literature is an important part of cultural heritage, including myths and legends, folk stories, proverbs and ballads. It is the crystallization of the wisdom of the working people and bears the national cultural genes and values. However, with the acceleration of modernization and changes in lifestyle, many folk literature works are facing the risk of inheritance interruption. The traditional inheritance methods, such as oral transmission and written records, are difficult to adapt to the communication needs of modern society^[9]. The emergence of AI technology provides new ideas for the digital protection and artistic re-creation of folk literature. Through in-depth mining and analysis of folk literature text data, the digital transformation and innovative dissemination of folk stories are realized.

From the perspective of text data collation, the speech recognition function of AI can collate the oral recordings of folk stories and accurately convert them into text versions. For content involving local dialects, AI can conduct continuous sample learning to truly achieve high recognition accuracy. For example, when carrying out digital collation of Yi folk stories in Yunnan Province, the speech recognition system of AI can process the Yi language, convert the stories (such as the story *Ashima* narrated by elderly Yi people) into a bilingual text in Yi and Chinese, and appropriately identify the Yi characteristic vocabulary and folk cultural symbols in the text for corresponding annotation.

At the same time, the natural language processing function of AI can process folk literature texts, carry out activities such as part-of-speech tagging and semantic analysis, excavate information such as character images and thematic ideas contained in the stories, and actively build a folk literature database to lay a data foundation for subsequent artistic re-creation.

In terms of the artistic re-creation of folk literature, AI realizes the innovative transformation of folk stories mainly through methods such as text generation, visual presentation and multi-media dissemination^[10]. In the field of text generation, based on the story elements in the folk literature text database, AI can automatically generate new folk story works. For example, by learning classic folk love stories such as *The Legend of the White Snake* and *The Cowherd and the Weaver Girl*, AI summarizes the typical plot structure (encounter-love-obstacle-reunion) and character relationship mode of such stories. Users only need to input key information, such as the theme of the story (e.g., “friendship” or “courage”) and the background of the era in which the story takes place (e.g., “ancient times” or “future”), and AI can generate a new text that conforms to the style of folk stories.

At the same time, AI can adjust the language style and plot complexity of the story according to the needs of different audiences. For example, folk stories generated for children have simpler and more vivid language, simpler and easier-to-understand plots, and integrate educational significance; folk stories generated for young people will increase the twists and turns of the plot and the delicacy of emotions, enhancing the appeal of the stories.

4. Conclusion

In conclusion, in the development of human civilization, cultural heritage plays the role of a “living fossil.” The quality of its protection and inheritance affects the continuity of national culture and is related to the construction of cultural confidence. This study conducts a systematic research on AI-driven digital protection and artistic re-creation of cultural

heritage, and clearly and intuitively demonstrates the unique value and potential of AI technology. From the perspective of digital protection, AI technology has excellent data collection capabilities and conducts intelligent data management activities, which can break the limitations of traditional protection methods such as low efficiency and easy distortion, truly protect cultural heritage information effectively, and lay a solid foundation for subsequent artistic re-creation activities.

Disclosure statement

The author declares no conflict of interest.

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