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The Path of Innovation-Driven Development of Museums in the Era of Artificial Intelligence

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Abstract: *The advent of the AI era brings new opportunities and changes to the construction and development of museums. Faced with the emergence of AI technology in new era, how can museums use new technology to enrich their own attributes and integrate into the new era is a problem that we must face and think about. This article takes the museum the AI era as the research object, constructs the museum entity as the long-term goal, makes an exploratory judgment on the development of the museum under the background of the development of AI technology, and proposes an innovative development path, actively explores and explores effective ways to promote the transformation and innovation of the museum. Firstly, combined with practical cases, application and influence of current AI technology in modern museums are analyzed. Secondly, the problems that should be paid attention to in the current development of museums under the implantation of AI technology proposed, and finally the new path of the innovation and development of AI technology and museums in the future is proposed. The author can explore the development impact of sustainable development as a longterm goal, and provide feasible theoretical basis and construction suggestions for the development of museums under the implantation of future AI technology while promoting the development of modern museums.*

Keywords: *Artificial Intelligence, Museum, Innovation Path*

1. Introduction

In recent years, museums have been introducing advanced concepts and technological innovation into their construction and development, aiming to protect and disseminate culture, to bring a better sensory experience to visitors, which has become a topic of keen interest. Since the 21st century, the internet and digital information technology have thrived, new opportunities for museum construction, not only improving the visitor's exhibition experience but also enhancing the output of functions such as publicity, exhibition, education, and cultural infiltration within the, building a bridge and form for visitors to contact cultural relics content in both vertical and horizontal aspects. China's museums actively absorb foreign experience in construction, introduce digital technology museum construction, not only enhance the interactive relationship between the museum and visitors, but also use various digital media, such as: AR, VR, holographic imaging, digital interaction and other, to output rich display information to visitors in a vivid, interactive, and immersive display device, thus making the exhibition form more vivid and rich. After years of continuous practice, Chinas museum construction has accumulated a large amount of combat experience and can organically combine the existing digital technology with the museum, and apply it rationally. However, the arrival of "ificial intelligence" has become another driving force for the innovation of the museum.

Since 2022, AIGC, which was born from the field of natural language processing and machine learning, has people's attention. The key technology of AIGC is a smart system with the main functions of digital content twinning, intelligent editing of digital content, and intelligent creation of content. AIGC technology has highly intelligent applications, covering various fields such as painting, Q&A, programming, virtual people, etc. This has not only attracted widespread attention all walks of life but has also triggered active discussions on whether AI can replace or even surpass humans. AIGC (Artificial Intelligence Generated Content) has finally established itself in digital age after its own efforts over the past decade and has welcomed its moment. AIGC includes various modular AI technologies. AI technologies represented by ChatGPT are rapidly developing and constantly people's cognition in continuous iterations. When AI begins to be widely used in the public, accepted, and

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integrated into our lives, it is likely to play an important role various fields of society. Museums, as the main public cultural institutions, will also become a necessary part of it. Theoretically speaking, AI uses its digital technology to make construction have endless possibilities, which also means it will become an important part of the construction of smart museums. Therefore, in the near future, AI technology can bring more new opportunities and to the museum, and how the museum uses new technology to enrich its own display attributes and benefit from it is a problem that we must face and think about.

The State Administration of Cultural Relics first launched the pilot project of smart museum in 2014, further introducing technologies such as AI Internet of Things, big data and 5G into the museum field, aiming to create a new type of museum form that integrates the exchange and communication among the three elements of ", object and information". This also signals the continuous exploration of the development path of traditional museums and digital museums, and the emergence of a new concept and model in front of people How to achieve a new transformation of museums? The application of artificial intelligence technology has become a powerful guarantee for the transformation of museums. It can not only construct a new mode of exhibition, but also establish a complete database and efficient information processing and management efficiency. Actively exploring the application of artificial intelligence technology in museums not only helps to improve the rapid development of, promote the quality and efficiency of the dissemination of popular culture, and realize the innovation model of the content of the exhibition from passive exhibition to the demand of the public in the of artificial intelligence. At the same time, it can also promote the intelligent construction of museums to a new level of cross-science, cross-field integration and win-win collaboration.

2. Relevant concepts

The concept of artificial intelligence (AI) was proposed in the 1950s, and it has experienced a "three rises and two" development stage with ups and downs for decades. With the breakthrough of computing power and the application of deep learning in recent years, a new generation of artificial intelligence is booming globally, a new wave. At present, artificial intelligence is accelerating its implementation in various industries and fields, replacing manual processing of classification, recognition, decision-making, prediction, and even, and showing its advantages of low cost and high efficiency. From a general conceptual point of view, artificial intelligence is a high-tech science and technology based on information technology, with algorithms based on big data as its core, and with the goal of simulating, extending, and surpassing human intelligence. The field of artificial intelligence is vast, and computer vision, learning, natural language processing, robots, and voice recognition have always been regarded as the five key fields or core technologies of artificial intelligence[1].

AIGC, which is born from the field of natural language processing and machine learning, is considered to have the potential to lead a new of productivity revolution in the content industry. AIGC, translated from Chinese as artificial intelligence generated content, is generally considered to be a concept proposed relative to PGC (professional generated) and UGC (user generated content). AIGC (AI generate content) technology refers to the generation of various forms of content, such as text, images, and, through algorithms supported by artificial intelligence technology. Its implementation relies on various AI technologies such as deep learning, natural language processing, computer vision, and audio processing. In a narrow, AIGC is a production mode that uses AI to automatically generate content; in a broad sense, AIGC can be seen as an AI technology that has the ability to and create like humans, namely generative AI. It can generate new texts, images, music, videos, 3D objects, and other forms of content and data based on training and generative algorithm models[2]. As an artificial intelligence generation platform, AIGC contains various generative models applied in different fields, which can help people solve various complex tasks and promote the development of artificial intelligence technology (Table 1).

Table 1: Types of generative models under the AI generative platform

Model Name	R&D Institution	Parameter Count	Main Application Fields
Tongyi Qianwen	Alibaba Group	1.2 trillion	Natural Language Processing
ERNIE Bot	Baidu Inc.	260 billion	Natural Language Processing
GPT-3	OpenAI	175 billion	Natural Language Processing
BERT	Google LLC	340 million	Natural Language Processing
Transformer-XL	CMU & Google Brain	115 million	Natural Language Processing
T5	Google LLC	1.1 billion	Natural Language Processing
GShard	Google LLC	650 million	Natural Language Processing
BigGAN	NVIDIA Corporation	130 million	Image Generation
DALL-E	OpenAI	Not Disclosed	Image Generation

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3. The development of AI technology in museums

Although the application of AI technology in the museum is still in its infancy, some museums have introduced AI technology and opened up a new path of museum exhibition In the specific process of integrating AI technology into the museum, foreign museums have tried a series of attempts earlier than domestic ones.

3.1 Overseas Development and Application

3.1.1 Overview of Development

Since the 1990s, the impact of artificial intelligence has been paid more attention by foreign design research institutions. However, at time, artificial intelligence was in a period of development low tide, so there were few related research documents, and the main research was limited to the content of design knowledge base and computeraided design. Later, the continuous update of machine learning algorithms promoted the development of artificial intelligence, which led to the rapid development of artificial intelligence and went to a new climax. technologies such as decision and prediction, rapid recognition of images and patterns, and intelligent interaction of voice in the artificial intelligence block began to try to apply them to all kinds of museums. countries comprehensively promoted the development of this research, emphasizing the all-round experience of the audience in the museum and the interactive relationship with the exhibits during the research. It explores to effectively use artificial intelligence and other technical means in all aspects of the museum. Among them, Elena and others point out that artificial intelligence and other technologies play an irreplaceable role in enhancing the user experience, and comprehensively sort out the performance form and important promotion role of AI in the application of museums[3].

3.1.2 Real Case

In 2010, Google held an AI art exhibition called "DeepDream: Art of Neural" in San Francisco. This exhibition embodied the perfect combination of art and technology, and it was also a profound experience of technology integrated into painting, which attracted widespread attention from all walks life, discussing whether the artworks created by AI could be used as manually created artworks. In 2014, the Tate Britain Museum held an exhibition about the online. Visitors from all over the world could visit and interact with the exhibits in the exhibition hall through the robots controlled on the Internet[4]. This exhibition broke the traditional exhibition mode, and felt an unprecedented exhibition experience because of the intervention of artificial intelligence.

In 2018, the Cooper Hewitt Design Museum in the United States held an exhibition called "The Value of a Face," which cultural and creative works with multiple emotional recognition and eye-tracking technology. For example, the interactive device "Emotion Mirror" mixes the expressions of multiple visitors to create new portraits; device "Emotion Portrait" requires visitors to face the screen and make expressions such as happiness, anger, sadness, etc., and the portrait will be judged by these expressions determine the visitor's age, gender, personality traits, so that people can feel the charm of artificial intelligence (as shown in Figure 1).

Figure 1: Interactive device "Emotion Mirror"

In 2019, Microsoft, MIT and the Metropolitan Museum of Art in the United States jointly opened up a new path for museum display innovation First, art elements were randomly selected from the collections of the Metropolitan Museum of Art, and then these elements were trained by computer, and

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then these elements were randomly recombined through algorithms form a work of art. Visitors can also adjust the ratio of the elements generated by the artworks, and finally form an interactive process of artistic creation participated by the audience, whicheered a new path for the interaction between museums and visitors in the exhibition[5].

3.2 Domestic Development and Application

3.2.1 Overview of Development

Some of the museums in our country have begun transform, introducing cutting-edge concepts and innovative technologies into the museum field to protect cultural relics and spread culture, and to bring a better exhibition experience to the public. The application artificial intelligence technology in museums is the development trend now and in the future. As early as 2015, China issued "Made in China 2025" in which it was pointed out that intelligent manufacturing leads the transformation of manufacturing methods, and the transformation and upgrading of China's manufacturing industry has brought major opportunities for innovative development[6].In 2016, the "13th Five-Year Plan for the National Economic and Social Development of the People's Republic of China" proposed the development artificial intelligence. In 2017, artificial intelligence was written into the government work report for the first time; in July of the same year, the State Council issued theNew Generation Artificial Intelligence Development Plan"; in October, it was once again written into the report of the 19th National Congress of the Communist Party of China, comprehensively the deep integration of the Internet, big data with artificial intelligence and the real economy; in December, it issued the "Three-Year Action Plan for Promoting the Development of New Generation of Artificial Intelligence Industry". General Secretary President Xi mentioned artificial intelligence in his three speeches in December 2017[7].On May 18 2018, the International Museum Day, the State Administration of Cultural Relics and Baidu joined hands to launch the "Carrying Forward Civilization with Technology AI Museum Project", using technology to make cultural relics come alive. By 2018, China has continuously issued a number of related policies on artificial intelligence. Artificial has become a necessary driving force to promote the development of science and technology, and the state has also elevated artificial intelligence to an important strategy for national developmen[8]t.

3.2.2 Real Case

In 2017, the Qin Shi Huang Lishu Museum and Tencent Company carried out-depth cooperation, committed to building a multi-dimensional online and offline display of the museum. In terms of display form, it relies on a variety of technologies, including digitization the Internet, artificial intelligence, and big data, with mobile applications, interactive games, interactive social media, film and television media as carriers, and has developed a series of cultural creative interactive projects. The projects effectively combine digital technology with technology, not only enrich the visitors'visiting experience, but also make traditional art exude new vitality[9].

In 2017, the Shanghai Museum launched the "Dong Qichang Digital Humanities Comprehensive Display System" project[10].The project introduced artificial intelligence technology and applied convolutional neural network deep learning technology to analyze the constituent elements of Ming Dynasty paintings, such as mountains, forests houses, etc., and the elements of the picture can be accurately identified and classified under the intervention of artificial intelligence, thus constituting an automated mode of data capture and clustering materials. The project reflects the combination of artificial intelligence and the display system .

In 2002, the Palace Museum and Tencent began their cooperation, launching the "Little Lion" assistant for intelligent guided tours of the. This program leverages the Palace Museum's knowledge graph and artificial intelligence audio guide technology, achieving real-time interaction between AI and visitors. The "Little Lion" program acts a tour guide, accompanying visitors throughout the tour and providing explanations. It can not only engage in real-time voice Q&A with visitors during the tour but also provide personalized expressions actions based on the attributes of the exhibits, offering a fun and comprehensive guide service to the audience.

ISSN 2616-7433 Vol. 7, Issue 7: 69-75, DOI: 10.25236/FSST.2025.070711

4. Issues to be Noted in the Application of Artificial Intelligence Technology in Museum Construction

4.1 The Construction of a Standardized Resource Library

Although some of our country's museums have built and introduced artificial intelligence technology from the beginning of construction, and launched all kinds of exhibition participated by artificial intelligence, the application of artificial intelligence technology in the field of museums is still in the primary stage of development. The "Little Lion" intelligent guide of the Palace Museum above is precisely because the resource database was built more completely in the early stage of development, which laid a solid foundation for the subsequent data integration and development. Therefore, it can be that without data, without the tool of establishing knowledge clues from related data, the application of artificial intelligence is bound to be empty. The "Guiding Opinions on Promoting Reform and Development of Museums" issued by the Central Propaganda Department and other departments points out: "Accelerate the progress of collection digitization, improve the collection database and increase the opening up of basic information." "Promote the construction of a big data system for museums, actively connect with the construction of the national cultural big data system,, deconstruct and reconstruct the Chinese elements and signs contained in the collections, and truly integrate into content production, creative design and urban and rural construction, and give full play to the of museums in the integration and development of culture and tourism, and promote cultural consumption." Therefore, the data resource database should not only be built well, but also be built completely The construction should aim at in-depth mining and accurate presentation of knowledge, and the data should be properly referenced and related[11].

4.2 Strengthen the Application of Artificial Intelligence Technology

Today, artificial intelligence technology is advancing rapidly, and how museums should develop the background of the AI era is an issue that needs to be considered in the future. Museums should have a correct understanding of the essence of artificial intelligence technology in their development, play their unique resource advantages, combine their own resources with artificial intelligence, and develop in a benign way in line with the times. Although the development of artificial intelligence in the future is, and it can even replace human beings to play its unique role in many fields, we should have a correct understanding of artificial intelligence technology. It is just a tool that human beings in the process of development to help us create a better human society. Therefore, we should fully realize the application of artificial intelligence generation tools in knowledge production, resource management, data and other related content, and master the application of artificial intelligence technology in museums with a scientific construction paradigm[12]. In short, we should follow the trend of the times, actively explore and effective ways to promote the transformation and innovation of museums while promoting the development of modern museums, pay attention to the new requirements for museum construction in the AI era, locate the core driving for the development of museums, and foresee the direction of future development of museums with sustainable development as a long-term goal.

4.3 Focus on Exhibition Ethics and Morality

The rapid development of artificial intelligence has prompted museums to begin transforming, and due to the breakthrough of learning, the application of artificial intelligence technology in future museum construction will show explosive growth, and the future application prospects are worth looking forward to. However, it also brings a series of ethical and moral issues challenges to the internal construction of the museum. Here, we divide the ethical and moral issues into two aspects, namely, moral issues and issues[13].

Firstly, there is a moral issue. Although artificial intelligence is still in its primary stage of development at present, it has already brought many innovative to modern museums. Artificial intelligence has a strong "human-like" thinking and consciousness, which is also the main manifestation of consciousness carrier. In the fields of museum management, research service, exhibition display, etc., it can replace manual labor to achieve the reproduction and simulation of human behavior, and the efficient development of specific work. If it develops to the stage, the powerful functions of super artificial intelligence are unimaginable for us modern people. When people can't control the powerful artificial intelligence technology, moral issues will be more, such as a large number of artificial positions being replaced, the implantation of biased humanistic values, and the

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uncontrollable information output[14].

The second is the issue of privacy, which is a powerful guarantee for the construction of museum data resources and the fundamental of the sustainable exhibition of culturalics in museums. The business scope of the museum mainly revolves around the management, collection, research, exhibition, and education of collections, belonging to an integrated knowledge institution, which a place to preserve human cultural heritage, cherish national memory, and the excellent cultural genes of the country. Due to the different attributes of collections, it is not suitable to disclose all, so the construction of museums should pay special attention to privacy issues. With the development and integration of various artificial intelligence technologies such as AIGC, museum data resources and collection may be stolen inadvertently, causing a dilemma that cannot be intervened manually. How to control artificial intelligence technology while avoiding sensitive information and preventing the leakage of important information is a problem that need to pay special attention to[15].

5. The innovative path of artificial intelligence technology in museum construction

5.1 Improve the utilization rate of cultural relics resources

Behind every museum lies the cultural heritage and humanistic spirit of a city. As one of the four ancient civilizations, our country is extremely rich cultural relics resources in its museums, with countless cultural relics for people to appreciate and analyze. However, there are phenomena such as low utilization rate, lack of exhibition forms, low visibility. The existing exhibition of the collection is just the tip of the iceberg, which can't help but make people feel regretful. As the American Alliance of Museum (AAM) stated: "In the 21st century, artificial intelligence is essential for museum management of large-scale data"[16]. At present, the visible cultural relics on display in the museum are very limited, and a large number of cultural relics can only be in the special warehouse. For example, Xi'an Urban Rail Transit Project plans to build a total of 23 subway lines by 2030. Since the construction started in 1993, it has been 20 years so far. A total of 174 pieces of cultural relics were unearthed from Line 2; although Line 8 is still under construction, 1356 ancient tombs have been discovered; and Xi'an Airport Line been under construction for 9 years, and 9 emperors' mausoleums have been discovered along the way. The cultural relics unearthed are extremely precious and countless. The number of cultural relics unearthed during the construction of Xi'an Rail Transit is in the tens of thousands, and its historical span ranges from the Western Dynasty to the Ming Dynasty, covering 1800 years. Such a large number of cultural treasures can only be silent in the warehouse after unearthing, can only rely on the staff to manage the massive cultural resources. The advent of the era of artificial intelligence has brought new opportunities for the use of cultural resources. Firstly, we can use the big data platform to establish a sound collection management mechanism, establish a database of cultural relics, and build a multi-platform sharing among museums to improve the utilization rate of relics. Secondly, it can also enhance the diversity of display methods by using artificial intelligence technology, make the silent cultural relics come alive by using digital virtual technology, push digital cultural relics resources to the public, and show their unique humanistic charm.

5.2 Enabling Diverse Exhibition Formats

Traditional exhibition formats in museums involve displaying exhibits in a static, where visitors can only mechanically understand the stories behind the exhibits through static text and images. This static presentation style puts visitors in a passive role of accepting information, making it likely for them to experience aesthetic fatigue and affecting the effectiveness of information transmission. The arrival of the AI era has fundamentally changed traditional exhibition formats. From the perspective of visitors, they hope achieve a diversified and interactive dialogue mode with the exhibits. The emergence of AI technology has brought unprecedented innovative opportunities for the future exhibitions of museums. Through the application and construction of technology it is possible to truly liberate the exhibits from the shackles of static display and allow visitors to understand more history and culture from a sensory perspective, standing on the cloud platform AI technology. For example, immersive and interactive exhibition content, with the introduction of AI technology, can bring visitors into an unknown virtual world, making them feel as if they are the historical time and space at that time, witnessing the prosperity of ancient cities and deeply exploring the charm of ancient culture[17].

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5.3 Enhancing Human-Machine Smart Interaction Services

Before the arrival of the AI era, some of our museums have already strengthened construction of digital museums, but they are limited to the application of AR, VR, multimedia network platforms, etc. Although the digital construction has achieved certain results, which has realized the of traditional display forms and experience participation for museums, the application field is not broad. The digital museum lacks two-way interaction with visitors, only carries out one-way information output can not grasp the effect of information transmission, lacks the diversified smart interaction between people and exhibits, people and the environment, exhibits and the environment, and can not meet the collaborative between people-exhibits-environment. The arrival of the AI era prompts the digital museum to strengthen the smart interaction between humans and machines, so that the construction of future museums meet the needs of the times[18]. The direct application of AI technology can promote the development of museums in the direction of intelligence and wisdom, and bring more possibilities to the construction of museums.

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