



# Research on the Application Strategies of Digital Technology in the Protection and Inheritance of Traditional Fine Arts of China's Intangible Cultural Heritage

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**Abstract.** Traditional Chinese fine arts carry rich historical and cultural connotations as a long-standing art form. They are an important component of the inheritance of Chinese national culture and an important embodiment of the spirit and cultural aesthetics of the Chinese nation. However, preserving traditional fine arts faces challenges in modern societal development, including declining traditional craftsmanship and diminishing inheritors. The rapid advancement of computer technology has significantly influenced the preservation of traditional fine arts, offering new opportunities for their development and presenting innovative methods for their protection and continuation. This paper proposes practical strategies and measures for the digital preservation and inheritance of Chinese traditional fine arts. The goal is to promote their sustainable development, achieve a harmonious integration of tradition and modernity, and provide a valuable reference for preserving, developing, and applying traditional fine arts in contemporary society.

**Keywords:** digital technology; Intangible cultural heritage; Traditional fine arts; Protection

## 1 Introduction

Cultural heritage can be divided into two categories: material cultural heritage and intangible cultural heritage. Intangible cultural heritage refers to traditional cultural expressions that exist in non-material forms, are deeply intertwined with people's daily lives, and are transmitted across generations. China's intangible cultural heritage encompasses ten categories: traditional fine arts, folk literature, traditional music, traditional dance, traditional drama, folk art, traditional sports and entertainment (including acrobatics), traditional skills, traditional medicine, and folk customs. Traditional fine arts include paper-cutting, printmaking, embroidery, weaving, New Year paintings, and

sculpture (such as bamboo, wood, and stone carving), along with other related projects [1]. Currently, China boasts 417 national-level traditional fine arts projects. These art forms possess a long history and profound cultural significance, embodying the aesthetic tastes and value orientations of the Chinese nation while serving as an essential medium for preserving China's rich traditional culture. With their distinctive value system, traditional fine arts play a crucial role in various aspects, including cultural inheritance, emotional cohesion, and economic development. First, traditional fine arts are a vital component of the cultural identity of the Chinese nation, encapsulating its collective memory and values. Safeguarding and perpetuating traditional fine arts is equivalent to preserving the nation's spiritual homeland and enhancing public cultural confidence and identity. Second, traditional fine arts possess significant economic potential. Many regions leverage the heritage of traditional fine arts as a key driver for developing cultural industries, promoting innovation through models such as "intangible cultural heritage + tourism" and "intangible cultural heritage + creativity", contributing to the high-quality development of the local economy. Additionally, traditional fine arts hold unique emotional and educational value. Each piece of traditional artwork reflects the wisdom and dedication of its artisans while conveying specific emotional experiences and values. Engaging with and learning about traditional fine arts can help the public appreciate the national spirit, cultivate moral sentiments, and significantly enhance their aesthetic and overall literacy [2]. In August 2021, the General Office of the Communist Party of China (CPC) Central Committee and the General Office of the State Council issued the "Opinions on Further Strengthening the Protection of Intangible Cultural Heritage." This document outlines the overarching goals and key tasks associated with preserving intangible cultural heritage, essential for inheriting and promoting China's rich traditional culture and constructing a robust socialist cultural nation. Traditional fine arts exhibit unique characteristics that reflect their dynamic nature as an integral part of intangible cultural heritage. They are not merely static artifacts but represent a culture deeply intertwined with specific lifestyles and values. The vitality of traditional fine arts is sustained through continuous practice and transmission. Each generation of practitioners innovates by building upon the skills of their predecessors while adapting to contemporary needs, thereby infusing new life into traditional fine arts.

In the 21st century, humanity is undergoing computing, informatization, and digital technology revolutions. Digital humanities present a novel research paradigm for the study of the humanities. This field has evolved into a comprehensive framework for the interdisciplinary integration of various humanities disciplines, as well as a significant platform for research on memory and related topics. Key issues within the expansive domain of digital humanities include digital memory preservation, digital memory reconstruction, and digital memory performance. [3] Document No. 18, issued in 2005 by the General Office of the State Council of China, proposes using various methods—including text, audio recordings, video recordings, and digital multimedia—to systematically and comprehensively document intangible cultural heritage and establish a digital archive database. Data compression, editing and modification capabilities, low costs, and virtual reality applications characterize digitalization. With the rapid advancement and widespread adoption of digital technology, the digital preservation and transmission of cultural heritage has become a significant trend of our time. Digital research on

cultural heritage is currently a focal point in archaeology, art design, computer science, and history [4].

The digital preservation and development of traditional fine arts primarily focuses on the digital collection, storage, display, and utilization of cultural artifacts. Government departments have actively encouraged the participation, exploration, and research of institutions from both the social and natural sciences. Domestically, research has mainly concentrated on fundamental theoretical issues related to the digital preservation of traditional fine arts. Lu Huyuan [5] and colleagues examined the challenges of inheriting traditional fine arts and discussed the application of computer technology in their preservation. Zhang Yunzhong and colleagues [6] analyze data production and reproduction processes for digital resources related to cultural heritage from five dimensions: factors, technology, rights, culture, and value. They emphasize the integration of these dimensions and the interplay between virtual and real environments, rights allocation, and cultural innovation in constructing digital resources for cultural heritage. Zhao Jin [7] has proposed a digitally intelligent development pathway for cultural heritage, emphasizing three levels: technology, capital, and talent. Bai Jie et al. [8] suggest that digital humanities offer innovative approaches for integrating semantic descriptions, related organizations, and visual displays of intangible cultural heritage resources. However, some scholars argue that the digital preservation of intangible cultural heritage still primarily emphasizes digital reproduction and virtual representation. In contrast, digital resource development, utilization, and popularization remain relatively underdeveloped [9]. Internationally, countries such as the United States, the United Kingdom, and Japan initiated early research on the digitization of cultural heritage, encompassing early digital recording technology, digital synthesis processing technology, computer-generated virtual simulation graphics and animation technology, digital modeling and rendering technology, as well as augmented reality and virtual reality technologies. In 1965, Fielding [10] published professional technical books on film and television production, animated film design, and special effects creation, which significantly influenced subsequent research on the digitization of cultural heritage. Debevec [11] proposed a method for modeling and rendering cultural relics based on a limited number of still images, creating a virtual modeling approach for large-scale material cultural heritage scenes. Levoy [12] utilized digital technology to collect, process, restore, and display cultural heritage, applying it to the Digital Michelangelo Project. Sarah Younan et al. [13] argue that digitalizing cultural heritage integrates it into popular culture through methods such as 3D modeling. This innovation enhances participation in cultural heritage, presents it to a broader audience, and stimulates reflection on memory and identity. Overall, the digital inheritance and preservation of traditional fine arts in China have made significant progress, with many regions achieving digital collection, storage, and dissemination of traditional fine arts forms. However, due to limited resources and experience, the depth of digital preservation and inheritance of traditional fine arts remains insufficient, and several challenges still need to be addressed.

## **2 Application Strategies of Digital Technology in the Preservation of Traditional Fine Arts in China**

Protecting traditional fine arts is essential for studying China's art history and culture. China has a rich heritage of traditional fine arts; however, some art forms have been damaged or partially lost over time. Effectively restoring these damaged works is impossible without comprehensive data and information on traditional fine arts from earlier periods. Once traditional fine arts are compromised, their historical value diminishes significantly. Therefore, it is crucial to enhance the protection of traditional fine arts, as this also contributes to developing and preserving human culture. Digital technology plays a vital role in safeguarding traditional fine arts by offering innovative solutions for their protection through digital collection, restoration, storage, analysis, and display.

### **2.1 Multi-Dimensional Deconstruction: Expanding the Diverse Expressions of Intangible Cultural Heritage in Traditional Fine Arts**

Innovative approaches to cross-border integration should be actively pursued to safeguard traditional fine arts. First, it is essential to strengthen connections with relevant fields of study by incorporating the latest research findings from anthropology, folklore, aesthetics, and other disciplines to expand the theoretical framework of visual expression. A deep understanding of the origins and evolution of traditional fine arts and their production processes and aesthetic styles is crucial for grasping the cultural essence of various categories of traditional fine arts. Secondly, it is important to establish strong relationships with the inheritors of traditional fine arts. It involves understanding traditional fine arts's current status and challenges through field surveys, participatory observations, and other methods. Additionally, it is vital to document rich cultural memories, such as oral histories and family narratives, to help preserve and restore traditional fine arts.

In addition, cross-border cooperation should incorporate various art forms to promote the diverse development of visual expression. We can draw inspiration from the expressive techniques found in art, such as painting, sculpture, and poetry, while also engaging in digital aesthetic exploration related to composition, color, and imagery. For instance, creating shadow puppets allows for manipulating light and shadow, blending reality with illusion. The translucent puppets interact with the performer's movements, emphasizing the dramatic tension inherent in this art form. Another example is the filming of embroidery, which can draw inspiration from the delicate brushstrokes and poetic essence of gongbi paintings. Close-up shots can capture the subtle variations in embroidery stitches, showcasing Jiangnan women's soft charm and restrained emotions. In traditional fine arts, intangible cultural heritage archives primarily utilize paper texts and high-speed scanners for batch scanning, image correction, and optical character recognition (OCR) to enhance the efficiency of digital collections. Some ancient book archives employ high-resolution digital cameras to capture images. For audio-based intangible cultural heritage archives, such as oral histories, the industry has developed digital recording

tools, including oral history collection applications (apps), which facilitate the convenient collection and transcription of oral materials. Additionally, technologies such as 3D scanning and panoramic photography have been extensively adopted for bamboo weaving and carving handicrafts, significantly broadening the scope and depth of digital collections in traditional fine arts archives.

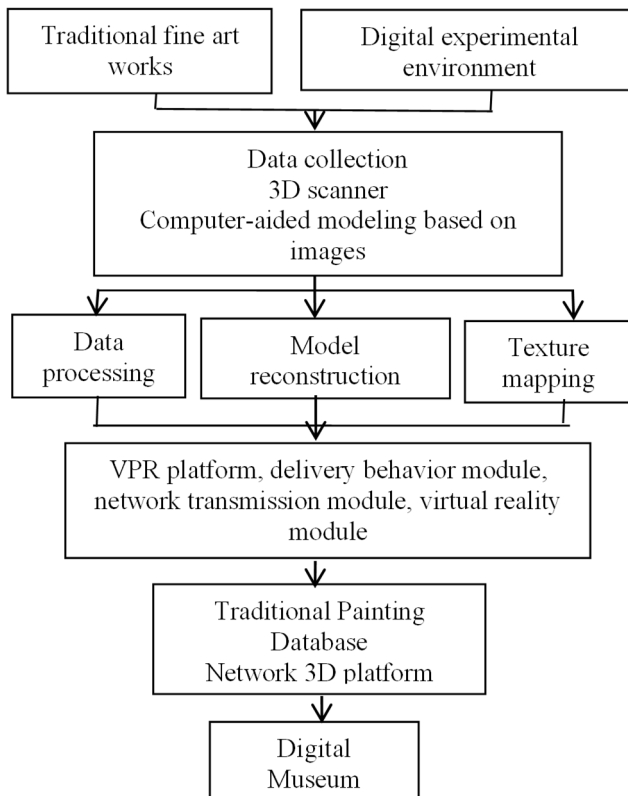
## **2.2 Intelligent Analysis: Digital 3D Imaging Technology Restores the Original Appearance of Traditional Fine Arts Works**

Traditional fine art pieces are invaluable resources, and the three-dimensional reconstruction of these works requires exceptionally high precision and lossless restoration. Technologies like three-dimensional laser scanning and hyperspectral imaging can capture traditional fine art with millimeter-level accuracy, thoroughly documenting physical attributes such as shape, material, and color. For instance, the Palace Museum employed multi-spectral scanning technology to conduct a layered analysis of the mineral pigment in "Thousands of Miles of Rivers and Mountains, a scientific foundation for subsequent restoration efforts. Research on key digitalization technologies for traditional fine arts focuses on data acquisition, processing, and reconstruction, which are both primary focuses and significant challenges. The most intuitive representation of the digitalization of traditional fine arts is the visual virtual display of these artworks. This method serves as the most effective means of digital preservation and inheritance. Virtual reality technology allows the public to genuinely experience the digital advancements in traditional fine arts, fostering understanding, protection, and dissemination of these cultural treasures. The virtual display of traditional fine arts can utilize the VR-Platform, a 3D interactive virtual platform developed by China Vision Digital Technology Co., Ltd. This platform can convert digital 3D models into real-time virtual reality formats. A virtual display solution for cultural relics has been developed using the VR tools platform, incorporating a built-in interactive behavior module and a network transmission function module. This design enables a web-based interactive virtual display of traditional fine arts. Ordinary users can browse and control digital restoration simulation models of traditional fine arts online. The digital virtual display scheme of traditional fine arts is shown in Figure 1.

## **2.3 Interconnected Drive: Empowering Digital Database Matrices for Traditional Fine Arts**

An interactive resource database revitalizes traditional fine arts through design transformation, interactive dissemination, and other functions. In May 2022, the General Office of the Central Committee of the Communist Party of China and the General Office of the State Council issued the "Opinions on Promoting the Implementation of the National Cultural Digitization Strategy." The "Opinions" clearly state that by the end of the "14th Five-Year Plan" period, a cultural digitization infrastructure and service platform should be established. It will facilitate forming a cultural services supply system that integrates online and offline interactions and provides comprehensive, three-dimensional coverage [14]. Which focuses on the "use of the cultural field has

been built or under construction digitization project and the results of the database, associated with the formation of the Chinese culture database, and encourage multiple subjects to build a cultural data service platform jointly”[15].



**Fig. 1.** Virtual display scheme of 3D models of traditional fine art works

Digitalization is the cornerstone of the matrix. Digitalization allows traditional fine arts archives to be liberated from conventional formats and transformed into editable data forms. This process enables the creation of a comprehensive dataset of traditional fine arts archives. As the primary driving force of the matrix, intelligent technology, with its advanced data analysis and pattern recognition capabilities, can thoroughly explore the cultural characteristics and artistic expressions embedded in these archives. Utilizing artificial intelligence technologies, such as machine learning and natural language processing, to perform semantic analysis, information extraction, classification, clustering, and text generation on archival data enables a precise understanding, structured classification, and engaging presentation of traditional fine arts archives. This approach enhances the structure and quality of knowledge related to traditional fine arts. Interconnected technology is vital in effectively linking traditional fine arts archival knowledge across various devices and platforms, creating a comprehensive knowledge network. In

the context of the Internet, establishing a traditional fine arts archive network platform enables users to easily access and utilize knowledge resources related to traditional fine arts, overcoming barriers such as culture, region, language, and time. This initiative enhances the usability and accessibility of traditional fine arts archival culture. Furthermore, online communication promotes the development of traditional fine arts archival knowledge and facilitates the acquisition of valuable insights through respectful exchanges with other cultures with intangible cultural heritage.

### **3 Application Strategies for Computers in the Inheriting of Traditional Fine Arts**

The dissemination of traditional fine arts plays a crucial role in preserving China's rich cultural heritage. However, with the rapid development of modern society, the mechanisms for inheriting traditional fine arts in China exhibit significant shortcomings. As a result, it has become increasingly challenging to scientifically and effectively preserve a vast array of cultural heritage, leading to difficulties in popularizing and promoting traditional fine arts. In response to these challenges, China has enacted a series of cultural heritage protection laws and regulations, including the "Cultural Relics Protection Law of the People's Republic of China. As policies continue to evolve and public interest in traditional fine arts grows, internet companies have begun to deeply integrate digital platforms with traditional fine arts, enhancing accessibility and engagement.

#### **3.1 Cross-Border Integration: Innovating Traditional Fine Arts Creation Methods Through Digital Technology**

The rapid advancement of digital technology has created unprecedented opportunities for innovation in traditional fine arts. By incorporating digital tools, algorithms, and interactive technologies, artists can transcend conventional media's limitations and expand their creative expression horizons. Combining computer technology with traditional fine arts is essential for preserving and innovating these art forms. Traditional fine arts often depend on manual techniques and conventional tools, while computer technology introduces new possibilities and challenges. It provides more convenient and efficient creative tools and platforms. In traditional fine arts creation, selecting materials and using tools can be time-consuming and labor-intensive. However, computer technology facilitates the digitization and automation of the painting process through software such as Procreate and Photoshop, drawing tablets, algorithms, and interactive technologies. This expansion of creative boundaries significantly enhances the efficiency and accuracy of artistic production. Furthermore, computer technology broadens the means and forms of expression available in traditional fine arts, overcoming the limitations imposed by conventional materials and techniques.

In contrast, computer technology facilitates the digital processing of paintings, image synthesis, animation, and various other forms of artistic expression. This innovation introduces a new artistic language and means of expression for traditional fine arts creation. Tools such as VR painting, Tilt Brush, and Quill enable artists to paint directly in

a virtual 3D space, allowing them to view their work from all angles in 360 degrees. Additionally, augmented reality (AR) enhances this experience; for instance, Adobe Aero transforms 2D paintings into dynamic scenes, making elements like fish-in-ink paintings appear as if they are swimming off the paper's surface. Computer technology enables the digital processing and multimedia display of paintings, facilitating the interdisciplinary fusion of traditional fine arts with digital art, video art, and other artistic forms. This integration opens new avenues for creating traditional fine arts. By combining computer technology with traditional artistic methods, we can broaden the means and forms of expression while enhancing the efficiency and accuracy of the creative process. Furthermore, this approach fosters innovation and collaboration between traditional fine arts and other art forms, infusing new vitality and energy into preserving and developing traditional fine arts.

Abbreviations such as IEEE, SI, MKS, CGS, sc, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.

### **3.2 Collaboration and Sharing: Utilize Online Platforms to Promote Traditional Fine Arts**

Using internet platforms to promote traditional fine arts can effectively broaden the audience, enhance cultural influence, and explore commercialization potential, thereby aiding in preserving and developing Chinese traditional fine arts. As a vital channel for information dissemination, internet platforms are characterized by their extensive reach and rapid dissemination speed, providing favorable conditions for promoting traditional fine arts. By establishing a professional platform for showcasing these works, traditional fine arts can be presented online digitally. Utilizing social media platforms such as Instagram, Pinterest, TikTok, YouTube, and Xiaohongshu (Little Red Book) to promote traditional fine arts can facilitate the widespread dissemination and sharing of these works. This approach attracts a larger audience to appreciate traditional fine arts and fosters viewer communication and interaction.

Furthermore, selling and trading traditional fine arts through e-commerce platforms like Taobao, JD.com (Jingdong), and Etsy can broaden the market for these works, enhance their popularity and influence, and create more favorable conditions for preserving and developing traditional fine arts. Additionally, traditional fine arts courses can be offered through online education platforms to promote accessibility and depth in traditional fine arts education, cultivate a new generation of artists, and infuse fresh vitality and energy into preserving and advancing these art forms. Therefore, leveraging internet platforms to promote traditional fine arts expands the channels of dissemination and audience reach, enhancing the popularity and influence of these works. It further encourages the integration and development of traditional fine arts within modern society, injecting new life and momentum into their preservation and evolution.

In the era of integrated media and advanced information technology, the Dunhuang culture has been continually enriched for global dissemination. Unlike traditional paper-based communication methods, such as newspapers and magazines, the current dissemination and preservation of Dunhuang culture primarily rely on digital platforms. This shift has led to the creation of new and diverse Internet media communication channels,

ultimately maximizing the benefits of integrating digital information resources related to Dunhuang culture. The WeChat official account of the Dunhuang Painting Academy has been actively promoting Dunhuang culture through its various sections. This initiative has achieved significant cultural influence while advancing modern cultural research, preserving cultural heritage, and cultivating a unique sense of cultural confidence. The official WeChat account, "Dunhuang Painting Academy," was established in 2014. It is committed to the principle of "Inheriting Aesthetics and Innovating for the Long Term." The official account consists of three sections: "Dunhuang Painting Academy," "Incredible," and "About Us." Fixed themes, such as "Dunhuang Study Tour," "Seeing Dunhuang," and "Incredible Dunhuang," are categorized under these three parts. The content includes the promotion and dissemination of information related to various activities, including Dunhuang art, cultural lectures, cloud classrooms, the popularization of intangible cultural heritage, cultural and creative collaborations, and salon classes.

### **3.3 Virtual Assistance: Developing an Intelligent Model for Traditional Fine Arts Education**

Developing an intelligent model for traditional fine arts education aims to enhance and advance China's rich cultural heritage in this field. This model integrates modern technologies, such as artificial intelligence and digital tools, with traditional fine arts instruction. It preserves the cultural essence of these art forms, improves teaching efficiency, personalizes learning experiences, and fosters interactivity. Ultimately, this approach enhances the effectiveness and quality of traditional fine arts education. The intelligent traditional fine arts education model can harness the virtual simulation environment provided by computer technology to offer students a more intuitive and engaging learning experience. Through virtual simulation technology, students can practice traditional fine arts disciplines such as painting and sculpture in a virtual setting, allowing them to appreciate the charm and atmosphere of these art forms while enhancing their interest and enthusiasm for learning. Furthermore, this intelligent education model can utilize personalized learning platforms enabled by computer technology to customize learning content and teaching plans according to each student's unique characteristics and needs, providing tailored support and guidance. Through these personalized learning platforms, students can choose their learning paths and methods based on their progress and skill levels, achieving individualized learning goals.

The intelligent traditional fine arts education model can leverage advanced tools provided by computer technology to enhance students' mastery of fundamental skills and theoretical knowledge in traditional fine arts. By utilizing these intelligent tools, students can quickly and accurately acquire essential techniques and creative methods, thereby improving their learning efficiency and effectiveness. Furthermore, this model can incorporate online communication platforms to facilitate exchanges and interactions between teachers and students, stimulating students' creative inspiration and potential while fostering innovation and development within traditional fine arts education.

### 3.4 Innovative Expression: Strengthening Cross-Border Collaboration Between Traditional Fine Arts and Modern Technology

Strengthening cross-border cooperation between traditional fine arts and modern science and technology aims to expand traditional fine arts' forms of expression and communication channels. This initiative seeks to promote the preservation and development of traditional fine arts by integrating their essence with modern science and technology innovations [16]. First, traditional fine arts can leverage modern technology in cross-border cooperation to explore new artistic expressions and innovative methods. For example, computer and digital media technologies can facilitate the digital presentation and virtual display of traditional fine artworks, infusing new vitality into their creation. Secondly, cross-border cooperation between traditional fine arts and modern technology can enhance communication channels and expand the audience's reach for traditional fine arts. Traditional fine arts can be promoted globally by utilizing contemporary technological platforms such as the Internet and social media, attracting a wider audience and encouraging collectors to engage with and appreciate these art forms. This approach fosters the international dissemination and exchange of traditional fine arts. Furthermore, the collaboration between traditional fine arts and modern technology can drive innovation and development in traditional arts education. By incorporating modern scientific and technological teaching methods and resources, we can improve the effectiveness and quality of traditional fine arts education. This integration can stimulate students' interest in learning and unlock their creative potential, cultivating a new generation of traditional fine arts talent and infusing fresh vitality and energy into preserving and advancing these art forms.

The "Thousand Mile Long River and Mountain Painting" is a quintessential example of Chinese painting and a classic of ancient Chinese art that has been preserved through the ages. Its methods of dissemination have undergone three successive transformations, reflecting a trend of coexistence among multiple dissemination techniques. The first transformation of the "Thousand Miles of Rivers and Mountains" was attributed to advancements in photography technology, the printing industry, and the Internet. Its high-definition images can now be appreciated globally through online platforms or in printed formats. The second transformation of "A Thousand Miles of Rivers and Mountains" marks a shift from static visual art to dynamic visual art, specifically transitioning from a "static image" to an "image flow." In August 2021, the digital intellectual property "Thousand Miles of Rivers and Mountains 3.0" was upgraded to "Painting a Thousand Miles of Rivers and Mountains - Immersive Art Exhibition of the Forbidden City" was showcased in Chongqing. This exhibition incorporated local cultural elements, further enhancing the interactive experience and strengthening viewers' sense of presence. The third transformation of "A Thousand Miles of Rivers and Mountains" involves its integration with music and dance, driven by a dynamic vision. This transformation bridges the cultural gap in painting, reconstructs the traditional art form, and establishes a new genre of "spatiotemporal art" in the contemporary era. Compared to paper-based dissemination, online image distribution, along with digital exhibitions and advancements in multimedia technology, has transformed the way famous paintings are shared across generations. This evolution has created a modern platform for spatiotemporal art

that retains traditional cultural elements in a "cross-media" format. This transformation deconstructed the elements of the image, facilitated media convergence and technological empowerment, and reconstructed its survival landscape through the dissemination and sharing of television and online media. [17]

## 4 Conclusions

Traditional fine arts represent a treasure trove of Chinese cultural heritage. Their unique artistic charm and profound cultural significance serve as a spiritual home for the Chinese nation. However, in the face of modernization, many traditional fine arts encounter challenges related to disrupted transmission and a lack of successors. Digital research on traditional fine arts is essential for their protection, preservation, and development. Utilizing digital technology to transform traditional fine arts represents a pioneering direction for comprehensive research and development in culture, science, technology, and art.

In the current context of technological advancement, it is a viable strategy to explore the essence of paintings through their appearance, reconstruct and recreate them using the power of technology and mass media, and imbue exceptional traditional paintings with widespread appeal. From a cultural perspective, presenting traditional paintings through vibrant and novel "space-time art" serves as an effective means to transcend the spatial limitations of dissemination and broaden their reach. Outstanding cross-media artworks, while evoking the aesthetic and cultural resonance of contemporary audiences, will undoubtedly enhance their "cultural confidence" and foster a deeper appreciation and affection for traditional Chinese painting, thereby promoting the development of contemporary art in a manner that is "shared by all."

This article thoroughly explores the development pathways and prospects for protecting and inheriting traditional fine arts in the digital era, contributing to their survival and advancement. It offers a fresh perspective and solutions for safeguarding cultural diversity in the context of globalization. This approach provides both theoretical support and practical guidance for preserving and innovating traditional fine arts. It fosters the inheritance and development of China's traditional fine arts while promoting the rich cultural heritage of the Chinese nation.

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