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Research on the Integration and Practice of Innovative Intelligent Technologies in Oil Painting Art Creation

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ABSTRACT

Currently, domestic oil painting creation in China faces challenges such as the interruption of traditional technique inheritance, the imbalance between creative efficiency and artistic texture, and difficulties in adapting to new materials. This study integrates literature research, technical testing, and empirical analysis to systematically organize the application logic of intelligent technologies—including artificial intelligence (AI), virtual reality (VR), and big data—in oil painting creation. Specifically, it constructs a three-level integration framework of "algorithm foundation - tool layer - application scenario," incorporating test parameters of technologies such as Generative Adversarial Networks (GANs) and Variational Autoencoders (VAEs). By analyzing practical cases of 50 domestic young oil painters and 200 of their works, the study identifies three human-machine collaboration models: auxiliary collaboration, interactive collaboration, and generative collaboration. To address pain points like brushstroke distortion and ambiguous copyright definition, it proposes a solution framework of "technical optimization - ethical regulation - ecosystem construction."The research shows that through the mechanism of "data-driven - manual calibration - full-process integration," intelligent technologies can increase creative efficiency by more than 300% while preserving the emotional warmth and cultural attributes of oil painting art. This provides a practical path for the innovative inheritance of domestic oil painting art in China.

KEYWORDS

Intelligent technology: oil painting creation; Technology integration; Human-machine collaboration; Domestic practice (China)

1 Introduction: Current Status and Dilemmas of Domestic Oil Painting Creation

Domestic oil painting creation in China is currently in a period of tension between "traditional inheritance" and "innovative breakthrough," presenting three core challenges: First, the inheritance of traditional techniques is at risk of interruption. A survey of 30 domestic art colleges shows that 62% of young oil painters report "insufficient training in manual brushstrokes." Over-reliance on photo copying leads to works lacking "brushstroke texture" and "vitality"; for example, only 15% of young creators can proficiently master the "multi-layer glazing" technique of classical oil painting. Second, creative efficiency is disconnected from market demand. In response to mass creation needs such as cultural and creative product development and public art customization, the traditional linear process of "sketching - coloring - revision" takes an average of 15-20 days per work, which cannot meet the rapidly iterating market demands. Some creators simplify the creative process due to efficiency pressure, resulting in rough work details.

Meanwhile, the application of intelligent technologies in China ' s oil painting field shows a "fragmented" characteristic: most creators only use AI for "style transfer" (e.g., converting photos into oil painting effects) or VR for "virtual sketching," without forming a full-chain integration covering "material analysis - creative assistance - conservation and restoration." For instance, an art studio used GANs to generate initial oil painting drafts, but failed to optimize them with material data —leading to a disconnect between the color system of the generated works and the color development rules of physical pigments, requiring repeated adjustments during subsequent manual coloring. Although the Dunhuang Academy uses AI to restore murals, this technology has not been extended to the daily creation of ordinary creators. This "technology island" phenomenon prevents intelligent technologies from truly solving the core dilemmas of domestic oil painting creation.

How to connect the inheritance of traditional oil painting techniques with modern innovation needs through the systematic integration of intelligent technologies? How to balance algorithm efficiency and the manual texture of oil painting art? Based on domestic practices, this study focuses on the cross-technological integration of AI, VR, and big data. Combining testing experiments and artist cases, it explores the path of "technology integration - practical implementation - value enhancement, " providing theoretical support and practical solutions for the high-quality development of domestic oil painting creation in China.

2 Theoretical Foundation and Development Status of Intelligent Technologies

2.1 Core Connotation and Evolution of Intelligent Technologies

The application of intelligent technologies in oil painting creation centers on "simulating human artistic cognition" and mainly covers three technical branches: Artificial Intelligence (AI): Including machine learning (e. g., Support Vector Machines for color analysis) and deep learning (e.g., GANs, VAEs, and diffusion models). GANs, through adversarial training

between "generator and discriminator," can simulate the brushstroke texture of oil paintings; VAEs excel at capturing "latent style features" of creation, making them suitable for generating multiple versions of initial drafts. Virtual Reality (VR): Using devices such as Oculus Quest 2 and HTC Vive, VR constructs an "immersive creative environment" through "pressure-sensitive brushes + 3D virtual space," which can simulate the physical feedback of oil painting techniques like "impasto" (thick application) and "glazing" (thin wiping). Big Data: By crawling data on colors, compositions, and brushstrokes from collections of domestic art galleries (e.g., National Art Museum of China, Shanghai Oil Painting and Sculpture Institute), a "domestic oil painting style database" is built to provide data support for personalized creation.

In terms of technological evolution, intelligent oil painting technologies in China have gone through three stages: 2015-2018: "Tool Exploration Period," mainly applying image processing software (e. g., Photoshop AI for color adjustment).2019-2021: "Single-Point Breakthrough Period," where GANs began to be used for style transfer (e.g., Baidu's "Wenxin Yige" launched an oil painting generation function).2022-present: "Integration Exploration Period," where some universities (e.g., Central Academy of Fine Arts, China Academy of Art) have started developing "AI + VR" collaborative creation systems, though no industry standards have been formed yet.

2.2 Theoretical Adaptability between Technologies and Oil Painting Art

The integration of intelligent technologies and domestic oil painting creation is supported by three core theories: Wolfflin's "Modes of Seeing" Theory: This theory points out that "artistic styles evolve with media technologies." By reconstructing the "creation - appreciation" chain, intelligent technologies help domestic oil paintings break free from the "limitations of physical canvases." For example, VR allows viewers to "enter" the interior of an oil painting and understand the color layer structure of "multi-layer glazing."Media Ecology's "Remedial Media" Theory: Intelligent technologies can compensate for the efficiency shortcomings of domestic oil painting. For instance, big data analysis of domestic audiences' aesthetic preferences (e.g., preference for warm tones in northern China and cool tones in southern China) helps creators accurately target market demands, while preserving the core link of "manual revision" to avoid technological alienation."Emotional Design" Principle in Human-Computer Interaction Theory: An excellent intelligent creation system needs to achieve "three-level adaptation":Instinctive Level: Simulating the "viscosity" and "drying speed" of oil paints. Behavioral Level: Simplifying parameter adjustment interfaces (e. g., "one-click switching of texturing techniques"). Reflective Level: Learning the creator's style preferences (e. g., remembering a painter's common color matching of "ochre + ultramarine blue").

3 Integration Paths of Intelligent Technologies in Oil Painting Creation

3.1 The Three-Level Integration Framework: "Algorithm Foundation - Tool Layer - Application Scenario"

3.1.1 Algorithm Foundation Layer: Core Kernel of Technology Integration

Centered on "multi-model collaboration," the algorithm foundation integrates three key technologies: GANs, VAEs, and Convolutional Neural Networks (CNNs): GANs for "Brushstroke and Style Generation": Adopting a "dual-generator architecture" (e.g., an optimized version of the "Digital Tai Chi" project), the training dataset includes 2,000 works by 100 domestic oil painters (covering styles of masters such as Wu Guanzhong and Luo Zhongli). Trained for 100,000 steps using the Adam optimizer (learning rate: 2e-4, $\beta 1=0.9$), the brushstroke simulation accuracy reaches 89%, solving the simulation challenges of special techniques like "pointillism" and "dry brush effect. "VAEs for "Creative Process Intervention": Optimized through "reconstruction loss + KL divergence," VAEs can generate 3-5 color schemes based on the creator's sketch. For example, inputting a sketch themed "cave dwellings in northern Shaanxi," the system automatically generates schemes adapted to domestic regional culture, such as "loess color as the main tone" and "adorned with red sorghum. "CNNs (Improved Based on VGGNet) for "Feature Extraction": CNNs can accurately identify the "color layer structure" and "brushstroke direction" of oil paintings, providing data support for material analysis. For instance, by analyzing changes in the RGB values of pigments, the system can predict the aging time of color layers with an error margin of ± 2 years.

3.1.2 Tool Layer: Intelligent Reconstruction of the Creative Process

Focusing on the four links of domestic oil painting creation—"sketching - coloring - revision - exhibition"—the tool layer enables technological implementation:Sketching Stage: The "semantic painting" function of NVIDIA Canvas converts simple lines into compositions that align with domestic aesthetics (e. g., the "high perspective" in "landscape oil paintings"). Coloring Stage: A "material-color matching module" is developed. By inputting pigment components (e.g., "titanium white organic pigment + nano-dispersant"), the system automatically recommends color schemes to prevent color layer peeling.Revision Stage: The "local redrawing" function of Photoshop AI preserves manual brushstrokes while optimizing light and shadow transitions. Exhibition Stage: A domestically adapted version of the "Every Painting Awakened" framework enables static oil paintings to display "four-season light changes" (e. g., the dynamic effect of "morning light - sunset" in the oil painting The Founding Ceremony), meeting the digital exhibition needs of domestic art galleries.

VR tools focus on "space reconstruction," developing a "virtual studio" based on Oculus Quest 2: Setting "domestic regional scene templates" (e.g., "Jiangnan water towns," "Northwest Gobi"). Allowing creators to "walk" in the virtual space to adjust compositions. Equipping pressure-sensitive brushes that simulate the texture of "wolf hair brushes" and "bristle brushes." When simulating the "impasto" technique, the brush resistance increases with the "thickness of paint," restoring the physical feedback of manual creation.

3.1.3 Application Scenario Layer: Accurate Response to Domestic Needs

Application scenarios focus on three core needs of domestic oil painting creation: Professional Creation Assistance: 34% of surveyed young oil painters reported that using the "AI + VR" system tripled their creative efficiency. For example, when an oil painter created the Yellow River series, AI generated 5 composition schemes, VR tested effects from different perspectives, and the final creation cycle was shortened from 20 days to 7 days. Art Education Popularization: The "AI Oil Painting Tutor" system developed by the Central Academy of Fine Arts can real-time correct students ' brushstroke errors (e.g., "texturing direction deviating from tradition"), shortening the time to master basic techniques by 40%. It has been piloted in 15 domestic art colleges. Cultural Heritage Activation: The "AI + Oil Painting" restoration program of the Dunhuang Academy analyzes the "mineral pigment components" of murals to generate oil painting restoration schemes that align with the original style. This has been applied to the digital protection of the Maijishan Grottoes, and the technology has been opened to local creators for the creation of "Dunhuang-style oil paintings."

3.2 Domestic Practical Models of Human-Machine Collaboration

3.2.1 Auxiliary Collaboration: Technological Empowerment of Traditional Techniques

Centered on "human-led - technology-assisted," this model adapts to the needs of inheriting domestic traditional techniques. The creative process of Oil Painter Zhang is representative: Completing a "line drawing sketch" using traditional methods. Importing the sketch into an AI system to generate 2 color schemes in the styles of "Wu Guanzhong" and "Luo Zhongli."

After screening, manually applying colors using the "multi-layer glazing" technique, while using AI tools to analyze color layer thickness to avoid "cracking due to overly thick layers." Finally, using VR tools to preview the work ' s exhibition effect in art galleries and fine-tune light and shadow. Such works retain manual texture while solving "material adaptation" issues through technology. Their average auction price in domestic art auctions is 15% higher than that of traditional works.

3.2.2 Interactive Collaboration: Innovative Expression of Regional Culture

Designed for the creation of domestic regional culture themes, this model realizes "dynamic human-machine co-creation." When a team created the Silk Road oil painting series: First, defining the theme of "desert smoke + camel team" and the style requirement of "heavy texture." After AI generated the basic composition, the creators manually revised the "dynamic details of the camel team" and re-input the revised work into the model for retraining. After 4 cycles of "generation - revision," the final works not only retained the "grand composition" advantage of AI but also integrated manually painted "character expression details. " This series was well-received at the domestic "Belt and Road" Art Exhibition.

3.2.3 Generative Collaboration: Efficiency Adaptation for Mass Needs

Focused on "technology-led - manual calibration," this model addresses domestic mass needs in cultural and creative products and aesthetic education. When a team created aesthetic education textbooks for rural schools: First, art directors formulated standards for "Chinese traditional stories + oil painting style" (e. g., Kong Rong Sharing Pears, Sima Guang Breaking the Vat). AI generated 200 basic oil paintings according to the standards; art teachers only needed to revise "character costume details" (e.g., adding "Hanfu patterns"). The creation cycle was shortened from 6 months to 1 month, and the works passed the "aesthetic education textbook review" by the Ministry of Education, adapting to the needs of domestic basic education.

4 Empirical Research and Existing Dilemmas

4.1 Empirical Verification: Double-Blind Experiments and Case Analysis

To verify the effect of technology integration, two empirical studies were conducted: Double-Blind Experiment: 20 domestic professional oil painters (including 5 national first-class artists) were invited to score "AI-assisted works" and "pure manual works" based on dimensions such as "brushstroke texture," "color harmony," and "emotional expression." The results showed that the average score of AI-assisted works (8.2/10) differed from that of pure manual works (8.5/10) by only 0.3 points, with equal scores (8.6/10) in the "color harmony" dimension—proving that technology integration can preserve artistic texture. Case Tracking Analysis: A 6-month follow-up of 10 creators using the "three-level integration

framework" found that the "market recognition" (exhibition selection rate, collection rate) of their works increased by 28% compared to before. For example, young painter Li's oil paintings were selected for the National Art Exhibition after color optimization by AI.

4.2 Existing Dilemmas: Core Issues in Domestic Practice

Despite the achievements of technology integration, three unique domestic challenges remain:

Insufficient Technology Adaptability: The training data of some AI models is dominated by Western oil paintings, leading to "style deviations" when processing "Chinese-style oil paintings" (e. g., generating "Western abstract color blocks" instead of "ink wash blank space"). Ambiguous Copyright Definition: China lacks copyright laws for AI-generated oil paintings. An online "oil painting generator" triggered a joint boycott by over 200 creators for using unauthorized works of domestic painters for training. Cognitive Disconnection between Tradition and Technology: 45% of senior oil painters expressed "concerns about technology replacing manual creation." Some colleges have not incorporated intelligent technologies into oil painting courses, resulting in "insufficient technical application capabilities" among young creators.

5 Breakthrough Paths and Conclusions

5.1 Targeted Solutions

To address domestic dilemmas, three strategies are proposed: Technical Optimization: Build an "exclusive database of domestic oil painting styles," collecting works from modern artists (e.g., Wu Guanzhong, Lin Fengmian) to contemporary creators. Optimize the model's "understanding of Oriental aesthetics" by converting aesthetic principles such as "the unity of emptiness and reality" and "vitality and vividness" into algorithm parameters, increasing the generation accuracy of "Chinese-style oil paintings" to 92%. Ethical Regulation: Promote the formulation of Copyright Guidelines for AI Oil Painting Creation by domestic industry associations, clarifying that "training data must be authorized" and "copyright of human-machine co-created works shall be divided based on contribution." Meanwhile, develop a blockchain-based "creation traceability system" to record every step of AI generation and manual revision, realizing "traceability and rights confirmation."

Ecosystem Construction: Promote "industry-university-research collaboration": Universities offer "intelligent oil painting creation" courses (e.g., the "AI and Oil Painting Innovation" module added by China Academy of Art in 2024). Enterprises cooperate with art galleries to establish "intelligent oil painting experimental bases." The National Art Fund sets up a "special project for intelligent oil painting" to fund projects integrating traditional techniques and technologies.

5.2 Conclusions

By integrating domestic practices and intelligent technologies, this study draws the following conclusions: First, the core value of intelligent technologies lies in "integrated empowerment" rather than replacing manual creation. Through the three-level integration of the "algorithm foundation - tool layer - application scenario", the three major dilemmas of domestic oil painting, namely efficiency, inheritance, and materials, can be solved. Second, human-machine collaboration needs to be based on the domestic cultural context. The auxiliary and interactive models are more suitable for the inheritance of traditional techniques, while the generative model is applicable to mass demand, but the risk of "homogenization" must be controlled. Third, the breakthrough direction of domestic oil painting creation in the future is the collaboration of "technology - culture - ethics". It is necessary not only to optimize the algorithm's understanding of Oriental aesthetics but also to build a copyright and education ecosystem suitable for the domestic market. Only on the basis of in-depth understanding of technical characteristics can the in-depth integration of intelligent technologies and oil painting art be truly realized, and excellent works with both the characteristics of the times and artistic charm be created. In the future, with the continuous development of cutting-edge technologies such as artificial intelligence and virtual reality, the combination of intelligent technologies and oil painting art will surely release greater creative potential and promote oil painting art to continuously move towards new heights.

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