



AI Drawing: An Exploration of Image Artistic Creation - Taking the Practice of "Tongyi Wanxiang" AI Drawing System as an Example

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Abstract. The emergence of AI drawing marks a shift in artistic creation from the traditional model reliant on human efforts to an intelligent innovation era driven by artificial intelligence. It has not only reshaped the relationship between artists and their tools but also transcended professional boundaries, injecting unprecedented vitality and innovation into the field of artistic creation. Nevertheless, AI drawing cannot replace human artistic creation, as it raises social, moral, and ethical controversies, prompting the international community to propose various regulatory measures. Alibaba Cloud's "Tongyi Wanxiang" AI image generation model, part of the Tongyi Model Family, offers artists brand-new creative tools and a source of inspiration, fostering opportunities for the general public to engage in artistic creation, sharing, and exchange.

Keywords: AI Drawing, Controversies Surrounding AI Drawing, Challenges and Opportunities, Era of Universal Artistic Creation, "Tongyi Wanxiang" AI Drawing System

1 PREFACE

Every technological innovation brings about a cultural transformation for humanity. Take graphic art as an example, it has always been intertwined with the origin and development of human civilization. The initial act of drawing images was to represent objects, and all perceptible, objectively existing images could be expressed through graphics. After entering the 21st century and the modern industrial revolution, graphic art has been evolving rapidly, with changes occurring in its media, creative methods, and even creative subjects. In 1975, Kodak invented the world's first digital camera, ushering in the era of digital photography accessible to all in graphic art. Painters, as the main creators of graphic art, have adhered to traditional painting forms for nearly two thousand years before welcoming the advent of AI drawing, a method of generating graphics through computer algorithms. This transition from intentional painting creation centered on humans to intelligent intentional painting creation reliant on computer

algorithms marks the emergence of a new era of universal graphic art creation. This article explores the development path of AI drawing in artistic creation through practical cases of Alibaba Cloud's "Tongyi Wanxiang" AI image generation model within the Tongyi Model Family and the innovation of artistic creation methods, and demonstrates the significant positive significance of AI painting in universal artistic creation.

2 WHAT IS AI DRAWING?

AI (Artificial Intelligence) refers to artificial intelligence, and AI drawing refers to artificial intelligence painting, a method of generating graphics through computer algorithms. AI drawing is one of the branches of the AIGC (Artificial Intelligence Generated Content) application field, which focuses on utilizing artificial intelligence technology in the creative process of painting. Traditionally, artists create paintings intentionally, with humans as the primary subject. However, with the advent of AI drawing, this intentional painting creation has shifted towards intelligent intentional painting creation reliant on artificial intelligence. The relationship between painting creators and AI is no longer a one-way use of artistic drawing tools but rather a two-way transformation and fusion of creative thinking, creative concepts, and painting tools. The intervention of intelligent human-computer tool integration naturally enables artists to create better works, while also breaking down the professional barriers between ordinary people and artists.

The system working principle of AI drawing can be mainly divided into three parts: input, computation, and output, as shown in Figure 1.

Input: Users can input the content or theme of the desired image through various methods such as text entry, voice input, or sketching simple drawings, describing the subject's background, image, style, parameters, and other elements (Prompt).

Computation: 1. Encoding: The AI drawing system converts the user's input instructions into a feature vector (Eigenvector) or encoding, which contains semantic and stylistic information from the input instructions. 2. Generation: Based on the encoding, the AI drawing system generates one or more candidate digital images through computation. This process is achieved using deep learning models such as GANs (Generative Adversarial Networks) and VAEs (Variational Autoencoders), which rely on extensive training data. 3. Optimization: The AI drawing system undergoes a self-optimization process to improve the realism and diversity of the generated digital images. This optimization process includes image denoising, resolution enhancement, contrast enhancement, defect repair, and the addition of detailed elements to the image.

Output: The AI drawing system outputs the optimized digital image files for users to view, download, provide feedback, or modify.

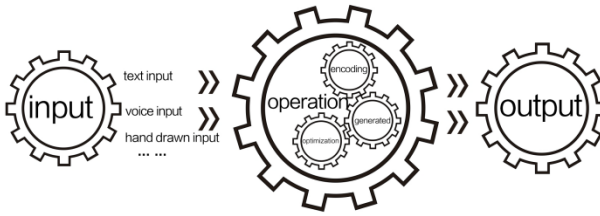


Fig. 1. System Working Principle of AI Drawing

2.1 The origin of AI Drawing

In 1952, Ben F. Laposky (1914-2000), an American mathematician, artist, and researcher at Bell Labs, created the world's first computer-generated "art" piece: a black-and-white computer image titled "Electronic Abstraction." This pioneering work marked the beginning of AI-assisted drawing and computer-generated art. [1] This work represents a groundbreaking contribution to the field of computer art, not only influencing its development but also having a profound impact on subsequent AI painting technologies. In 2012, Stanford University computer scientist Andrew Y. Ng and Google researcher Jeff Dean utilized 16,000 CPUs and 10 million images of cats from the video website YouTube to train "Google Brain," the largest deep learning model at the time, over a period of three days. Ultimately, they generated the first AI-drawn work: a blurred image of a cat's face. This research achievement marked the dawn of a new direction in AI painting research. [2]

2.2 The Controversies of AI Drawing

One of the most significant controversies surrounding AI drawing since its emergence has been whether AI technology can replace human artistic creation in painting.

In October 2018, Christie's, the world-renowned art auction house, sold the first-ever artificial intelligence (AI) painting, titled "Edmond Belamy," for a price of \$430,000. This landmark auction marked the official entry of AI-generated artwork into the art market and its recognition by the industry. This event not only reframed people's understanding of AI-driven art creation but also foreshadowed profound changes that may occur in the art market due to the intervention of AI technology. The question arises: Can AI-drawn works truly replace human paintings?

At its core, this debate revolves around the fundamental differences between the human brain and computers. As Mary Shelley argued in her novel "Frankenstein," by one standard definition, artificial intelligence is a field within computer science that aims to program computers to perform tasks that would otherwise require human intelligence. [3]

Emotion and Consciousness. In the pursuit of AI that mimics human consciousness as closely as possible, engineers involved in related research and development are increasingly focused on incorporating emotional computing capabilities into AI systems. However, AI is inherently driven by computer programs, and the process of AI drawing involves processing data, devoid of the emotions and consciousness that characterize human artistic creation. Currently, AI lacks the ability to self-evaluate and modify its own drawings, nor can it perceive and engage in communication with the outside world. In contrast, human painting creation allows for self-evaluation and evaluation by others through social interaction, fostering a corresponding dialogue. As long as AI drawing lacks the unique qualities of human emotions and consciousness, it cannot replace human painting creation.

Creativity and Imagination. Artificial Intelligence (AI) excels in processing known data compared to human intelligence, fueled by three primary factors: algorithms, data, and computing power. These three elements are all grounded in human-developed programming languages, lacking the unique human traits of creativity and imagination. Lev Manovich, Professor at the Graduate Center of the City University of New York and Director of the Cultural Analytics Lab, once noted that the assessment of creativity and novelty often depends on how we, as humans, perceive an act as creative. [4] Humans can draw inspiration from seemingly unrelated and unordered situations, find connections between material and conscious existences, and create entirely new themes and styles in artistic creations, thereby contributing to a vast database. In contrast, AI drawing relies on these databases and operates within prescribed algorithms, leading to an endless cycle of artistic styles without breaking through the core of creativity and imagination in facing the future and unknown domains.

Concurrently, from a socio-ethical perspective, AI lacks the capability to make sound moral judgments and decisions, posing certain socio-ethical risks. Zhang Ping, from the Department of Philosophy at Nanjing University, profoundly pointed out in his article "Reflections on AI Ethics: Risks and Responses" that AI not only carries potential and non-negligible technical ethical risks but also increasingly impacts existing social structures and values as digitization progresses rapidly. Fundamental human values such as dignity, fairness, and justice are facing challenges as a result. He believes that the challenge AI poses to human moral agency is not merely a romantic imagination from movies and novels but has increasingly become a real-life risk, [5]as shown in Figure 2.

3 CHALLENGES AND OPPORTUNITIES FOR TRADITIONAL PAINTING CREATION IN THE AGE OF AI

The widespread adoption of digital drawing tablets, along with the development of accompanying digital painting software, has empowered artists to create vibrant and diverse artworks using stylus pens as substitutes for traditional brushes on these tablets.

This transformation not only offers artists more creative possibilities and freedom but also facilitates the dissemination and exhibition of their works in a more convenient and efficient manner. The era of computer graphics has laid a solid foundation for the emergence and development of AI drawing technology. The advent of AI drawing technology has also sparked discussions about the essence and value of artistic creation. Regardless, the development of AI drawing technology represents an inevitable trend in the digital age.

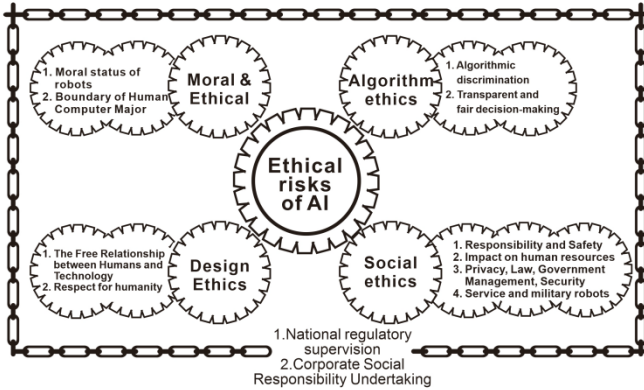


Fig. 2. Illustration of Ethical Risks in AI and Artificial Intelligence

3.1 Breaking Professional Barriers and Cultural Divides

As a technological branch of Artificial Intelligence (AI), AI drawing is not isolated from other disciplines; rather, it has become a wedge driving interdisciplinary and cross-disciplinary integrations. The advancement of AI technology continually propels the innovation of the emerging STEM (Science, Technology, Engineering, and Mathematics) interdisciplinary teaching concept. AI drawing technology introduces more innovative possibilities to STEM education. For instance, students can learn the fundamental principles and techniques of AI drawing through programming and algorithm studies, enabling them to create artistic works with personal styles and creativity. This creative process not only involves technical knowledge but also necessitates a profound understanding and appreciation of art, design, and culture.

Furthermore, AI drawing technology can be deeply integrated with other disciplines. In the field of science, students can utilize AI drawing technology to simulate and visualize scientific phenomena and processes. In engineering, AI drawing can assist in product design and optimization. In mathematics, students can leverage AI drawing to solve complex mathematical problems and model construction.

From an idealistic perspective, the gradual elimination of information imbalance is fostering the eventual disappearance of cultural divides worldwide. However, with the development of AI, the global society seems to be heading towards a multipolarization characterized by the construction of high data barriers. Governments and corporations may adopt various measures to restrict data flow and sharing to safeguard their interests, leading to the emergence of information silos and data barriers. In this era of big data,

which should ideally benefit humanity, we observe that some western developed countries, leveraging their technological superiority, have occupied digital high grounds and closed off data-sharing channels through stringent regulations and the pretext of data privacy protection.

3.2 The Digitization of Art and the Era of Universal Artists

AI drawing has given every ordinary person the opportunity to participate in artistic creation and become an artist, thereby prompting genuine artists to set higher creative standards for themselves.

The Transformation of Creation and Presentation Methods. Digital tools have made artistic creation more efficient and convenient. Artists can create through various drawing software, which offer a myriad of brush tools, color options, and special effects processing functions, significantly enhancing the expressive power of artworks. Furthermore, the introduction of AI technology has brought new possibilities to artistic creation, such as automatically generating artworks and simulating the styles of different painters. Digital technology has also diversified the presentation methods of artworks. Works can be showcased and disseminated online through the internet and social media, breaking geographical and temporal barriers. Additionally, the application of technologies like Virtual Reality (VR) and Augmented Reality (AR) has introduced novel experiential ways to present artworks.

Autonomy of Art. Digital art removes spatial and locational constraints from the creation and exhibition of artworks, significantly reducing time and financial costs. Every creator can utilize a broader range of digital tools for creation and uploading, while every audience member can access artworks anytime, anywhere through data portals, thereby maximizing the autonomy of artistic creation and appreciation. However, this ideal state presupposes the elimination of the divide between developed and underdeveloped regions to the greatest extent possible. In the era of AI, digital art still relies on operational hardware and data storage hardware, consuming resources. In underdeveloped regions, due to economic, technological, and other constraints, many people may not have access to sufficient hardware support or high-speed internet connections to participate in the creation and appreciation of digital art.

The Sociality of Art. In the process of presentation and dissemination, digital art blurs the boundaries of artistic creation through communication with audiences on social media, making the roles of creators and viewers no longer deliberately distinct. At the same time, aesthetic requirements become more democratized. An important characteristic of digital art is the extensive participation in social practice, which benefits from the vigorous development of current social networks. Contemporary new media artists utilize digital technology and media to transform between virtual and real spaces for

artistic creation. The interconnection between humans, art, and digital technology provides us with new channels to interact with the world beyond social networking, information gathering, and entertainment. As we enter the AI era, digital art has become a hot topic on social media. An increasing number of digital artists leverage AI technology to continue creating new aesthetics and exploring the limitless possibilities of artistic creation. This has made art no longer the exclusive domain of a few but a cultural resource shared by all.

4 THE PRACTICE OF AI DRAWING IN ARTISTIC CREATION

With the proliferation of AI drawing platforms in Europe and the United States, major Chinese model enterprises have also released a batch of AI drawing tools with local characteristics, such as Alibaba Cloud's Tongyi Wanxiang, 360 Zhihui, Tencent HunyuanAide, Baidu's Wenxin Yiyao and Wenxin Yige, iFLYTEK Spark Drawing Assistant, Zhipu AI's Zhipu Qingyan, Douyin Doubao, Meitu's MiracleVision, etc. This article takes "Tongyi Wanxiang," an AI painting creation model launched by Alibaba Cloud's Tongyi Model Family on July 7, 2023, as a practical case for AI drawing creation.

4.1 "Tongyi Wanxiang" AI Drawing System

"Tongyi Wanxiang," an AI drawing system, is a member of Alibaba Cloud's Tongyi Model Family. Developed based on Composer, a compositional generation model created by Alibaba, the "compositional generation" framework Composer, which utilizes diffusion models, achieves a high degree of controllability and significant freedom in image generation effects by deconstructing and combining image design elements such as color schemes, layouts, and styles. Figure 3 illustrates the working principle of diffusion models. [6]

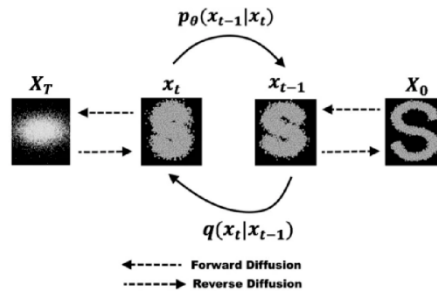


Fig. 3. Working Principle of Diffusion Models

The working principle of diffusion models involves learning the information decay caused by noise and then using the learned patterns to generate images. This concept also applies to latent variables, as it attempts to learn the noise distribution rather than

the data distribution. The noise distribution is modeled using the concept of Markov chains, making it a probabilistic model. [7]

Where:

$q(x_t|x_{t-1})$: is the noise distribution for state x_t given state x_{t-1} .

$\mathcal{N}(x_t; \sqrt{1 - \beta_t}x_{t-1}, \beta I)$: is the gaussian distribution represented by \mathcal{N} .

B_t : is the variance for the gaussian distribution for state t .

We can then iterate over the equation for states t from 0 to T . However, we can get the noise t given the noise at state 0 by using the following equation.

$$q(x_t|x_0) = \mathcal{N}(x_t; \sqrt{\alpha_t}(1 - \bar{\alpha}_t) I)$$

Where:

$$\alpha_t = 1 - B_t$$

$$\bar{\alpha}_t = \prod_{s=0}^t \alpha_s$$

Unlike the working principle of Stable Diffusion, the "compositional generation" framework Composer is capable of decomposing training images into multiple components and then retraining the diffusion model (DM) based on these elements, enabling it to flexibly combine them. This "decomposition-composition" core working concept results in a "combinatorial explosion" effect in the output. Assuming there are N images in the database, decomposing them into N types of elements allows for the generation of N to the power of N combination results. This process first decomposes the training images into a series of different design elements that can be freely modified and edited, including shapes, colors, compositions, brushstrokes, styles, emotions, semantics, materials, etc., and then trains the diffusion model on these elements. The AI model can then combine these decomposed elements into new images during the inference phase, achieving maximum controllability over image details and generating customized images. Based on this framework, Tongyi Wanxiang can flexibly handle various image-to-image creation tasks. The "Tongyi Wanxiang" AI drawing system primarily features three major functions: text-to-image generation, similar image generation, and style transfer.

4.2 AI Drawing Practice Works

The author utilized the doodle drawing function of Tongyi Wanxiang, blending AI technology with unique artistic styles, to create a series of AI drawing works. Below are two of these works, Figure 4 and Figure 5, showcasing the limitless possibilities of the integration of technology and art.



Fig. 4. "Magical Castle" by Zhiding Zhang, created using Tongyi Wanxiang's doodle drawing function, 2024.



Fig. 5. "Extraterrestrial Sci-Fi City" by Zhiding Zhang, created using Tongyi Wanxiang's doodle drawing function, 2024.

5 CONCLUSION

AI painting can accurately mimic every detail of human creation and far surpasses humans in its ability to process data, even capable of creating entirely new artistic styles based on existing data. However, it can never replace the central role of human artists in artistic creation. Human artists can infuse their emotions into their paintings, expressing themselves and venting inner feelings through self-portraits and other means. This emotional power is something that AI painting cannot imitate. AI painting provides artists with unprecedented creative possibilities while also lowering the threshold for artistic creation, enabling more people to participate in the creative process and promoting the involvement of the entire populace in art creation, making art more accessible and diverse.

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