

Review

# The Evolution of Digital Art: From Early Experiments to Contemporary Practices

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**Abstract:** This paper explores the evolution of digital art, tracing its development from the early experiments of the 1960s to the diverse contemporary practices of the 21st century. It examines key technological advancements, such as the transition from 2D to 3D art, the rise of the internet, and the integration of artificial intelligence, which have redefined artistic creation and audience interaction. The role of Non-Fungible Tokens (NFTs) and blockchain technology in the commercialization and authentication of digital art is discussed, as well as the impact of Augmented Reality (AR) and Virtual Reality (VR) in creating immersive art experiences. Additionally, the paper addresses ethical and philosophical questions regarding authorship, ownership, and the environmental impact of digital art. Ultimately, this study highlights the profound influence of digital technologies on art and offers insights into the future trajectory of the field.

**Keywords:** Digital art; evolution; AI in art; NFTs; blockchain; augmented reality; virtual reality; art commercialization; technological advancements; authorship in digital art

## 1. Introduction

### 1.1. Background and Definition of Digital Art

Digital art, at its core, refers to artistic works or practices that utilize digital technology as an essential part of the creative process. Unlike traditional mediums such as painting or sculpture, digital art is often created using computer software, algorithms, and various forms of new media technology. As a term, "digital art" encompasses a wide range of creative outputs, including digital painting, 3D modeling, animation, virtual reality, and even forms of interactive art. It is both a tool and a medium, opening up unprecedented opportunities for artists to explore, innovate, and push the boundaries of what art can be.

The emergence of digital art can be traced back to the 1960s, when pioneering artists began to experiment with computers and programming in their creative work. As early as this period, artists like Frieder Nake, who used computer algorithms to generate geometric patterns, and Harold Cohen, who developed the drawing program "AARON," began to explore the artistic possibilities of computational systems. These early endeavors, though rudimentary by today's standards, laid the foundation for what would become a rapidly expanding field.

Throughout the decades, advances in technology, from more powerful computing systems to sophisticated software tools, have significantly expanded the potential of digital art. Today, artists can create intricate 3D landscapes, develop immersive virtual worlds, and even employ artificial intelligence to assist in the creative process. With the rise of the internet and digital platforms, the accessibility and distribution of digital art have also flourished, allowing artists to reach global audiences in ways that were previously unimaginable.

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Digital art, therefore, is more than just an extension of traditional art forms; it represents a paradigm shift in the way art is conceived, produced, and experienced. This technological integration has challenged long-standing notions of authorship, originality, and the materiality of art, inviting both artists and viewers to rethink the very nature of artistic expression in the digital age.

### *1.2. Importance of Studying the Evolution of Digital Art*

Studying the evolution of digital art is essential for understanding how technology has transformed the creative landscape and continues to shape the future of artistic expression. Over the past few decades, digital art has not only expanded the toolkit available to artists but also redefined the ways in which art is created, distributed, and consumed. By examining its development, we can gain insights into the intersection of art and technology, the societal shifts that influence creative practices, and the broader implications for cultural production.

One of the key reasons for studying the evolution of digital art is to appreciate its role in democratizing artistic creation. The accessibility of digital tools has enabled a much wider range of individuals to engage in art-making, removing some of the barriers traditionally associated with physical materials or formal artistic training. As software becomes more user-friendly and affordable, more people can experiment with creative processes, leading to a more diverse and inclusive artistic landscape.

Furthermore, the evolution of digital art reflects broader technological advancements and their impact on culture. From the early days of computer-generated graphics to the rise of artificial intelligence, each technological leap has brought new possibilities for artistic innovation. These developments have not only allowed artists to push creative boundaries but have also provoked philosophical discussions about the nature of art itself. Questions surrounding authorship, originality, and the role of the artist in an increasingly automated world have become more prevalent, prompting deeper inquiry into the meaning of creativity in the digital age.

The study of digital art's evolution also highlights the shifting dynamics of the art market and the role of digital platforms in art dissemination. The rise of online galleries, social media, and more recently, the emergence of NFTs (Non-Fungible Tokens) has disrupted traditional art market models, offering new ways for artists to monetize their work and reach global audiences. These changes not only influence the financial structures of the art world but also alter the relationship between artists, collectors, and audiences.

Finally, exploring the evolution of digital art helps us anticipate future trends and challenges in art and technology. As new forms of media like virtual reality, augmented reality, and generative art become more sophisticated, the line between the digital and physical worlds continues to blur. Understanding the historical trajectory of digital art allows us to better contextualize these emerging technologies and their potential to further revolutionize the art world.

In conclusion, studying the evolution of digital art is crucial for grasping its profound influence on modern culture, its role in shaping new artistic practices, and its ongoing impact on how art is perceived and valued in a digitally connected world.

### *1.3. Scope and Objectives of the Paper*

The scope of this paper is to explore the development of digital art from its early experimental stages to its current form in contemporary artistic practice. It will trace the key milestones in the history of digital art, starting with the pioneering efforts in the 1960s, moving through the rise of digital technologies in the 1990s, and culminating in the modern-day applications of artificial intelligence, virtual reality, and blockchain technologies. This paper will also examine the technological, cultural, and economic factors that have influenced digital art's evolution and its role within the broader context of modern art.

The primary objective of this paper is to provide a comprehensive understanding of how digital art has transformed over the years and to analyze the impact of technological advancements on artistic creation. Through this exploration, the paper will highlight the critical moments and technologies that reshaped artistic practices, as well as the new opportunities and challenges that digital art presents to both artists and audiences.

Another key objective is to analyze the philosophical and ethical implications of digital art, particularly in relation to concepts of originality, authorship, and the intersection of technology and creativity. Additionally, the paper aims to discuss how digital art has democratized artistic production and dissemination, allowing more individuals to participate in the art world and enabling new forms of expression.

## 2. Early Experiments in Digital Art (1960s–1980s)

### 2.1. *The Birth of Computer Art*

The 1960s marked the emergence of computer art, where artists began to explore computers as tools and mediums for creative expression. Early pioneers, like Frieder Nake, used algorithms to generate abstract geometric patterns, such as his work *Homage à Paul Klee* in 1965, demonstrating how computers could mimic artistic processes. Similarly, Harold Cohen created AARON, a program that autonomously generated drawings, sparking debates on whether machines could be considered artists.

Exhibitions like *Cybernetic Serendipity* in 1968 showcased the intersection of art and technology, bringing computer-generated works to a wider audience. Though limited by the early hardware, these experiments challenged traditional notions of creativity and paved the way for future digital art [1].

### 2.2. *The Role of Early Technology in Shaping Digital Art*

Early technology played a crucial role in shaping the development of digital art by providing artists with new tools and creative possibilities. In the 1960s and 1970s, computers like the IBM 7090 and GE 225, though limited in processing power and graphical capabilities, allowed artists to experiment with algorithmic art and computer-generated visuals. These machines enabled the creation of intricate patterns, geometric shapes, and abstract designs, which were previously impossible to produce by hand.

Early software programs, although basic, were essential for pioneering artists like Frieder Nake and Harold Cohen, whose works relied heavily on algorithms and code. Artists used simple programming languages to instruct computers to create visual compositions, introducing a new form of collaboration between humans and machines. Despite the technical limitations, the innovation and experimentation during this period laid the groundwork for the evolution of digital art, demonstrating the potential of technology to expand artistic boundaries.

Additionally, the development of digital art was supported by institutions and exhibitions that embraced these technological advancements [2]. Events like *Cybernetic Serendipity* in 1968 helped legitimize digital art, bringing attention to the creative possibilities offered by early computers and inspiring a new generation of artists.

### 2.3. *Early Digital Art Exhibitions and Reception*

Early digital art exhibitions played a pivotal role in introducing computer-generated art to the public and shaping its reception. One of the most notable exhibitions was *Cybernetic Serendipity* (1968), held at the Institute of Contemporary Arts in London. This groundbreaking exhibition showcased the creative potential of computers, featuring works by artists, scientists, and engineers. It highlighted the interdisciplinary nature of digital art and demonstrated how technology could be used as a medium for artistic expression.

These early exhibitions were instrumental in legitimizing digital art within the broader art community. While traditionalists were initially skeptical, viewing computer-

generated works as lacking in human touch or creativity, others embraced the innovative nature of digital art. These exhibitions sparked conversations about the role of technology in art and the shifting definitions of creativity and authorship.

As digital art gained visibility, it also began to attract a wider audience, with institutions and galleries gradually recognizing its value. The public reception was mixed, with some fascinated by the novel possibilities that computers brought to art, while others questioned whether machine-generated works could truly be considered art. However, the growing interest and experimentation during this period set the stage for digital art to evolve into a respected and influential movement in contemporary art.

### 3. The Rise of Digital Art in the 1990s and Early 2000s

#### 3.1. Technological Advances: From 2D to 3D Art

The 1990s and early 2000s marked a significant turning point for digital art, driven by rapid technological advancements that expanded creative possibilities. One of the key shifts during this period was the transition from 2D digital art to more complex 3D art forms, enabled by increasingly powerful computers, sophisticated software, and improved graphics processing units (GPUs).

In the early 1990s, 2D digital art was predominantly created using programs like Adobe Photoshop and CorelDRAW, allowing artists to experiment with digital painting, photo manipulation, and vector graphics. These tools gave artists precise control over their work, revolutionizing traditional forms of illustration and design.

However, the development of 3D modeling and rendering software, such as Autodesk Maya and 3D Studio Max, introduced a new dimension to digital art. Artists were now able to create fully realized 3D environments, characters, and objects, offering unprecedented depth and realism. This leap from flat, two-dimensional works to intricate, three-dimensional creations not only expanded the aesthetic potential of digital art but also opened up new avenues for its application in industries like video games, film, and virtual reality.

The rise of 3D art also blurred the boundaries between art and technology. Artists began collaborating with engineers and computer scientists to push the limits of what was possible, resulting in visually stunning and immersive digital experiences. These technological advances allowed for greater experimentation, enabling artists to explore new techniques, such as procedural generation and photorealistic rendering, which had a lasting impact on the digital art landscape [3-5].

#### 3.2. Internet and Interactive Digital Art

The rise of the internet in the 1990s dramatically transformed the landscape of digital art, introducing new forms of interactivity and global connectivity. The internet allowed digital artists to not only share their work with a global audience but also engage with viewers in real-time, creating art that was interactive and participatory.

One of the most significant developments in this period was the emergence of net art—art that exists specifically on the internet and is shaped by its environment. Early net artists like Olia Lialina and Jodi experimented with the web's structure, creating works that were fluid, non-linear, and often dependent on user interaction. Viewers became participants, influencing the outcome of the artwork by navigating through links, making choices, or interacting with digital interfaces.

Interactive digital art extended beyond the confines of the traditional gallery, with websites, online forums, and virtual spaces becoming new venues for artistic expression. Tools such as Macromedia Flash allowed artists to create dynamic, interactive experiences that blended animation, sound, and user participation. Artists could design works that responded to the viewer's actions, creating a more immersive and engaging experience.

The internet also facilitated the collaborative creation of digital art, where multiple users could contribute to a piece in real-time [6]. Projects like The Teleporting Anagram

Artist allowed participants from around the world to work together to create art, highlighting the decentralized and global nature of the internet. This level of interactivity redefined the relationship between artist and audience, making digital art more democratic and accessible.

### 3.3. *The Commercialization of Digital Art*

The 1990s and early 2000s saw the growing commercialization of digital art as it moved from experimental spaces into mainstream industries. With advancements in digital tools and the rise of the internet, digital art became more accessible and widely adopted, particularly in industries such as advertising, entertainment, and design.

One of the key drivers of commercialization was the increasing demand for digital content in video games, animation, and film. As 3D modeling and animation software improved, digital artists found opportunities to work in these rapidly growing fields, creating visually stunning graphics, special effects, and virtual environments. Companies like Pixar and DreamWorks revolutionized animated films with fully digital productions, showcasing the power of digital art to captivate global audiences. Video games, too, became a major platform for digital artists, with franchises like Final Fantasy and Tomb Raider pushing the boundaries of 3D art and immersive experiences [7].

The advertising and design industries also embraced digital art, using it to create eye-catching visuals for marketing campaigns and branding. The flexibility and efficiency of digital tools made it easier for designers to produce high-quality content, and as a result, digital art became a standard medium for commercials, websites, and graphic design.

In addition, the internet facilitated the sale and distribution of digital art. Platforms like DeviantArt and Etsy allowed artists to sell their digital works directly to consumers, bypassing traditional gallery spaces [8]. This new digital marketplace provided independent artists with a global audience, enabling them to monetize their creations more easily.

The commercialization of digital art also raised questions about intellectual property, originality, and authorship. As digital works became more widely circulated, issues related to copyright and the protection of digital art became increasingly important, especially in an age where works could be easily replicated and shared online.

## 4. Contemporary Digital Art Practices (2010s–Present)

### 4.1. *The Influence of AI and Machine Learning in Art Creation*

In recent years, artificial intelligence (AI) and machine learning (ML) have emerged as transformative tools in the field of digital art, reshaping both the creative process and the role of the artist. AI-based programs, such as DeepDream and Generative Adversarial Networks (GANs), have enabled machines to generate original artworks, ranging from abstract patterns to photorealistic images, by analyzing vast datasets of visual information.

AI-generated art often relies on algorithms that "learn" from existing artwork, allowing the software to produce new compositions based on patterns and styles it has studied. One of the most well-known examples of AI-generated art is Edmond de Belamy, a portrait created by a GAN, which sold at auction for over \$400,000 in 2018. This highlighted the growing interest in and acceptance of AI as a legitimate creative tool in the art world.

Artists today use AI not only to automate aspects of the creative process but also to explore new aesthetic possibilities. For example, Mario Klingemann, a pioneer in AI art, utilizes machine learning algorithms to create complex, evolving digital artworks that challenge traditional notions of creativity and authorship. These AI systems can produce art that is surprising and innovative, offering fresh perspectives on both abstract and figurative work [9-11].

The influence of AI and machine learning extends beyond visual art into areas like music, literature, and performance, further blurring the boundaries between human creativity and machine-assisted processes. Some artists view AI as a collaborator, rather than

just a tool, emphasizing the unique dialogue between human intention and machine output.

However, the rise of AI-generated art has also sparked debates regarding originality, authorship, and the role of the artist. Questions about whether machines can truly "create" art or if the human artist is still the primary source of creativity remain central to discussions around AI's place in the art world.

#### 4.2. *The Role of NFTs and Blockchain in Digital Art*

The emergence of Non-Fungible Tokens (NFTs) and blockchain technology has revolutionized the digital art world, offering new ways to create, sell, and own digital works. NFTs are unique digital tokens stored on a blockchain, which can represent ownership of a specific piece of digital art, giving artists a secure way to authenticate and monetize their creations [12].

One of the most significant impacts of NFTs is that they allow digital artists to sell their work as one-of-a-kind pieces or in limited editions, similar to traditional physical art forms. This was demonstrated by the landmark sale of Beeple's NFT artwork "Everydays: The First 5000 Days", which fetched \$69 million at a Christie's auction in 2021, catapulting NFTs into the mainstream and reshaping how digital art is perceived and valued.

Blockchain technology ensures the authenticity and provenance of digital works, solving a long-standing issue in digital art where works could be infinitely reproduced without a way to prove originality. NFTs establish a clear ownership record, enabling collectors to invest in digital art with confidence that they hold an authentic and unique piece [13]. This innovation has not only attracted major artists and collectors but has also provided independent digital artists with direct access to global markets, bypassing traditional gallery systems.

Moreover, NFTs have introduced new possibilities for how art is experienced. Digital artworks can now include interactive elements, animations, and augmented reality features, all while being secured by blockchain. Artists can also set up smart contracts within NFTs, ensuring they receive royalties every time their work is resold, thus creating ongoing revenue streams.

However, the rise of NFTs has also sparked debates about sustainability, as blockchain networks like Ethereum (which powers many NFTs) consume significant amounts of energy. Additionally, critics question the speculative nature of the NFT market, where some buyers treat digital art more as an investment vehicle than as an appreciation of creativity [14,15].

#### 4.3. *The Future of Digital Art: Augmented and Virtual Reality*

Augmented Reality (AR) and Virtual Reality (VR) are at the forefront of the next wave of digital art, offering immersive experiences that push the boundaries of how art is created, displayed, and experienced. These technologies are transforming digital art from a static medium into interactive, multi-sensory experiences that fully engage the viewer.

Virtual Reality allows artists to create entirely virtual worlds where users can explore, manipulate, and interact with 3D artworks. VR platforms like Tilt Brush and Google Blocks enable artists to paint or sculpt in a 360-degree space, opening up new possibilities for creativity and expression. Artists can build environments that audiences can walk through or interact with, offering a level of immersion and engagement not possible in traditional or even digital 2D formats. VR also allows for the creation of exhibitions that exist entirely in virtual spaces, such as The Museum of Other Realities, where digital artworks can be displayed in an infinite virtual gallery.

Augmented Reality brings digital art into the physical world by overlaying virtual elements onto real-world environments. Artists use AR to create works that interact with physical surroundings, blurring the line between the real and the digital. AR art installations can be experienced through smartphones, tablets, or specialized glasses, allowing

for public art projects that engage viewers in new, dynamic ways. Artists like Kaws have used AR to create large-scale virtual sculptures that appear in real-world settings, giving audiences the chance to experience art in any location, at any time.

The integration of AR and VR into digital art is also opening up new possibilities for storytelling and narrative-driven experiences. Digital artists are creating immersive worlds that allow viewers to explore different perspectives, interact with characters, and influence the course of the experience, turning the audience into active participants.

Looking ahead, the future of AR and VR in digital art promises even greater innovation, as advancements in hardware and software continue to enhance the level of realism and interactivity. The convergence of these technologies with AI, blockchain, and other digital tools is set to further expand the possibilities for artistic expression and audience engagement.

#### *4.4. Ethical and Philosophical Questions in Contemporary Digital Art*

As digital art evolves, it brings with it a range of ethical and philosophical challenges, particularly as new technologies such as AI, blockchain, and immersive environments reshape the way art is created, consumed, and valued. These emerging issues provoke deep questions about the role of the artist, the ownership of digital works, and the societal impact of technological advancements on art.

One significant ethical question involves authorship and creativity. With AI-generated art becoming more prominent, there is ongoing debate about who should be credited as the creator of a piece. Is the artist the one who designs and trains the algorithm, or is the machine, which produces the final work, deserving of the creative credit? The use of machine learning in art creation challenges traditional notions of creativity, raising questions about the nature of artistic expression and the role of human agency in the process [16].

The rise of Non-Fungible Tokens (NFTs) and the commercialization of digital art have also sparked concerns around ownership, intellectual property, and environmental impact. While NFTs offer a way to authenticate and sell digital art, critics argue that the speculative nature of the market turns art into a commodity, prioritizing financial gain over artistic value. Moreover, the energy-intensive process of maintaining blockchain networks has raised environmental concerns, with critics pointing to the high carbon footprint associated with NFT transactions on platforms like Ethereum.

Another pressing issue relates to access and inclusivity. As AR and VR technologies become more central to the digital art experience, questions arise about who has access to these technologies. The high costs of VR equipment and the technical knowledge required to create immersive art may limit the participation of artists and audiences from disadvantaged backgrounds. This raises concerns about a growing digital divide in the art world, where only those with the resources to engage with these technologies can fully participate in this new frontier of artistic expression.

Furthermore, the philosophical implications of immersive and interactive digital art challenge traditional understandings of the viewer's relationship with art. In virtual or augmented reality environments, the boundary between artist and audience becomes blurred, as users have the power to manipulate and alter the art itself. This shift questions the authority of the artist and suggests new forms of co-creation, where art is not only consumed but also shaped by the audience.

## **5. Conclusion**

The evolution of digital art, from its early experiments in the 1960s to its current, highly sophisticated practices, reflects the profound impact of technology on artistic expression. Over the decades, digital art has expanded the boundaries of creativity, offering artists new tools and mediums to explore. From the pioneering work of algorithmic artists in the early days to the rise of interactive, AI-driven, and blockchain-authenticated art,

digital technologies have continuously reshaped how art is conceived, produced, and consumed.

Technological advancements, such as the shift from 2D to 3D art, the rise of the internet, and the development of AI, have not only introduced new aesthetic possibilities but also challenged traditional notions of authorship, ownership, and creativity. The emergence of NFTs and blockchain technology has transformed the digital art market, while the growing use of AR and VR promises to further revolutionize the way audiences experience and interact with art. However, these innovations also raise important ethical and philosophical questions, from issues of accessibility and environmental impact to debates about the role of human agency in art creation.

In sum, the evolution of digital art showcases how closely intertwined art and technology have become in the modern world. As digital tools continue to advance, they will undoubtedly continue to influence and expand the scope of artistic practice, offering new opportunities for creativity while also presenting new challenges for artists, audiences, and society as a whole. Understanding this evolution is essential for navigating the future of art in an increasingly digital and interconnected world.

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