

The Impact of Artificial Intelligence Technology on Visual Effects: An Essential Component of Industrialization

Name: SHIQI MA

E-mail: s.ma0620221@arts.ac.uk

Supervisor: Nigel Mairs

Abstract: Artificial Intelligence is profoundly revolutionizing the Visual Effects (VFX) industry, offering groundbreaking advances and efficiencies. This article delves into the revolutionary impact of AI on VFX, detailing its significant contributions towards improved visual realism, automation, and efficiency. AI has transformed tasks such as creating complex 3D models from 2D images, real-time rendering and developing cost-cutting methodologies. Game sector technology innovation powered by AI-driven techniques such as Deep Learning Super Sampling and Anti-aliasing has enhanced visual quality and gameplay smoothness, leading to better visuals and gameplay experiences for gamers. However, this rapid technological progress also presents unique challenges, ranging from potential job displacements and ethical considerations like AI misuse. This paper will discuss the impact of artificial intelligence on today's society and industry from the perspective of risks and opportunities, while looking forward to the future of AI in the field of visual effects.

Keywords: artificial intelligence, visual effects, technology, graphic design, creativity.

Introduction

Our society is witnessing a technological revolution, led by Artificial Intelligence. AI's widespread application has had an immense effect on various industry sectors, most notably Visual Effects (VFX). Visual effects play an integral part of modern industrialization with ever expanding uses across many fields including game production, film production and many other fields.

With AI technologies maturing and evolving rapidly, they have presented both opportunities and challenges to visual effects (VFX). Traditional visual effects production processes typically rely heavily on manual labor which can be time consuming and costly, whereas AI not only enhances production efficiency but also drastically enhances visual effect quality and realism through deep learning and neural network technologies which now allow artists to quickly generate highly realistic 3D models and textures to enhance the realism of VFX effects. Additionally, in the gaming industry, AI applications are expanding dramatically. From game character design and animation production through real-time rendering and ray tracing to real-time rendering and ray tracing, AI technologies like Deep Learning Super Sampling, and Deep Learning Anti-aliasing not only increase the visual effects of games but also facilitate their smooth running on various hardware.

The development of AI technology also raises some potential concerns and risks. Our society needs to consider the consequences of over-reliance on AI, including a loss of creativity and reduced motivation to create. At the socio-economic level, we also need to consider that while AI technology saves costs, it will also bring a lot of unemployment. On the moral and legal level, we still have a lot to pay attention to, such as the abuse of artificial intelligence technology may bring crime. All in all, artificial intelligence is affecting the field of visual effects in an unprecedented trend, which brings more opportunities and greater risks at the same time. We will discuss the impact of artificial intelligence in the field of visual effects in detail in this article..

Literature Review

With the rapid development of artificial intelligence technologies, practitioners of the film industry have started to explore the possibility of AI's assistance to produce better film products. Chow, Pei-Sze(2020), discussed the AI newly published practical applications on film production during the greenlighting phase, which is a very important period for movie production, because it is highly related to the analysis of the potential outcomes and movie project's feasibility. Chow discussed how artificial intelligence could help this decision-making process, and give us an insight into the film industry in the future.

Similarly, Li, Yaxing(2022) focused on the progress of AI assistance participation in the fields of script writing, special effects production, and video restoration within the film industry. A very valuable view was introduced, that due to the rapid development of artificial intelligence technologies, the participation of AI during film production is unavoidable, and this will speed up the production cycle, this paper discussed how we can make production more efficient with the help of AI.

Smith, David(2023), discussed rising waves of AI services in Hollywood in recent years, including AI writing, AI voicing and AI visual effects producing, which makes experts in the film industry concerned about the influence in the future. Smith explored the sentiment within the film industry towards this technological blooming and thought about the potential landscape of Hollywood facing the continued development of AI applications.

The film industry as a developed and popular form of visual entertainment, the continuously rising attention of AI technologies also reflects the development of AI technologies in the field of visual effects, because visual effect is almost the core part of a large amount of movies. Adrian Pennington(2019) introduced how machine learning and deep learning methods improved the development of computer vision, he mentioned that the perfect rendering of characters in popular projects, for example, Avengers Endgame, highlights the great impact of AI technologies on visual effects, shows the potential for more realistic and high-quality visual creations in the film industry. Pavlov, Antonio (2023) holds the point that AI will change visual effects forever, according to his points of view, AI technologies and their related applications have great potential to improve the speed and quality of visual effects, he emphasized that these advancements could bring visual effect with very high quality to those filmmaker with very low budget, which means filmmakers don't necessarily need to spend a lot of money on visual effects, AI applications will solve this in a very cheap but effective way. By analyzing the recent progress of artificial intelligence applications, he mentioned a perspective on how AI is democratizing high quality visual effects production, thus potentially altering the visual effects landscape permanently.

Method

In order to explore how artificial technologies and related applications could influence the visual effects industry, to recognize the rapid development of artificial intelligence in recent years, and how these technologies can make datasets obsolete in a very short time, This study organizes and presents applications of artificial intelligence related to the field of visual effects, with related reports and data.

Primary data sources include news articles, website reports, academic papers and some industry reports. News articles that provided insight into recent AI trends and perspectives within VFX, website reports offer industry-specific development, statistics and breakthroughs as well as academic papers which examined theoretical dimensions, complexity and innovation associated with AI's infiltration of VFX as well as special effects industry reports which offered insight into operational and economic repercussions associated with its introduction into the sector. After the analysis of the data sources we mentioned above, it was subjected to an in-depth analysis procedure and review process about AI's impact on VFX such as creativity boosting capabilities, automation benefits, economic ramifications and industry sentiment were highlighted.

With this study method, we can engage with expansive data sources from the existing study, however, it has a very obvious shortage, the secondary data, which is presented in other reports or studies, brought its own set of challenges, the data that we engaged with might still reflect the bias or limitations of original data collectors, which will make the data not as objective as we expected. At the same time, AI technologies' rapid progress further complicated matters, for example, even data that was considered current at its initial gathering may no longer accurately represent cutting-edge developments by the end of the study.

In the next section, we will discuss how AI technologies and related applications will influence the visual effect industry with the following consideration, the impact of artificial intelligence technology on visual effects, the use of AI technology in today's visual effects industry, the butterfly effect caused by the explosive growth of AI technology, the concerns and dangers of artificial intelligence technology in the visual effects industry and the future development prospect of artificial intelligence technology in visual effects industry.

Analysis

1. The impact of artificial intelligence technology on visual effects

Artificial Intelligence technology has played an important role in many scenes in our daily lives, gradually changing the way we live but its impact is particularly striking within visual effects (VFX). With the participation of AI technologies, many fields like film production, advertising campaigns and virtual reality production, are totally revolutionized, AI technologies are able to create scenes which are more realistic, interactive, and most importantly, with lower cost. If we want to explore the impact of artificial intelligence technology on visual effects, we need to focus on its two major areas of influence, improvement of visual accuracy & realism, and automation & efficiency. One focuses on the result of the production, while another one focuses on the process of the production.

Visual Accuracy and Realism

With the assistance of artificial intelligence technologies, visual accuracy and realism have been obviously improved, for AI can stimulate real-world lighting, textures, and dynamics to produce more convincing experiences for viewers. Deep learning techniques enable AI to learn how to simulate light and shadow in natural environments by analyzing large amounts of real videos (Anantrasirichai & Bull 2020).

At the same time, AI technology plays an increasingly vital role in character animation production. While traditional character animation requires animators to draw each frame manually, AI now automatically generates realistic character animation based on human facial expressions and movements analyzed through facial analysis software, in this way not only increases production efficiency but also gives animated characters more naturalistic movements (Verganti Vendraminelli lansiti 2020).

Automation and Efficiency

Another important application of AI technology in visual effects production is to increase automation and efficiency. While traditional VFX production requires a lot of manual work, AI technology can automatically finish many tasks such as scene matching, object tracking and color correction. This technology not only reduces production time but also production costs (Verganti et al., 2020). For example, machine learning algorithms can quickly recognize and segment objects in a video and automatically add special effects or post-process them. In addition, AI can predict possible problems and automatically make corrections, thus avoiding human error. This technique not only improves production efficiency but also ensures high quality of visual effects (Anantrasirichai & Bull, 2020).

In the next section, we are going to explore the specific use of AI technologies in the visual effect industry.



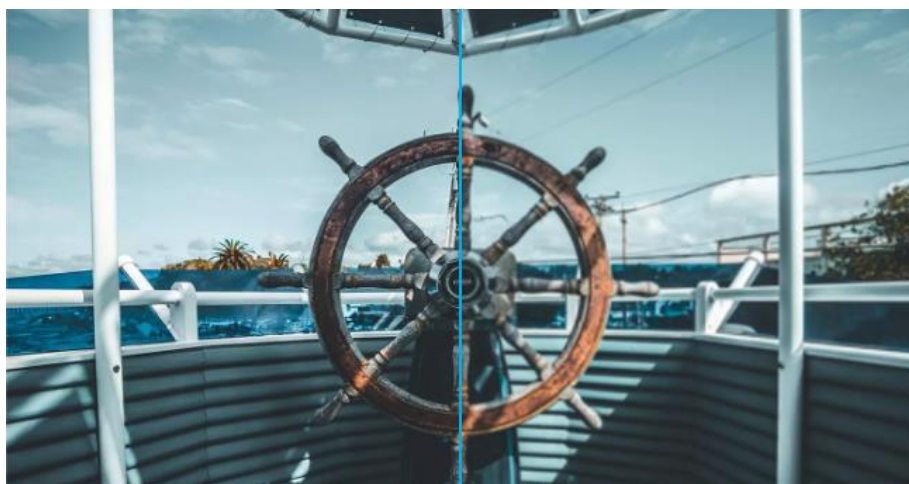
Source: <https://deepsense.ai/ai-movie-restoration-scarlett-ohara-hd/>

Fig.1. Color enhancement to aged images with AI technology.

2. The use of AI technology in today's visual effects industry

Restoring and Revitalizing Old Movies

In the previous few years, automated image synthesis and restoration technology was created, using convolutional neural networks and state-of-the-art image recognition techniques, to give cinematic classics new life. These networks enhance image quality, reduce noise levels and apply color enhancement to aged images to modernize them for nowadays audiences. Restoring old movies will face challenges such as eliminating image distortions, and increasing resolution and format conversion, but with the assistance of AI-driven solutions, particularly supervised learning techniques, have proven highly successful at eliminating cracks and black spots from digital versions of films even after years of wear and tear, making even severely damaged material viewable once more (Konrad Budek, 2019).



Source: <https://deepsense.ai/ai-movie-restoration-scarlett-ohara-hd/>

Fig.2. Convert really old movies into HD

Figure 1 shows the result of color enhancement to aged images with AI technology, with the assistance of AI technology, the old image, which we call it 2-channel gray image, becomes a 3-channel RGB-like image. To help make very old movies look like modern HD films, similar training techniques have been employed to develop neural networks dedicated to improving them. This process includes injecting missing details and upgrading resolution from outdated to HD quality to create an enhanced viewing experience for audiences used to modern resolution standards, we can find this example in Figure 2, the left half is reconstructed high resolution image and the right half is the original low resolution image.

Generating Animated Characters with GANs like Midjourney

GANs have transformed virtual character creation and animation, bring us creative possibilities like never before. Platforms such as Midjourney based on GAN technology, enable artists and developers to quickly and efficiently generate high-quality animated characters, especially 2D illustrations where Midjourney provides detailed control over its generation process, providing users with customized output with high levels of customization and detail. Midjourney's GAN starts by creating an initial sketch for each character, serving as a starting point for its automated generation process. After making adjustments based on this initial sketch, Midjourney's GAN refines it over time by refining details, textures, and colors in order to produce high-quality 2D characters that according to their initial designs.



Source: <https://letstryai.com/midjourney-prompts-for-characters/>

Fig.3. The mouse character designed by Midjourney through interaction.

Midjourney provides a friendly user interface that allows for the modification of various parameters, giving artists control to shape characters that meeting specific aesthetic and thematic requirements. The GAN based technology will run different iterations of their character quickly while testing different styles. In this way, this method allows Midjourney to accelerate character design for modern animation projects. Figure 3 shows how we can generate a high quality character design by Midjourney with following prompts(Milan K, 2023):

/imagine 2D illustration of an anthropomorphic mouse running through the city training for a marathon, simple illustration, cute, children's book --v 5 --ar 16:9

A simple sketch of a mouse quickly turns into a vibrant, detailed, and expressive character through Midjourney, showing its ability to revolutionize animation and visual effects fields with GANs like Midjourney will make creating high-quality animated characters more accessible and efficient than ever before.

Real-Time Rendering and Ray Tracing

The convergence of AI with real-time rendering and ray tracing technologies in today's visual effects industry has significantly expedited and enhanced creative processes. NVIDIA's Deep Learning Super Sampling (DLSS) technology plays an important role here, through features such as Ray Reconstruction, Super Resolution, and Deep Anti-aliasing DLSS

features that serve to speed up this creative process.

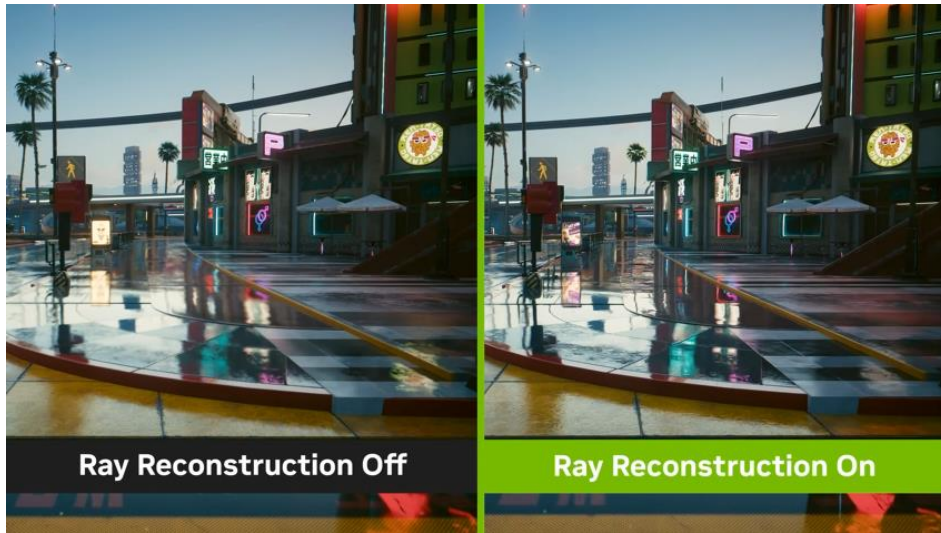


Fig.4. The effect of Deep Learning Super Sampling technology.

DLSS Ray Reconstruction

DLSS Ray Reconstruction with AI technology to predict color values in each pixel and re-use these across multiple pixels for more efficient ray tracing. By intelligently extrapolating ray paths and extrapolating their paths into multiple pixels at once, DLSS Ray Reconstruction reduces the number of rays required to trace and accelerates rendering times without compromising image quality. Its inclusion enables real-time global illumination rendering times as opposed to traditional methods without compromising image quality, Figure 4 shows the effect of this technology(NVIDIA, 2023).

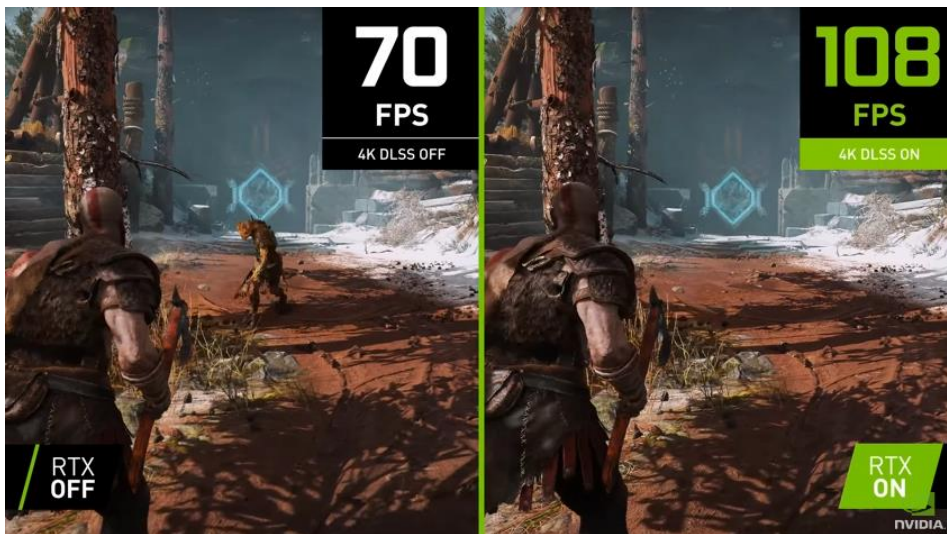


Fig.5. The effect of Super Resolution technology.

DLSS Super Resolution

Using deep learning methods to upscale lower resolution images to a higher resolution prior to rendering, significantly speeds up real-time rendering for complex scenes and makes real-time rendering more feasible in general. AI-powered upscaling ensures the final image retains high levels of detail and sharpness which is often lost through traditional upscaling methods. As a result, DLSS Super Resolution stands as an exceptional way of reconciling rendering speed with image quality, Figure 5 shows the effect of this technology(NVIDIA, 2023).



Fig.6. The effect of Deep Learning Anti-aliasing technology.

Deep Learning Anti-aliasing

DLAA is another groundbreaking feature of Deep Learning Spatial Semantics, using deep learning and neural networks to eliminate jagged edges in images which is what we call aliasing. While traditional anti-aliasing techniques utilize static pixels or filters, DLAA takes an entirely different approach, it implements deep neural networks to understand image data for processing ensures more efficient anti-aliasing results in significantly smoother and more realistic output, particularly effective against scenes featuring complex geometries, Figure 6 shows the effect of this technology (NVIDIA, 2023).

3. The butterfly effect caused by the explosive growth of AI technology

The exponential development of Artificial Intelligence, propelled by strategic investments from tech titans such as NVIDIA and Microsoft, has catalyzed an explosion of progress throughout visual effects, film, and gaming industries.

Investments and Collaborations

NVIDIA has been at the forefront of collaborative efforts to catalyze AI industrial revolution. This tech giant has strategically aligned itself with industry heavyweights, forging partnerships that support advancement of AI technology across various fields and applications. One such example is Foxconn's partnership to accelerate this change by building AI-centric factories and systems, such efforts demonstrate NVIDIA's dedication to using AI for industrial advancement.

NVIDIA and Microsoft's long-term partnership seeks to build one of the world's most formidable artificial intelligence supercomputers. Powered by a combination of Azure's supercomputing infrastructure and NVIDIA GPUs, networking, and AI software solutions, this venture aims to assist enterprises with training, deploying, scaling and expanding AI applications, thus expanding computational capacity while spurring innovation across industries. NVIDIA and Google Cloud's partnership is another sign of NVIDIA's collaborative spirit in furthering AI computing. It offers new AI infrastructure and software, helping construct massive models for generative AI to accelerate data science workloads faster. Furthermore, this alliance brings AI solutions closer to more users and developers while offering essential tools necessary for harnessing its power (NVIDIA, 2023).

Impact on Filmmaking

Adrian Pennington(2019) introduced how machine learning and deep learning methods improved the development of computer vision, he mentioned that the perfect rendering of characters in popular projects, for example, Avengers Endgame, highlights the great impact of AI technologies on visual effects, shows the potential for more realistic and

high-quality visual creations in the film industry. AI has revolutionized film making by providing more creativity, efficiency, and immersive storytelling opportunities. One prime example of AI-driven real-time processes can be seen in The Mill's proof of concept, which integrated Epic's Unreal game engine and other tools into broadcast, film, and commercial productions. AI has also revolutionized how filmmakers create computer generated imagery (CGI), craft realistic visual effects.

Visual Effects Enhancement

The use of AI technology has brought new life to the visual effects industry. It is adding fresh blood to old movies, making them shine again by fixing blurs and color issues with the assistance of deep learning and machine learning methods. Also, creating animated characters has become a simple and efficient thing with tools like Midjourney, which helps artists make lively characters quickly and with satisfactory detail. At the same time, the technology speeds up the process of making visual scenes look real and sharp, especially with NVIDIA's smart tools that make images clear and smooth in no time. All in all, AI is like a magic wand, making the process of creating and fixing visual effects faster, easier, and way better.

Game Development

Deep Learning Super Sampling technology, which we mentioned in the previous section, leverages artificial intelligence and machine learning techniques for image production at high resolution without burdensome computation loads, DLSS works by rendering only part of an image before using AI to predict what the rest should look like, and creating high-quality images faster while still giving players a smooth gaming experience even on less powerful hardware.

Various AI technologies like DLSS benefit both game developers and gamers. For gamers, they are able to enjoy games with high-quality visual effects, and for game developers, it means they can create visually stunning games with high frame rates without worrying too much about the hardware limitations of the end users. This technology not only allows for a better gaming experience but also expands the potential for more complex and visually appealing game design.

4. The concerns and dangers of artificial intelligence technology in the visual effects industry

With the rapid development of AI technologies, there is also growing concerns and potential dangers in the visual effects industry, followings are some related points:

Disruption and Unintended Consequences

Integrating AI into visual effects industry workflows may cause significant disruptions, uprooting traditional methods that rely on human expertise and intuition, potentially to be replaced with AI-driven processes. Mhlanga (2022) highlights this potential unintended consequence as part of technology's fourth industrial revolution, the AI tool may produce visually impressive effects but without emotional resonance or narrative coherence like what a human artist could provide which will lead to visuals that feel out of place or awkward within their film or video game context.

Unpredictability in AI outcomes can cause trust issues among industry professionals. When AI tools produce unexpected or undesirable results, such as delays or revisions that come as a surprise, trust issues arise among professionals in the industry. As Mhlanga (2022) notes, governments and industry regulators need to establish trust in these technologies by assuring reliable outputs from them.

Human-Centric Focus

The visual effects industry is inherently creative. Anantrasirichai and Bull (2020) argue that artificial intelligence should be designed to augment rather than replace human creativity. While AI may handle repetitive tasks or complex simulations more efficiently than humans do, storytelling through visual effects remains human at its core, over-reliance on AI could result in visually pleasing but soulless productions with no emotional depth or connection with viewers.

For optimal results, AI tools should work alongside human artists collaboratively, each augmenting each other's strengths to produce results that resonate both technically and emotionally with audiences. This human-centric approach ensures that audiences find meaning in what is created at both an emotional and technical level. Within Visual Effects industries, the implications of AI's integration with humans will be far reaching.

Societal Impact

Lauterbach (2019) discusses its societal ramifications by emphasizing how decisions made today could determine tomorrow. If AI tools favor certain visual styles over others, this could result in homogenizing media content, further decreasing diversity and representation. Adopting AI responsibly is essential. Ensuring AI tools are utilized ethically can prevent potential societal repercussions like perpetuating harmful stereotypes via visual content.

Over-reliance on AI

AI's efficiency and precision may lull studios into overly relying on it, potentially losing some of the human touch that makes memorable visual effects so remarkable. Furthermore, over-automation could reduce innovation as artists may become less inclined to experiment or push boundaries if they realize that AI tools can do their work for them.

Job Displacement

As AI tools become increasingly advanced, there's cause for alarm about job displacement in the industry. Tasks which once required multiple artists could soon be handled by a single AI program, this potentially leading to significant job displacement, especially at entry-level roles or for repetitive work.

Ethical Considerations

Lack of transparency in AI's decision-making processes is a serious cause for concern in visual effects production. For instance, training an AI tool on limited or biased datasets may lead to misrepresentative visuals produced from it, at the same time, there's also the threat that this content might be misused or used inappropriately such as deepfakes and doctored videos that use this content improperly.

5. The Future Development Prospect of Artificial Intelligence Technology in Visual Effects Industry

According to the McKinsey Global Survey, generative AI tools have experienced remarkable expansion worldwide since their initial release (McKinsey 2023). Many organizations incorporated them quickly after launch. Generative AI holds great promise for the visual effects industry as it allows creators to quickly produce high-fidelity visual effects that were previously difficult or time consuming to realize. Artificial Intelligence technologies in the visual effects industry promises significant advances that are set to revolutionize workflows, expand creative potentials and establish innovative methodologies for creating realistic visual representations. Below is a curated discussion from multiple distinct sources published in this year that depict the progress of AI technology within this realm.



Source: <https://www.matthewtancik.com/nerf>

Fig.7. The effect of generated 3D model of a red car from 2D image with NeRFs technology

One notable development is the creation of Neural Radiance Fields (NeRFs). NeRFs enable the creation of detailed 3D models from 2D images via deep neural networks, rendering realistic lighting and intricate details with stunning visuals which means VFX artists have the ability to render realistic lighting and details in scenes with the assistance of NeRFs. Constant improvements of NeRFs open up new opportunities for creating immersive visual effects while pushing realism limits, Figure 7 shows the effect of this technology (Visual Skies 2023).

In the next few years, we can predict that AI will enhance efficiency, realism, and creativity in VFX production by generating textures, animating, and compositing CG characters. It's aiding in tasks like background replacements and rotoscoping, which are essential in VFX workflows. Moreover, AI's ability to automate the editing process by analyzing video footage, detecting patterns, and enhancing clips significantly contributes to a faster and more efficient post production landscape (Filmmakers Academy, 2023). With AI tools, filmmakers can generate stunning computer generated images (CGI) that enhance visual storytelling. AI also empowers filmmakers to de-age actors and create realistic visual effects, thus pushing the boundaries of what's achievable in visual storytelling.

AI in visual effects industry is ushering in an age of hyper-realistic content production. AI techniques like NeRFs will likely allow more tailored solutions tailored to specific projects' requirements for enhanced visual experiences. As hardware evolves in tandem with AI algorithms, computational power available to VFX artists will increase exponentially further decreasing the gap between imagination and on screen reality.

We can predict in the future, AI assistant visual effects technologies will democratize the industry. Independent filmmakers and content creators who might not previously have had access to top-tier visual effects tools will gain access to top-of-the-line tools enabling top-tier effects - leading to a proliferation of narratives, perhaps ushering in a golden age for cinema and digital content production.

However, with these advancements come ethical considerations. AI's power to produce hyper-realistic visuals may blur the line between fiction and reality in the future, making it essential for industry leaders to establish guidelines ensuring responsible and transparent use. Those questions that we discussed in the previous section will be more and more vital, we have to handle the challenges, and only in this way, we can enjoy the convenience that AI technologies have brought to us. Overall, the future of AI visual effects holds both remarkable opportunities and obstacles.

Conclusion and Discussion

AI technology's transformation of visual effects represents nothing short of a revolution for visual effect industries. As audience expectations evolve and their desire for unparalleled realism increases, visual effect industries will soon find themselves at the crossroads between art and advanced technology, due to AI bridges by offering tools that enhance artistic vision while simplifying complex processes.

Visual effects are at the heart of visual storytelling and serve to illustrate producers' imagination. Early visual effects were often limited by technology but today with the assistance of AI technologies, the only thing holding back producers' visions seems to be their imagination itself. Generative Adversarial Networks have become powerful artistic tools capable of producing textures, lighting effects and physics simulations with close resemblance to reality. GANs process vast amounts of visual data in order to produce imagery tailored specifically for artists' intent, it enables artists to create textures to lighting effects bespoke to their intention in an authentic manner that replicates reality closely enough. But the AI revolution isn't just about enhanced quality, at the same time, it also increases efficiency. Many manual tasks have become less burdensome to complete. With the assistance of AI technologies to finish such tasks, VFX artists can focus more on the nuanced creative aspects of their projects rather than mundane repetitive work. Considering AI tools enabling deep image compositing or automatic green screen extraction, which are not just conveniences, but enable faster completions of projects than ever before.

From the economic points of view, AI technology's financial implications are equally profound. By eliminating manual labor hours and the repeated creation of assets for each frame, AI technology offers substantial cost savings that allow production houses to allocate budgets more strategically for narrative development, casting or other critical areas. Furthermore, its capacity for simulating real-world phenomena means less dependence on costly physical effects or lengthy location shoots.

AI's most exciting breakthrough lies in real-time rendering and virtual production, where filmmakers are now seeing photorealistic visuals instantaneously for on-the-fly adjustments and decisions. VR production sets are another significant departure from traditional visual effects that introduces a future, where boundaries between actor and environment will be blurred further, leading to immersive storytelling experiences. Advanced AI's ability to customize visual effects based on audience preferences will be revolutionary, films and games products and content could soon be designed specifically for each viewer based on user data, making their viewing experience as engaging as possible.

At this juncture, it is evident that AI and the visual effects industry are working hand-in-hand to revolutionize the visual effects industry. While tools and techniques will certainly adapt, and technologies will update generations by generations, their essential purpose will remain unchanged, that is pushing back the limits of what can be visually achieved.

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