

Embrace AI to Complete Film Odyssey: A Comparative Analysis of Conventional and AI-generated Production Design-Crisis and Prospect

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Abstract. Artificial Intelligence (AI) technology has been applied to humongous industries and tested out its beneficial potential in finance, engineering, transportation, and so on. Therefore, filmmakers have started to learn and practice the feasibility and efficiency of ai-generated work. This paper explores the crisis and prospects that production designers and art directors could face when using AI technology to produce films. To better understand the pros and cons of AI-generated work in filmmaking, this paper draws a comparative analysis of the conventional and ai-generated production design in three aspects, correspondingly: time efficiency, amount of staff, and production cost. Using interviews and data analysis, this research finds out that AI can improve the efficiency and creativity of production designers; however, it also risks art directors getting replaced in the job markets. Besides, AI-generated production design develops the overall performance of films that require complex visual effects. Yet, the potential of AI-generated production design is a huge topic, enlightening the importance of human intelligence's role in AI technology and producing a qualified film. Furthermore, this research is significant in discovering strategies to fit in the rapidly changing era of AI-generated production designs.

Keywords: artificial intelligence, filmmaking, production design, virtual background

1. Introduction

Production designers and art directors are crucial for conceptualizing and visualizing the overall visual style of a film. It is common for production designer and art director to work on set to create the ideal environment for shooting, and the differentiation between production designers and art directors is not obvious. However, this article defines and distinguishes between production designers and art directors to explore the impact of both in the AI era. Production designers are responsible for the building of a film's key concept and providing diverse ideas for the film's aesthetics, and art directors hear production designers' voices and practically build everything possible on set for shooting.

AI, a tool that relies on advanced algorithms, machine learning, and neural networks, can process large amounts of data, analyze it, recognize it, and then make decisions based on the information.

However, AI does not only benefit science but also provides more possibilities in the process of film production.

This paper explores the revolution that AI technology brings into production design by comparing the innovation and effectiveness that ai-driven apps, Midjourney, Stable Diffusion, and Stable Houdini provide for production designers while mentioning the crisis of jobs and prospects for production designers and art directors from comparing the amount of staff and cost in conventional and AI-generated production design on big budget films. Therefore, this paper will discuss the concerns of the originality and authenticity of ai-generated production design and provide suggestions for using AI to assist filmmakers and develop AI-driven apps to achieve a better version in production design. However, it is worth mentioning that the creativity and manpower of filmmakers are significant and indispensable for completing the film Odyssey.

2. AI-driven apps in the progress of production design for production designers

AI-generated effects in many digital painting apps change the mindset of production designers as they use AI-driven drawing apps to assist in the creation of their works. In this part, an analysis of the use of Midjourney, Stable diffusion, and Stable Houdini will be provided to prove that AI-driven apps are improving overall time efficiency and providing astonishing inspiration for production designers. Moreover, by analyzing the difference in production design between Blade Runner(1982) and Blade Runner 2049(2017), it can be seen that there is no job crisis for production designers for now.

2.1. Midjourney

For production designers, Midjourney stands out for its ability to generate images through prompts and text messages. That means Midjourney is more like an interpreter that only generates images from a text description regarding styles. Therefore, it can be applied as a tool for the production designer to get a rough visual image in the first place, shrinking the time for a sketch. According to a survey by Alışık, Midjourney performs its ability to generate visual images for literary works, assisting in recreating the visual concepts and emotional depth of a text [1]. Hence, it is for sure that Midjourney can help production designers visualize the literature text when it comes to the film adaptation of a novel [2]. Compared with Stable Diffusion and Stable Houdini, Midjourney stands out for its user-friendly features. It enables people without painting techniques to generate ideal pictures.

2.2. Stable diffusion

Moreover, Stable diffusion technology can increase time efficiency for production designers by automating the refining of designs and color filling. From the research of Yan, the Semantic segmentation (Seg) function and line draft (Canny) function of the ControlNet plug-in in Stable Diffusion enable the coloring and optimization of hand-drawn manuscripts [3]. Stable Diffusion develops its function of color filling by Seg function. It separates the areas that need to be filled in a sketch to achieve a more detailed and accurate color filling. However, it requires a more complex procedure to place the order than Midjourney, so the users need to put it into practice to use Stable Diffusion more expertly.

2.3. Stable houdini

When it comes to Stable Houdini, the generated AI can be controlled from within Houdini to generate 2D images based on text prompts, source images, or the composition of 3D scenes. It is convenient for production designers to create simple 2D images or 3D scenes for further discussion in production design with directors when a new site for shooting needs to be constructed [3]. Therefore, a large amount of time will be spared. By far, Stable Houdini is one of the most refined AI software that can complete simple animations and videos. It has a clearer subject cognition and detail cognition than Midjourney. Compared with Stable Diffusion, Stable Houdini has a more controllable function of generating and fast-shifting steerable image style without changing image composition [3].

For previous production design, production designers need to find inspiration through searching the Internet, browsing books and magazines, and experiencing art. However, the introduction of AI-driven apps has changed the way how production designers observe information. In an interview with four production designers-Anu Schwarz, Sara Millan, Alexsander Whittenberg, and Rose Lagace, they all mention that AI-driven apps can sift through society's collective digital thinking and spit out images from the keywords prompt tools search for [4]. It is easier for production designers to get inspiration from generated art rather than browsing the humongous art database online. Moreover, it is also a derivative process that still requires human participation.

3. Crisis and prospect for production designer

Some problems lie behind three of the AI-driven apps. Midjourney cannot recognize the composition and the position of the subject in sketches. It is worth mentioning that the problem of subject cognition ambiguity exists in the way of using Stable diffusion to color the freehand manuscript and optimize the output [3]. Stable Houdini, however, has a certain technical threshold for beginners and requires high hardware configuration. Therefore, production designers need to practice adjusting these rising AI apps to improve time efficiency and gain inspiration.

As AI gains popularity and proves the efficiency it can bring to film production, concerns of originality and authenticity in production design have been raised in public. It is complex to determine the copyright ownership of AI-generated content in terms of the difficulty in attributing the copyright under the lack of legal personhood of AI [5]. For production designers, the only procedure that AI can assist with is for inspiration and a sketch. It is worth mentioning that AI creates images based on the data it captures in the input of its maker. And the input is usually thousands of existing art pieces. In the current stage, AI is only a tool for production designers to quickly observe existing artworks and gain inspiration without searching countless information online and offline. Moreover, AI's functions of detailing and color filling only reduce the amount of time the production designer spends on repetitive tasks, which means that the originality and authenticity of the work presented by the production designer remain unchanged.

According to a micro documentary-A Good Start, and behind the scene clips that show the production design process of Blade Runner (1982) and Blade Runner 2049 (2017), most of the visual effects are finished in the production design part on set in pre-production and there is little effect finished in post-production [6-7]. Compared to Blade Runner 2049 (2017), although it introduces advanced AI-driven visual technology, the concept and style of production design also come from the production designer's imagination and creation. Moreover, only a small part of background visualizing is generated. Based on the crew list on IMDb, it is clear that both Blade Runner and Blade Runner 2049 hired one production designer to conceptualize the film style [8-9].

Also, for most of the film crew listed on IMDb, the amount of production designers is usually around 1-3 per film in films from 1982 to 2024, which remains stable for over 40 years. In conclusion, it can be seen that the demand for production designers has not diminished with the development of AI and it is for sure that AI-driven apps can improve time efficiency and inspire production designers more in the future.

It is undeniable that although the works generated by AI are not yet perfect enough to directly achieve commercial purposes, in the case of continuous development of future technology, if AI works are put into commercial use, and the data copied by AI is all from existing artworks, then the benefits generated by the ai work should be partially distributed to the artist being used to protect the copyright. This provision to protect the rights and interests of original artists should be more widely applied to various AI-powered apps that generate scripts, images, and videos. In addition, AI developers and technology companies have a responsibility to implement ethical codes and safety protections to prevent unauthorized use or infringement of copyrighted materials [10]. By proactively addressing copyright issues, the film industry can harness the transformative power of AI while respecting intellectual property rights and fostering creativity within the law [10].

4. Impact of AI-driven technology for art directors and visual effects department

AI-driven technology influences the personnel of art directors in film production. A comparative analysis of the ratio and production cost in two big-budget films - Blade Runner and Avatar- shows that the art direction department and visual effects department have a certain competitive relationship, leading to a job crisis for art directors. Moreover, the advanced AI-driven virtual background technology creates a crisis for the visual effects department but gives new possibilities for art directors with the example of The Mandalorian.

4.1. Blade runner and avatar

The departments of art direction and visual effects contribute to the overall visual style of a film, so it is necessary to mention the ratio of both when analyzing the influence brought by the development of AI technology. A chart is shown by comparing the ratio of the amount of staff in the art direction department to the total amount of staff, the amount of staff in the visual effects department to the total amount of staff, and production cost in Blade Runner and Blade Runner 2049, Avatar and Avatar: The way of water. The statistics below are from the IMDb website. Production cost stands for the overall production cost of each film with a unit of one dollar. The total amount of staff, the amount of staff in the art direction department, and the amount of staff in the visual effects department are counted from the IMDb crew list [8-9, 11-12].

4.1.1. Blade runner and blade runner 2049

Table 1. Production cost and the ratio in Blade Runner and Blade Runner 2049

	Production cost	Total staff count	Art staff count	Art direction staff to total staff	Visual effects staff count	Visual effects ratio to total staff
Blade Runner (1982)	\$28,000,000	366	45	0.12	118	0.32
Blade Runner 2049 (2017)	\$150,000,000	2179	202	0.09	1150	0.52

In these two films, the production cost and the total amount of staff quintuples, the decrement rate of art director reaches 25%, while the visual effects department staff grows by 63%. From the statistics, it can be said that the demand for art directors in Blade Runner 2049 diminished but the demand for visual effects staff and the production cost grew immensely from 1982 to 2017 due to the development of AI technology.

4.1.2. Avatar and Avatar: The way of water

In these two films, it can be shown that the production cost rises by 48%, the total amount of staff is down 14%, the ratio of the art director to the amount of staff rises by 50%, and the ratio of visual effects staff to the amount of staff decreases by 12%. The statistics show that the demand for art directors in Avatar: The Way of Water rises while the demand for visual effects staff reduces.

Table 2. Production cost and the ratio in Avatar and Avatar: The Way of Water

	Production cost	Total staff count	Art direction staff count	Art direction ratio to total staff	Visual effects staff count	Visual effects ratio to total staff
Avatar (2009)	\$237,000,000	3266	213	0.06	1911	0.58
Avatar: The way of water (2022)	\$350,000,000	2822	261	0.09	1426	0.51

The results of these four films show that the need for art directors relatively depends on the need for visual effects staff. According to statistics, the demand for visual effects staff increased rapidly with the development of AI technology from 1982 to 2017, while the proportion of visual effects staff in science fiction films has remained stable between more than 50% and less than 60%. Although the fluctuation is small, it can be seen that the amount of staff in the art direction department is inversely related to the amount of staff in the visual effects department.

Besides, with the number of 0.09, it can be seen that the ratios of art directors to the total amount of staff are the same in both Blade Runner 2049 and Avatar: The Way of Water, concluding that the percentage of the amount of art directors is around 10% in big-budget science fiction films.

4.2. The mandalorian

Films that need heavy visual effects require different ways of directing, framing, shooting, lighting, and designing. Before the widespread of digital techniques, backdrops, matte paintings, and front and rear projections were widely used in the early and mid-20th century [13]. Conventional films often require elaborate set constructions that the art direction department is responsible for, but with the current possibilities provided by blue and green screens and AI-driven virtual backgrounds, it can be finished in post-production or during the shooting stage. It is worth mentioning that the blue and green screens technique still requires much work from the visual effects department in the post-production stage. However, AI-driven virtual background not only replaces the traditional techniques for scenes but also shakes up the status of the blue and green screens technique for its time efficiency and cost economizing. According to Lama, the virtual background provides the flexibility of reducing the cost of location scouting, travel expenses, and the associated challenges that the visual effects department may face in the post-production stage [13]. For The Mandalorian, there is no need for the production team to shoot in a desert or put a heavy load on visual effects post-production to create an outer space for the background. It uses an AI-driven virtual background

LED screen to complete the visual environment for big scenes. Therefore, both art directors and the visual effects department face the competition that virtual background brings out.

However, the LED virtual background has its limitations in distance, lighting, and lack of interactivity. For distance, camera movement is restricted due to the range of the screen, yet *The Mandalorian* applies the gaming software program Unreal Engine 3 by Epic Games 4 to create the possibility of real-time rendering of the footage with projected background and the use of In-Camera VFX5 to avoid the limitation of perspective [13]. The requirements for lighting are relatively high because it could look fake if the lighting does not match the light effect on the virtual screen. For interactivity, the foreground of the virtual background still needs art directors to create and blend it with the virtual background. Under this condition, it is the art director and AI-driven virtual background cooperate to complete the visual effect in the pre-production and shooting stage.

On the one hand, AI technology has now run through the pre-, during, and post-stages of film production, mainly improving the efficiency and results of production designers and the visual effects department. On the other hand, the development of AI-driven virtual backgrounds leaves a threat to blue and green screen technology, which is directly related to the visual effects department. As a result, the job crisis for art directors still exists. Although art directors and visual effects personnel are involved in the visual effects of movies, the competition between the two will become more intense with the improvement of AI technology.

5. Conclusion

With the comparative analysis of conventional and AI-generated production design in time efficiency, amount of staff, and production cost in big-budget films, it can be shown that the use of AI can benefit production designers while not threatening their job opportunities. However, the visual effects department, which also belongs to the realization of visual style, develops rapidly with the development of AI technology and has a large demand for personnel in film production. In this case, the job crisis is persistent and threatening for art directors. As the industry navigates the dynamic interplay of technology and creativity, virtual filmmaking, exemplified by *The Mandalorian*, has emerged as a dynamic force, taking the visibility of cinema to another level. As a result, the competition between the art director and the visual effects team will become more and more intense with the development of AI technology, and the development of virtual background technology will make the visual effects department face a new employment crisis.

Not only that, creative content generation is now empowered by AI algorithms that can analyze vast amounts of data, such as scripts, storyboards, and existing movies, to generate new and original ideas. In this case, the issue of copyright ownership of originators cannot be ignored. Therefore, new laws must be established to protect the rights and interests of creators to realize the vision of peaceful coexistence and common progress of artificial intelligence and human beings. Placing an eye on the future, it is sure that AI technology will play an important and indispensable role in the film industry. As AI technology becomes more accessible and sophisticated, we will be thrilled to see the innovation and efficiency it brings to filmmaking. Meanwhile, there are still risks and challenges lying behind its fast development, and every filmmaker should bear in mind that AI technology is driven by human intelligence and the key to a masterpiece is our creativity.

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