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Comparison of the Characteristics of Green Screen and LED Wall in Virtual Production System

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Abstract

In recent years, with the continuous innovation and upgrading of engine software, the real-time rendering technology in film and television has been continuously improved, and the virtual production technology has also developed rapidly. This paper introduces the green screen often used in traditional film production and a virtual production technology based on light-emitting-diode background wall that was proposed and implemented last year. We analyzed the two production methods of virtual production and compared their characteristics. Based on these results, we can better understand the differences and respective advantages of the two production methods. And we also can according to the production budget, production cycle and the creative and technical capabilities of the team make better choices during the production process. We believe virtual production technology will be production in the future to provide a more solid technical guarantee for the development of the film industry, and this work will pave the way for further research on virtual production technology.

Keywords: Virtual Production, Green Screen, LED Wall, Film and TV Production, Post-synthesis Technology

1. Introduction

1.1 Objectives and Background of the Research

In recent years, with the rapid development of computer graphics and image technology, interactive technology, and artificial intelligence technology, new technological changes have been brought about in movies, which is virtual production. In essence, virtual production is to replace and realize traditional film and television production with more thorough digital and intelligent means[1,2].

The purpose of this paper is to introduce traditional green screen technology and virtual production

technology using light-emitting-diode (hereinafter referred to as LED) background wall, and compare their respective characteristics. Especially for the era of virtual production of global film and television, we will focus on analyzing the process of virtual production of LED background wall, hoping to lay a solid foundation for in-depth research in the later stage.

1.2 Scope and Method of the Research

In recent years, The research scope of this paper is the virtual production technology used in film production. The characteristics of green screen synthesis and LED wall are analyzed, and the corresponding content of the production process is summarized.
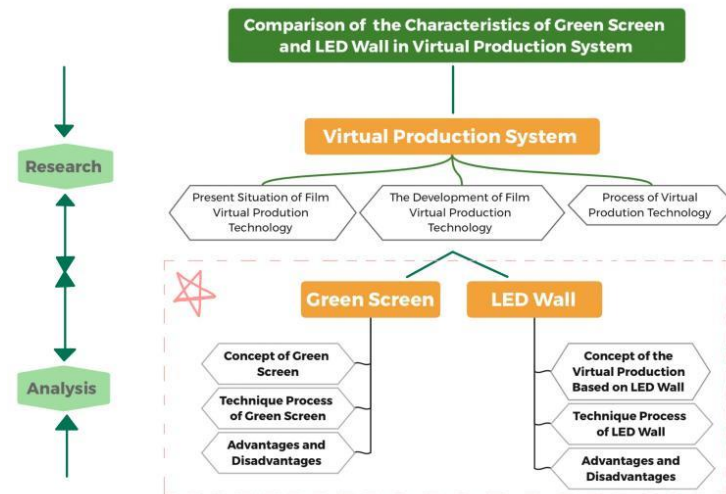

Figure 1. Research procedure

For the reference, the study mainly focused on the analyzing the production process and advantages and disadvantages of traditional green screen synthesis technology and virtual production technology based on LED wall, and the technology is based on the existing shooting application range.

The following Figure 1is a brief summary of the scope and method of the research through the overall analysis study[3].

2. Virtual Production Technology

2.1 The Development and Present Situation of Film Virtual Production

Film is the product of the combination of technology and art, and every major reform of film technology is an extension of scientific and technological reform. The 5G era and the birth and development of the concepts of virtual reality, mixed reality, and Metaverse have driven the development of film technology, which is one of the current hot spots in virtual production technology.

With the emergence of virtual shooting technology in movies such as "Avatar"(2009) and "The Lion King"(2019), the virtual film shooting industry chain has gradually formed. Since then, this traditional virtual production technology with the help of green screen (or blue screen) synthesis has been widely used in various film and television shooting and production.

In essence, film based virtual production replaces and realizes traditional film production with more thorough digital and intelligent means, and traditional green screen synthesis technology is constantly being updated. Especially after the 2019 years global outbreak of SARS-CoV-2, film shooting has also encountered unprecedented difficulties and restrictions.

At SIGGRAPH 2019, Unreal Engine and partners presented a demo video of "Virtual LED Stage" and "In-camera Visual Effects". In 2020, under the premise that the development of the epidemic (SARS-CoV-2) around the world has an impact on film and television production, "The Mandalorian" released by Disney+ has achieved amazing results by applying virtual production technology. Since then, the concept of "virtual production" has taken the film and television production industry by storm[4]. In 2021, SAMSUNG in South Korea also stated that through a new partnership with CJ ENM, a large-scale micro LED "The Wall Display" embodying a "virtual production studio" will be installed in CJ ENM studio[5]. In March of the same year, Absen (China) built the largest indoor panoramic LED stereo digital virtual studio in Asia, with a total area of more than 700 square meters and a display resolution of over 8K[6].

2.2 Process of Virtual Production

Virtual production technology is currently the most cutting edge production technology in the film and television industry around the world. It combines virtual reality(VR), augmented reality(AR), Computer-generated imagery(CGI), motion capture, camera real-time inversion and game virtual engine (like UNREAL ENGINE) technology, and through the combination of LED wall and intelligent lighting system, so that the real actors and the virtual scenes are perfectly integrated[7].

Virtual production covers virtual set construction, preview, scene visualization, virtual filming, character development, and the digital asset production management processes that connect all these practical sections.

3. Analysis on Green Screen & LED Wall

3.1 Green Screen

Concept&Technique Process of Green Screen. When it comes to the green screen real-time synthesis technology in film, we have to mention the movie "Avatar" (2009), which is an earlier and successfully completed virtual production technology's film based on green screen real-time synthesis. The entire film is shot with a blue or green background, using multiple links such as post-editing, special effects and dubbing, with blue or green cloth background shots, match the shots and language one by one against the script text. Since then, the virtual filming technology of the film has appeared in front of the film production team as a unique commercial module.

Advantages of Green Screen. This kind of shooting technology under the background of green screen can more accurately strip the foreground and background, and greatly compress the production time of special

effects. At the same time, this technology also makes the computer special effects technology more perfect use of the film shooting process. By making computer graphics, the technicians integrate the scenes that cannot exist in daily life into the real film shooting.

Table 1. The still photos from "Avengers: Endgame"

Time	The shooting scene	The final movie scene
43'28''		
1:19'02		
1:19'42		

Disadvantages of Green Screen. Firstly this kind of art based on real-time keying rendering still stays in the live preview stage of film virtual production, and often uses lower-quality virtual assets, just to provide a concrete reference for the on-site creators, not the high-quality images used in the final film. The following Table 1 is a still from the movie "Avengers: Endgame"(2019)[8]. By comparing the recorded photos of the shooting scene and the final movie screen, we can find out that during the filming of "Avengers: Endgame" (2019), more than 2,400 shots were produced through green screen composite, motion to capture, etc. The actors almost all rely on strong imagination to complete the performance on the scene, and the pictures that the audience sees are mostly pictures completed through post-production. Secondly whether green screen or blue screen is used, there are certain limitations to the matching of clothing or accessories of the same color in the scene. And in the green screen environment, if you use materials such as metal, glass, etc. that produce specular reflection or refraction, it will greatly increase the workload of the later stage. Thirdly this technical means make the actors unable to obtain real-time environmental reference during the performance, and can only understand the specific environment through the replayed live preview video, which will increase the number of shootings unnecessarily[7].

3.2 LED Wall

Concept of LED Wall. With the rapid development of LED technology, its dot pitch, brightness, color rendering, contrast, dynamic range and other technical indicators have been greatly improved, and it has been able to meet the requirements of direct film shooting background and lighting environment.

In November 2019, the release of "The Mandalorian" attracted the attention of Hollywood in the United

States and even the global film and television industry. In addition to the hot spot based on "Star Wars", the European super IP itself, the new technology "virtual production" which applied in the production process of "The Mandalorian" has also greatly shocked the global film and television industry, and has greatly improved the film and television industry for film and television creators, it shows a wider creative space.

Figure 2. "The Mandalorian" StageCraft system

More than half of "The Mandalorian" was shot using the "StageCraft" system based on LED background walls, which greatly reduced the reliance on external locations. As shown in the Figure 2, the "StageCraft" system includes a set of 270-degree ring screens about 6 meters high and composed of multiple LED screens, providing an actual performance area of about 23 meters in diameter[9].

Technique Process of LED Wall. Different from the traditional virtual production which used green screen, the virtual production technology based on LED wall puts more emphasis on move the post-production process to the early process, aiming to hand over the control of the final presentation of the film to the live director and main creators. Therefore, it is necessary to complete the production of virtual models, visual effects, virtual-real interaction and other content produced by post-production companies in the traditional sense before the start of shooting, and make preparations for the actual filming of the film.
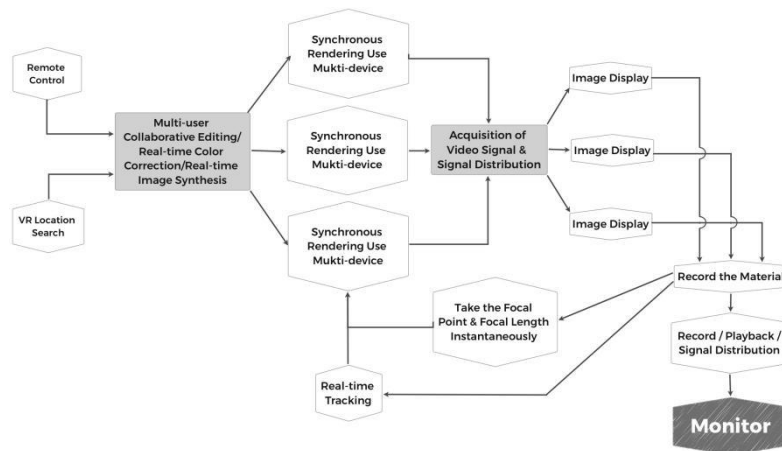

Figure 3. The process of LED wall virtual production

In the process of film shooting, the main creator can edit the scene in real time through external devices

such as VR Equipment, perform color correction, matting, synthesis and other technologies. On the basis of synchronous rendering and display of multiple devices, and share the video synchronously to the LED wall, and make it the background of the shooting environment. Finally, on the basis of real-time acquisition of camera position and other information, the composite picture in the camera can be directly shot, and the picture effect of the scene shot will be used as the final material. As shown in the [Fig. 4], it is the implementation technical process based on the virtual production of the LED wall.

Advantages of LED Wall. Compared with the green screen real-time synthesis technology of traditional virtual production, the virtual production technology based on LED wall makes the nonlinear characteristics of the whole production process more obvious, and requires the high cooperation of various shooting and production departments[10-11]. It can provide a virtual space for film creators to give full play to their imagination and perform performance creation, and display it on the LED wall, and various departments can work together to create a film in an on-site visual and immersive environment.

Disadvantages of LED Wall. [1]Since the use of LED wall is still a relatively new virtual shooting technology, there are also some technical problems that need to be overcome and solved in the future, one of which is the input cost of LED wall. In order to get a better video picture effect, the LED wall currently used at home and abroad is a 270-degree ring screen composed of multiple LED screens. Like the LED wall studio built by CJ ENM in 2021, it consists of LED displays with a maximum size of 1000 feet and 16K pixels. At the same time SAMSUNG introduces new frame speed options such as 23.976, 29.97 and 59.94 Hz to ensure smooth video synchronization with the most widely used camera frame speed. This makes its cost continue to increase, making it impossible to build the LED wall studio on a large scale. [2]In this virtual production process, due to the LED flashing, the method of shooting at high frame rate may have a "chemical reaction" with the refresh rate of the LED screen. And pictures containing the LED flashing will be difficult to eliminate through digital intermediate, so usually will be deprecated. [3]When using a digital camera to shoot the LED screen playback picture, if the spatial frequency of the pixels of the photosensitive element is close to the spatial frequency of the stripes in the image, there will be some irregular water ripple patterns in the imaging picture, which is what we call Moiré Pattern. This Moiré Pattern will seriously affect the image quality. In order to prevent the appearance of strobe and Moiré Pattern, a lot of post-adjustment work is required, and under the current technical conditions, it is difficult to completely eliminate it[12].

4. Conclusion

In conclusion, whether it is the green screen real-time synthesis technology of traditional virtual shooting or the virtual production technology based on LED wall, both can help us solve some problems that cannot be achieved during film shooting like special weather and scenes, etc.. The emergence of virtual production technology has broadened the imagination and creative space of film artists. When our production budget is limited and the production cycle is relatively sufficient, we can choose to use green screen to set up the scenes used to present a virtual environments, which can greatly reduce our production costs. But this has higher requirements on the imagination of the actors and the production ability of the post-production team. On the contrary, if the production budget is sufficient and the film production team has a strong ability to coordinate and cooperate, We can try to use the new LED wall virtual production technology, which can effectively reduce the shooting cycle and get a more realistic and controllable picture effect.

The continuous advancement of computer hardware is the precondition for the development of virtual

production. Every upgrade of computer hardware means that the graphics image is closer to the real scene that we see with the naked eye. At the same time, the engine technology is constantly developing, and it will provide technical support such as real-time ray tracing in our successful virtual production. In the future, we believe that virtual production technology will gradually become popular, and will be further integrated with emerging technologies such as artificial intelligence production and cloud production in the future to provide a more solid technical guarantee for the development of the film industry.

References

[1] MiRa Kim, "Post Coronavirus, a shift of Video Contents Production Technology: Virtual Production System", Moving Image Technology Association of Korea, 15(8), pp. 27-44, 2021.
DOI: http://dx.doi.org/10.34269/JDC.2021.1.35.002

[2] Xinyi Shan, JeanHun Chung, "Comparison of the Characteristics of Three Premium Large-Format Platforms IMAX, Screen X and 360 Degrees Circular Screen", Journal of Digital Convergence, Vol.15, No.8, pp. 375-381.
DOI : http://dx.doi.org/10.14400/JDC.2017.15.8.375

[3] Hansol Joo, SeungJung Shin, "A Study on the IP Transmission Stream for High-Definition Image Transmission", International Journal of Advanced Smart Convergence, Vol.10 No.2, pp59-63, 2021
DOI : http://dx.doi.org/10.7236/IJASC.2021.10.2.59

[4] Title of Website, Virtual LED Stage. *https://www.bilibili.com/read/cv9087698/*

[5] Naver Blog, Samsung Electronics installs a virtual micro LED wall studio at CJ ENM's new headquarters.*https://blog.naver.com/namgoocha/222461538974*

[6] Digital Audio Video, Absen built the largest indoor panoramic LED stereo digital virtual studio in Asia. *http://www.dav01.com/article/2021/03/a6243006.html*

[7] UNREAL ENGINE, Virtual production partners. *https://www.unrealengine.com/en-US/virtual-production*

[8] SaiChengCloudrender, "Avengers4" behind-the-scenes special effects production comparison. *http://www.1strender.com/cn/list/info_59.aspx?itemid=296*

[9] IndieWire. "The Mandalorian". *http://www.dav01.com/article/2021/03/a6243006.html*

[10] Tong Wu, "Application and Prospect of Virtual Film Shooting", Audio Engineering, 45(4), pp.61-63,2021.
DOI: http://dx.doi.org/10.16311/JDC.2021.04.016

[11] Cg channel, FMX 2012: Where next for virtual production?. *http://www.cgchannel.com/2012/05/fmx-2012-where-nextfor-virtual-production/*

[12] Sina Weibo, The "pattern" that is entangled with us in LED virtual shooting. *https://weibo.com/ttarticle/p/show?id=2309404706408980677040*