Post-print: Application of Mobile Virtual Studio Technology in Television Program Production in the Converged Media Era

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Abstract

As a representative new technology in television program production, mobile virtual studio technology offers distinct advantages. The technical requirements for virtual studio technology are not particularly complex; its core function is to digitally composite computer-generated virtual three-dimensional scenes with real scenes captured by television cameras. Accordingly, this paper begins with an analysis of the development background of virtual studio technology, and explores the practical applications of mobile virtual studio technology in television program production within the converged media era, aiming to provide reference and guidance for industry professionals.

Full Text

Mobile Virtual Studio Technology in TV Program Production in the Era of Media Convergence

Abstract: As a representative new technology in TV program production, mobile virtual studio technology offers distinct advantages. This technology does not involve overly complex technical requirements; its primary function is the digital compositing of computer-generated virtual 3D scenes with real scenes captured by TV cameras. Based on this, this paper begins by analyzing the development background of virtual studio technology and explores its practical applications in TV program production in the era of media convergence, providing a reference for industry professionals.

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Thanks to the development of information technology, virtual reality has permeated every aspect of our lives. In TV program production, virtual reality technology has been widely applied, with virtual studio technology being the most representative example. Mobile virtual studio technology represents a further innovation of traditional virtual reality technology, fully breaking the temporal and spatial constraints of TV program production. It plays a prominent role not only in enhancing viewing experience but also in significantly reducing production costs. Drawing on years of frontline experience, this paper focuses on examining the application of mobile virtual studio technology in TV program production during the era of media convergence.

1. Development Background of Mobile Virtual Studio Technology

Mobile virtual studio technology integrates virtual reality technology with chroma keying to construct a virtual world that meets TV production requirements. This technology primarily utilizes computer hardware, with the entire application process running on computer equipment, which is crucial for improving the intensification and precision of TV program production. Generally, mobile virtual studios can be divided into two basic types: 2D virtual studios and 3D virtual studios. As the name suggests, 2D virtual studios involve relatively simple keying processing, which is rarely used in actual TV program production. In contrast, 3D virtual studios make full use of stereoscopic imaging technology, incorporating real-time pan-tilt-zoom rendering functions to build a complete virtual system. The main implementation approaches for 3D virtual studios in television stations are varied. The first is sensor-based 3D, which involves installing sensing devices between the camera lens and its mount, enabling the computer system to capture and analyze image information. We can then use chroma keying to overlay and output the required images, finally compositing them into our desired scene. However, this method demands extremely high technical expertise and must be operated by professional technicians, with every aspect of the workflow requiring careful attention. The second approach is non-sensor 3D, which primarily involves keeping the camera in a fixed position.

2. Practical Applications

2.1 Virtual Character Design In recent years, with the continuous development of virtual technology, virtual characters have appeared in various communication formats. As an important technical support for virtual character design, virtual reality technology has always played a crucial role. Virtual character design follows established procedures: we simply need to install sensing devices on various parts of a real person's body, mainly at the joints. When the person moves, a large amount of motion data is generated. The sensing

devices store this data comprehensively and transmit it to the central workstation, where staff can then control the virtual character accordingly. The virtual character can then demonstrate and mimic movements according to the real person's motion program, achieving the predetermined TV program effect. Additionally, virtual studios innovate upon traditional studios by effectively enabling interaction between real and virtual characters. This is mainly manifested when real and virtual characters appear simultaneously in the studio—they can freely exchange positions and communicate naturally, representing a significant innovation over traditional studios. Finally, mobile virtual studios can deliver impactful visual effects for TV programs, ultimately achieving excellent program results and improving audience ratings.

2.2 Virtual Shadow Design To make TV program visuals more realistic, lighting effects for characters must be designed. Based on mobile virtual studio technology, we can perfectly create lighting effects for characters in TV program footage, which represents an important capability of 3D virtual technology. Therefore, in post-production, we must combine specific circumstances to model lighting effects using virtual studios. For example, when we are under sunlight, we notice that shadows have certain directional patterns. Modeling processes must also pay attention to light direction to match real-life conditions. However, the studio environment has certain particularities: due to strong lighting, chroma keying in post-production becomes more challenging, potentially preventing the foreground host's shadow from blending well with background objects. This is an area requiring focused attention.

2.3 Technical Support for System Modeling During actual TV program recording, our subjects are frequently in motion, requiring systematic modeling for such scenarios. To improve program quality, we must establish a standardized modeling system. However, several points must be emphasized during the TV program system modeling process. First, system modeling must be simple and operable to avoid excessive complexity. Second, when converting lighting parameters, relevant software can be introduced for matching operations to reduce conversion difficulty. Third, to enhance the realism of virtual studio system visuals, mask effects can be employed to achieve the desired realistic results. In summary, when applying virtual studio technology, situations may arise where a host walks from behind a virtual foreground object to the front, turning the foreground into the background. This creates certain difficulties for image processing, requiring scientific operation and dedicated staff to control mask switching. Regarding this aspect, we must coordinate workflows between hosts and directors before recording, clarifying specific program procedures to prevent errors during actual production.

2.4 Applications in Infrared Detection Infrared detection is a technology that can lock onto the position of detected objects, derived from virtual studio technology. During this process, cameras are used, and parameters such

as lens zoom, focus, horizontal angle, tilt angle, and depth of field change during shooting. These changes are transmitted to the central computer, which can then adjust the 3D view based on the constantly changing parameters. To fully leverage virtual studio technology, infrared detection technology must be comprehensively applied. The most basic implementation approach involves capturing the depth position of foreground subjects within the background in the studio, thereby effectively preventing errors. In this regard, there are three implementation paths: First, install approximately four infrared cameras above the studio to receive images. Second, use these infrared cameras to define the studio's range. Third, based on the previous two steps, map out the movement patterns of program subjects in the studio and draw a grid map. This allows us to describe the host's position by locating them on the grid map with comprehensive coordinate representation. The data is then transmitted to the terminal workstation via the transmission system to calculate the true depth and accurate 3D position of objects in the model, completely avoiding errors.

2.5 Virtual Scene Generation Virtual studio technology can be divided into 2D virtual and 3D virtual components. During actual TV program recording, 2D virtual scenes exist primarily as planar graphics, making them mainly suitable for use as TV program background walls. 3D virtual scenes are the more commonly applied form, allowing the introduction of relevant production software such as Alias, Front, Softimage3D, 3ds Max, Maya, etc., all of which can meet current TV program production needs. Simultaneously, using virtual scenes enables adjustment of various program parameters, such as studio lighting, studio models, and studio textures, ultimately supplemented with virtual lighting effects to present realistic visual experiences in TV program footage.

2.6 Complete Video Synthesis TV program production does not involve a single complete video but rather results from editing, adjusting, and synthesizing multiple video clips. Based on virtual studio technology, intelligent chroma keying technology is applied to process captured scenes and characters. After corresponding processing, these video images can be composited with virtual scenes and virtual characters to construct complete TV program visuals. Virtual scenes created by computers assign a depth value to each pixel, which primarily provides parameters to control switching and ultimately completes position transformations of real characters within virtual scenes, achieving the fusion of foreground and background.

In summary, the era of media convergence has introduced many new characteristics to information dissemination media, particularly for TV programs, which have been impacted to some extent by online media. Strengthening the application of new technologies to continuously enhance competitiveness requires fully recognizing that mobile virtual studio technology application is a systematic project requiring comprehensive development strategies, such as strengthening applications in infrared detection, system modeling, and virtual characters, ultimately achieving effective innovation in TV programs.

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Note: Figure translations are in progress. See original paper for figures.