Design and Implementation of the Large Screen System for Yancheng Television Station's All-Media Studio (Postprint)

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Abstract

As viewers' expectations for television programs continue to escalate, program production formats have undergone significant transformations, necessitating more sophisticated information presentation capabilities in studio environments. Traditional backdrops and even virtual backgrounds have become insufficient to meet contemporary production demands. Large-screen systems, characterized by multi-source input versatility, display diversity, structural flexibility, and operational efficiency, effectively enhance both the expressive modalities and information capacity of programs. To satisfy our station's requirements for live broadcasting and content diversification, a studio large-screen system has been integrated into this all-media studio construction project. This paper principally explicates the design and implementation of the large-screen system for Yancheng Television's all-media studio from architectural and functional perspectives.

Full Text

Design and Implementation of the Large-Screen System for the All-Media Studio at Yancheng Television Station

Abstract: As audience demands for television programs continue to increase, program production formats have undergone significant transformation, placing higher requirements on studio information presentation methods. Traditional background boards and subsequent virtual backgrounds can no longer satisfy modern production needs. Large-screen systems, characterized by diversified inputs, varied display modes, flexible structure, and efficient operation, effectively enrich program expression and information capacity. To meet our station's requirements for live broadcasting and program diversification, we have introduced a studio large-screen system in this all-media studio construction project. This

paper primarily introduces the design and implementation of the large-screen system for the all-media studio at Yancheng Television Station from structural and functional perspectives.

Keywords: Studio; Large Screen; Program Production

As an indoor broadcasting system, studio space is limited, which restricts the amount of information that can be displayed. Initially, large studios used stage background boards to supplement information for performances such as skits, while news studios used background boards to highlight program themes. However, changing background boards for different programs and storing unused boards within the studio space affected operational efficiency. With the development of electronic technology, large-screen systems have greatly enriched program expression forms and information capacity. Through coordination between large-screen backgrounds, stage machinery, and camera work, numerous creative effects can be achieved. In news studios, background large screens not only emphasize program themes but can also play videos according to program requirements, providing intuitive display and supplementation for host analysis and commentary. Additionally, by integrating information aggregation, audience feedback and host viewpoints can be displayed simultaneously on the large screen for secondary discussion, substantially enhancing program depth and audience engagement.

1. Working Principle and Connection Diagram of the Large-Screen System

In our large-screen system, we selected the MVM-1616 HD DVI matrix, which supports 16 inputs and 16 outputs with hot-swappable cards. The input and output support both network cable and optical fiber signal transmission, enabling seamless switching without black frames or blue screens, ensuring uninterrupted signal display. Input and output image resolutions are arbitrarily adjustable. All DVI signals in the system are converted to optical fiber signals for transmission, reducing transmission loss and improving signal quality. [Figure 1: see original paper] shows the connection diagram of the large-screen system.

2. Large-Screen Display System

As shown in Figure 1, the Aurot Mariana 5D DP background broadcast server, multi-screen broadcast workstation, commentary system workstation, and global hot-backup workstation all connect to the DVI matrix inputs. The 12-square-meter and 8-square-meter LED screens, 84-inch touchscreen, and three 55-inch linked screens connect to the DVI matrix outputs. This architecture enables flexible signal distribution to any large screen as needed, providing a hardware foundation for program diversity. Based on the different functions of each screen, we connected a backup signal to every large screen.

The 12-square-meter LED screen primarily serves as the background for the standing broadcast area, with the Aurot Mariana 5D DP background broadcast server signal directly connected to its primary and backup splicers. The 8-square-meter LED screen serves the seated broadcast area background, with the global hot-backup server signal connected to its primary and backup splicers. The 84-inch LCD touchscreen primarily serves the commentary system, with the commentary workstation signal converted from SDI to HDMI via a converter and connected to the screen's HDMI interface. The three 55-inch linked screens primarily receive signals from the multi-screen workstation, with each screen's signal converted from SDI to HDMI and connected to the respective LCD screen's HDMI interface. This design ensures both flexible scheduling of main system signals and emergency backup signals for each large screen, guaranteeing safe system operation.

2.1 Display Technology Selection

For screen selection, the current mainstream options are LED and DLP large screens, each with distinct advantages. DLP screens have smaller seams controllable within 0.5mm, while LED screens have relatively larger seams. Smaller seams provide superior image quality, giving DLP an advantage in this regard. However, DLP screens are thicker and require rear maintenance access, demanding more space. LED screens are thinner and support front maintenance, requiring less space. DLP lamp life is significantly shorter than LED screens, and after extended use, color and brightness decay inconsistently across DLP panels, requiring professional adjustment. Therefore, LED screens are superior in terms of equipment maintenance and long-term upkeep. DLP screens also require regular dust removal, imposing specific requirements on studio air conditioning, sealing, and waterproof/dustproof measures, whereas LED screens have lower environmental requirements. Additionally, LED screen surfaces have a granular texture that doesn't easily reflect studio lighting, while DLP screens have mirror-like surfaces with higher lighting requirements. After comprehensive consideration, we selected LED screens.

A major challenge with LED screens is the moiré pattern issue—irregular patterns that appear in camera footage when the host is too close to the background screen, affecting recording quality. The most effective solution is applying optical film to magnify discrete LED points, improving the screen's physical structure by transforming point emission into surface emission to create continuous high-definition images, thereby eliminating moiré patterns. However, this increases costs and requires reapplication when replacing LED modules, complicating maintenance. For our installation, we employed LED screens with smaller pixel pitches (P1.9), combined with lighting adjustments, camera position optimization, and maintaining appropriate distance between hosts and the background screen. This approach effectively avoids moiré pattern interference.

Unlike common electronic devices for close viewing such as mobile phones or laptop screens, LED displays are designed for long-distance viewing. For any

given LED product, viewing distance determines the perceived display quality. Our selected P1.9 screens have a minimum viewing distance of 0.54m and an optimal viewing distance of 4.1m, fully meeting our studio construction requirements. Both the 12-square-meter and 8-square-meter P1.9 LED screens employ dual-backup redundant power supplies, with signals connected to the display via primary and backup splicers forming two loops. The primary splicer signal serves as the main source, with the backup automatically taking over if the primary signal is interrupted, ensuring continuous display operation. This dual backup system for both power and signal significantly enhances broadcast security.

3. Signal Sources for the Large-Screen System

The large-screen broadcast signals originate from three sources: the Aurot Mariana 5D DP background broadcast server, the commentary system workstation, and the multi-screen broadcast workstation.

3.1 Mariana 5D DP Background Broadcast Server

The Mariana 5D DP background broadcast server is equipped with broadcast-grade HD graphics cards, supporting multiple media formats including databases, crawls, animations, data graphics, and video streams. With a powerful GPU rendering engine, it enables real-time visualization of 3D graphics and images. The system also supports multi-channel input windowing functions, automatically adapts to large-screen physical resolution, achieves full-screen playback, and maintains one-to-one correspondence between output resolution and screen pixels to ensure image clarity without distortion. The system supports new media data integration, with various social media information (WeChat, Weibo, web, APP, etc.) collected and reviewed through an information aggregation system, then pushed to the large-screen packaging system for flip-screen and bullet-comment display.

3.2 M5DTouchPro Online Packaging Commentary System

The M5DTouchPro online packaging commentary system is touchscreen broadcast control software based on the Mariana.5D online graphics packaging system. Utilizing touch-controllable LCD displays combined with multimedia software technology, it provides a platform for television hosts to express viewpoints. The system enables commentary on videos, images, newspapers, and other information, supports multi-channel video inputs, and can produce various DVE effects and multiple video connection effects. The system offers three control methods: large-screen touch, iPad remote control, and director control. Hosts can control commentary content via the large screen or iPad, greatly increasing presentation freedom. Meanwhile, if the host makes an operational error, the director can perform backstage rescue operations using mouse and keyboard on the director's screen, ensuring broadcast safety.

3.3 Multi-Screen Broadcast Workstation

The multi-screen broadcast workstation is a fully digital multi-screen display technology and multi-element presentation production and display system. It integrates fusion, splicing, control, and calibration functions, capable of rendering and broadcasting content for linked and multi-screen displays. It provides high-resolution, high-quality broadcast content for large screens while perfectly combining multi-screen fusion, linkage, cross-screen, and splicing technologies to deliver diverse content presentations for different screen configurations, fully satisfying the creation, modification, and broadcast control of high-definition 3D content for various program linking and multi-screen requirements.

4. Applications of the Large-Screen System

The 12-square-meter and 8-square-meter large screens serve as backgrounds for the standing and seated broadcast areas respectively, playing background videos and enabling "face-to-face" interactions between in-studio and remote locations through video windows. The three linked screens in the interview area can display different images or videos according to program requirements. The 84-inch touchscreen in the commentary area facilitates commentary and interaction on daily newspapers, Weibo, and WeChat hot topics.

Since its completion in December 2016, our station's all-media studio has operated smoothly for six months, with the large-screen system performing excellently and successfully supporting various program productions. As audience demands for television program quality continue to increase and studio information presentation methods become more diversified, the studio large-screen system has become an essential component of all-media studios. It can flexibly distribute signals to all studio large screens, presenting real-time situations from outside the studio to the audience, greatly enhancing program interactivity and enriching our station's program production formats.

References: [1] Tian Anhua. Application of LED Large Screens in Studios[J]. Wireless Internet Technology, 2014(4): 195-196, 217.

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