A Portable Electronic Field Production of Live Broadcasting System for Campus Events

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Abstract. The development of technology has made live broadcasting an important way of social interaction with people in contemporary society. The campus activities of colleges and universities are also upgraded and innovated through live broadcast technology. Various campus activities such as small and medium-sized conferences, small evening parties, teaching competitions, and course production also have innovated production methods in the new media era. Given the COVID-19 pandemic and the need for online conferencing, live broadcasting of electronic field production has become frequent and normal in colleges and universities in recent years. It is necessary for colleges and universities to introduce a portable live broadcasting system for electronic field production for small and medium campus events. We present a small system that helps college video producers to complete electronic field production more portable and efficient. Four elements of the system are (1) The directing switcher. (2) The shooting equipment. (3) Wireless HD video transmission. (4) Wireless communication. Such a system is also helpful in large-scale activities as a second-level directing part, which plays a complementary role in a complex broadcasting system.

Keywords: Portable · Live Broadcasting System · Electronic Field Production · Campus Events · college and university

1 Introduction

It is well-known that video is an important medium for producing, storing, and processing live and stored multimedia events [1]. For the past two decades, electronic news gathering (abbreviation of ENG) has been a common way of recording videos of campus events for college TV producers. The basic requirement is a portable camera and a portable recorder, a microphone, batteries, and perhaps a lighting source [2], shooting the highlights, taping interviews and the progress of the event, then processing and editing. The number and scale of campus activities were small and relatively simple. The function is to campus electronic news gathering and record the historical activities of the development of the university.

In the past ten years, with the development of computer, television, and network technology, social media has become an important way for people to communicate and express themselves. People demand the acquirement of information timely and efficiently, colleges and universities should constantly upgrade and adjust the technological equipment and environment to prepare for completing digital video recordings of campus activities in a timely and efficient manner in the new media era. The development of colleges and universities has accompanied an increase in various teachings, scientific research, and publicity activities. The video presentation and production of these activities are getting more complex, and this is also pointed out in Yang Suwei's article discussing exploring broadcast TV technology [3]. Campus Meetings have changed from offline meetings to online + offline combined participation; Campus evening parties have changed from simple single camera shooting to live screen projection. Teaching competitions have become from only needing to record the teacher's speech to recording the entire progress of the interaction between the teachers and judges. The requirement for course recording varies from a few high-quality courses video production to universal massive online open courses. Therefore, the small and medium-scale campus activities in colleges and universities have gradually developed from single camera recording to 2–6 channel electronic field production (abbreviation of EFP) as the primary method because of education and teaching informatization digital services' upgrade. EFP is professional video shot outside a TV studio, not for electronic media journalism or electronic news gathering (ENG) [4]. It refers to a TV program production method that connects multiple types of equipment capable of live shooting and editing. Multiple cameras shoot synchronously, and the switcher switches and combines in real time for live broadcast and recording.

1.1 Improve Administrative Work Efficiency

Combined with the internet, electronic field production could meet communication needs through online live broadcasting of small and medium-sized conferences on various campuses and improve the administrative work efficiency of multi-campus.

1.2 Liven up the Atmosphere by Live-Streaming LED Display

With the development of large LED display devices, it becomes easy and simple to connect and control various video sources in real-time at the performing place, which contributes to the encouragement of audiences [5]. The electronic field production live-streaming the highlights and progress of the party onto the strategically placed screen to show the event scene in an all-around way, which could liven up the event, transport attendees to an entirely different environment, and ensure no one misses a highlight.

1.3 Promote Course Production Efficiency

Electronic field production can complete the first cut directly on the switcher, which can help teachers and course producers to improve course production efficiency. Xu Feng also proved this by producing TV Teaching Materials at Qiannan Normal University for Nationalities [6].

But there are some problems in traditional electronic field production. Liu Liang and Hao Lei point out that one of the problems with the live production of TV shows is that the equipment is bulky [7]. According to the practical needs, this study designs a live electronic field production system with 2–6 channels as the main channel, specially designed for small and medium-scale campus activities. It can complete conferences, evening parties, teaching competitions, online open courses, and other activities on campus, which runs stably, saves time, and improves work efficiency.

2 Design Principle of Live Broadcasting System for Electronic Field Production

2.1 Principle of Advancement

System design, construction, and equipment selection should follow the principle of advancement to ensure that the system's life cycle is extended as much as possible and to ensure compatibility with existing or foreseeable future equipment.

The construction of small-scale live broadcast systems in colleges and universities should focus on laying the foundation for future system expansion while ensuring to meet the current needs. The live broadcast system should be compatible with and support new business requirements in the future and support video recording equipment with multiple devices and formats to adapt to multi-scenario and multi-standard live broadcasting and recording.

2.2 Principles of Economy

System design and equipment selection should focus on practical functions, reduce overall investment, achieve the unity of advancement and economy, and achieve the best combination of equipment performance and price. Discard all the flashy things that do not need.

The difference between TV stations and college video production studios is that TV stations' expensive equipment requires professionals. However, colleges and universities cannot afford the expensive equipment and the time, economic, and labor costs of long-term training. Therefore, it is necessary to configure a system that is easy to use and affordable.

2.3 Portable and Simplicity

According to the actual operational needs of the system, the signal acquisition, transmission, and switching design are carried out to improve the overall system's efficiency. Small-scale campus activities are usually held in small or medium classrooms and conference rooms, with limited space and fewer participants. Therefore, the system should be integrated with a small size, low operation threshold, fewer wiring, etc.

Figure 1 below shows three principles for the design of an electronic field production live system (Fig. 1).
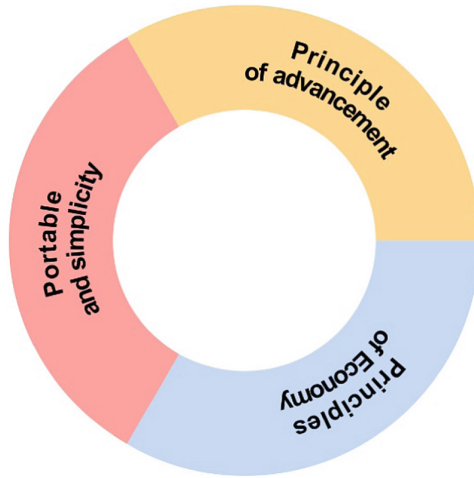
Fig. 1. Design Principle of Live Broadcasting System for Electronic Field Production

3   Architecture and Implementation of Live Broadcasting System for Electronic Field Production

We have formulated a set of electronic field production systems suitable for colleges and universities according to the characteristics of small and medium-sized activities in colleges and universities(Fig. 2). The system consists of four main parts. (1) The directing switcher. (2) The shooting equipment. (3) Wireless HD video transmission. (4) Wireless communication.

3.1   Core Equipment-Directing Switcher

This system takes AWS-750 multi-functional video and audio switcher as the core equipment after several practices in the past years. The switcher adopts a portable design,
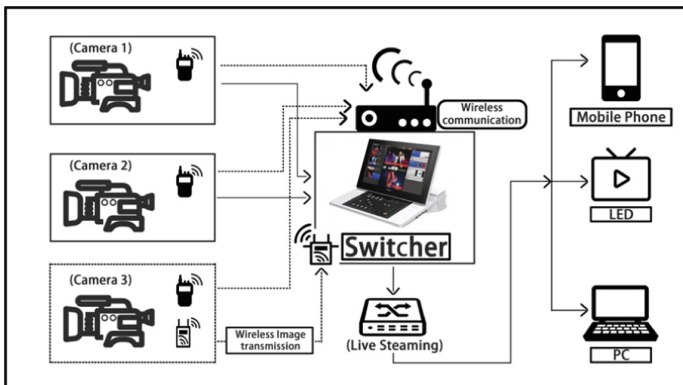

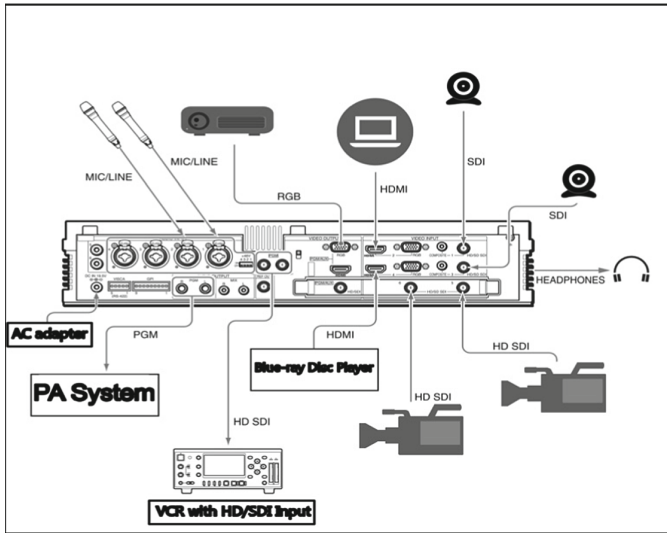**Fig. 2.** Model of Portable Electronic Field Production System

Fig. 3. Multi-functional videos and audio switcher with high integration

which is portable by its lightweight and small size. The operation mode of the full touch screen significantly simplifies the operation of the traditional radio and television mode. You Lei mentioned that using SONY AWS-750 simplifies the traditional EFP multi-camera shooting equipment, from equipment connection to director operation and post-processing are easier [8]. The switcher requires little training, and staff with no professional background can operate the switcher deftly in a short time. The production effect is professional, and the practicality rate is high.

AWS-750 integrates video switcher, mixer, recorder, multi-viewer, subtitle, and streaming encoder and supports multiple monitors with 4 SDI inputs and 2 HDMI or VGA inputs, which can be seen clearly in Fig. 3(Fig. 3). PowerPoint can directly connect to the switcher by computer signals through HDMI and VGA. The external video can reach six channels in total, realize video mixing between video sources of various formats, provide a full-featured six-channel mixer, and freely de-embed and embed multiple audios. The internal SSD can record up to 10 h of video and audio. Except for the extremely high integration, the system construction is convenient and straightforward, and the live broadcast screen is stable and reliable. It can not only meet the live broadcast requirements of small and medium-sized conferences but also solve the needs of on-site multi-camera directors to shoot MOOC videos [9], shortening the production time and improving efficiency.

3.2 The Shooting Equipment

The leading camera equipment used in this system is 2–4 sets of Sony PXW-Z280 for shooting panorama, close-up and audience images. The advantage of the Sony Z280 is that it is a model with true 4K output capability, which can meet the needs of future 4K live multi-camera recording. The camera part of the Z280 uses a 17x zoom lens, and

three independent control rings allow manual control of focus, zoom, and iris for precise adjustments. Compatible with multiple formats, including XAVC Intra/Long, MPEG HD422/HD420, and DVCAM, flexible recording formats support different workflows. It can transmit high-definition signals quickly. Similar key layout and operation method as the previous camera, which needs no more extra training. The PXW-FS7 is also available as a backup model for the system. This camera features a 4K Super 35 mm Exmor CMOS sensor with an alpha mount lens system, 4K/2K RAW, and XAVC recording options. These two cameras are mature enough and stable. They can also be used for feature film shooting, thoroughly improving the equipment utilization rate and performing well in producing small and medium-sized campus activities.

3.3   Wireless Image Transmission

According to the environment of small and medium-sized activities, this system is equipped with a set of MOMA wireless image transmission. Wireless data transmission is not restricted by geographical environments and cables. It just needs to connect wireless data transmission and antenna at each terminal. At the same time, the cost of this set of wireless image transmission is lower than other similar equipment, which is suitable for colleges and universities.

The device supports HD 1080P High-Definition picture quality and realizes uncompressed transmission. Because its' antenna increases the signal strength by more than two times, the transmission span is up to 600 m. Underlying software has been optimized many times for ARRI Mini to achieve the playback in seconds without black screen. It can observe the current frequency, signal strength, video format, fan status, device temperature, and other statuses through the Oled(Organic Light Emitting Display) screen. The transmitter supports SDI input/output and HDMI input, and the receiver supports dual SDI output and HDMI output. It is easy to install and repair, suitable for various equipment and can be moved flexibly, which is an essential part of electronic field production.

Wireless image transmission is based on WHDI technology, abbreviated as Wireless Home Digital Interface, which provides a high-quality, uncompressed wireless connection. It adopts MIMO (Multiple-Input Multiple-Output, MIMO) technology, achieving a transmission rate of up to 3 Gbps. It works in the 4.9 GHz–5.875 GHz frequency band, 20 MHz or 40 MHz channel, the range is within 30 m, it can penetrate walls, and the delay is less than one millisecond. It uses a 2×5 MIMO system, the transmitter uses two antennas, and the receiver uses five antennas (Fig. 4).

3.4   Wireless Communication

In order to ensure the continuity of multi-camera screen switching, it is necessary to ensure that all camera personnel communicates at any time. Therefore, equipping each camera personnel with wireless communication equipment is the most fundamental guarantee for EFP on-site production. The internal wireless communication system enables the director and the videographer to communicate in time, coordinate scheduling, and ensure the progress of the live broadcast production. This system chose MOMA 450T, a wireless communication system. It is specially designed for group calls, supporting
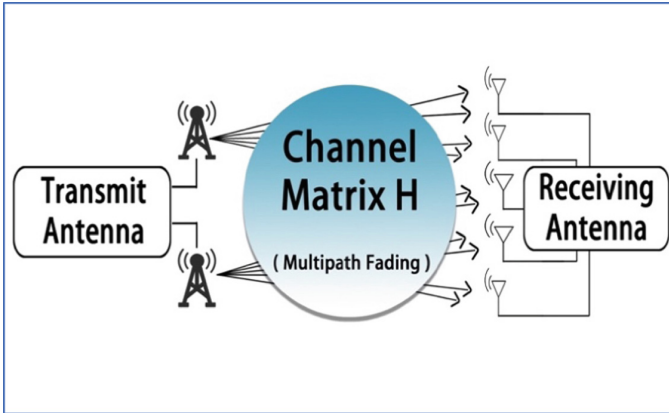
Fig. 4. Wireless image transmission signal processing

eight internal communications talking in the same channel simultaneously, supporting 450-m long-distance signal transmission without wires. It brings great convenience to electronic field production, which is simple and improves work efficiency.

4   Application of Live Broadcasting System for Electronic Field Production

For the past five years, we have been experimenting with live broadcasting campus events with a portable live broadcasting system. Hundreds of regularly scheduled conferences and events have been broadcasted on the campus internet using this portable live broadcasting system(Table 1). Online conference attendance from five campuses in three cities, including Guangzhou, Shenzhen, and Zhuhai. The system conveyed policy information timely, greatly saving the transportation and time costs of staff on different campuses. The system supports focusing the highlights and progress of the party on the screen to show the event scene, liven up the event, and help teachers and course producers to improve course production efficiency.

This portable electronic field production of live broadcasting system has completed more than one hundred and fifty small and medium-sized campus activities over the past five years. It is proved that the system has high integration, substantial convenience, high reliability, less staffing, and saves time and cost.

Table 1. Application of Electronic Field Production System of Live Broadcasting for Campus Events (2017–2021)

Year	Quantity		
	Quantity Of Multiple types of small and medium-sized events		
	Conferences	Campus events	Course production
2017	3	3	8
2018	9	9	6
2019	9	6	18
2020	12	2	11
2021	13	13	22
Total	**46**	**33**	**65**

5   Conclusions

As mentioned above, a portable electronic field production and live broadcasting system is necessary for the operation of colleges and universities and important content for the informatization of college education. Colleges and universities without the support of the electronic live production live broadcast system will lose their advantages in the wave of a digital live broadcast.

This research provides a reference for relevant producers and researchers in colleges and universities. It promotes the innovative application of information technology in college governance and publicity. It has provided technical support to the regional interactive joint and provides new services for teaching, scientific research, and propaganda in colleges and universities. Promotes the optimization and upgrading of traditional video production services and offers strong support for realizing the goal of building a first-class university.

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