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## Application of Intelligent Assistance Systems in Broadcasting Systems (Postprint)

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### Abstract

With the advancement of modern technology and the technological development of the computer industry, monitoring of environmental conditions and equipment status can be achieved through intelligent approaches. Consequently, intelligent auxiliary systems have emerged to ensure favorable environmental conditions and equipment status, enable timely access to broadcast audio-visual status and corresponding alarm information when issues arise, and provide an intuitive and convenient monitoring interface, which holds significant importance for broadcast security.

### Full Text

## Application of Intelligent Auxiliary Systems in Broadcast Transmission Systems

**Journal:** ChinaXiv Cooperative Journal • Media Technology & Media Industry

**Abstract:** With advancements in modern technology and the development of the computer industry, environmental monitoring and equipment status monitoring can all be realized through intelligent means. Consequently, intelligent auxiliary systems have emerged to ensure favorable environmental conditions and equipment status, enabling timely inspection of broadcast audio/video status and corresponding alarm information when problems arise. These systems provide intuitive and convenient monitoring interfaces, which are of great significance for safe broadcasting. Compared with traditional broadcasting monitoring systems, the most significant difference in modern systems lies in the intelligent auxiliary system, which plays a crucial role in contemporary broadcasting monitoring systems. Professional broadcasting functions such as monitoring, listening, recording, and emergency backup broadcasting provide duty personnel with comprehensive and convenient detection means, reliable safe-broadcasting data,

and rapid and effective emergency measures, thereby ensuring safe broadcasting. This paper takes the design and construction of the intelligent auxiliary system of Tianjin Radio and Television Station's broadcast transmission system as an example to conduct in-depth research and discussion on the design methods, design schemes, construction processes, and implemented functions of intelligent auxiliary systems for broadcast transmission systems.

**Keywords:** safe broadcasting; intelligent auxiliary system; large screen monitoring; equipment status monitoring

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## 1. Environmental Detection System

In existing equipment rooms and studios, there is a large amount of precision equipment with strict requirements for operating environmental conditions such as temperature and humidity. Therefore, temperature and humidity sensors should be installed to monitor these parameters in real-time in equipment rooms and critical equipment areas. Consequently, several temperature and humidity sensors are installed in equipment rooms and each studio. These sensors transmit the detected temperature and humidity values of each area in the equipment rooms and studios to the monitoring host in real-time, and display the values intuitively on the screen. Simultaneously, upper and lower limits are set for temperature and humidity. When the measured values exceed these limits, an alarm is triggered. The system automatically pops up an alarm box displaying the alarm information and emits an audible alarm, alerting duty personnel that the temperature or humidity in the corresponding area has exceeded the limit. By adjusting the air conditioning settings, optimal operating conditions are provided for the equipment.

## 2. Equipment Status Detection System

Equipment status is monitored by two servers: a primary control server and a backup control server. All device drivers run on these two servers and monitor equipment status in real-time. After the drivers on these servers obtain the status of all equipment, they transmit the equipment status to various clients through a service program. The machine equipment status, temperature, and humidity of each studio can all be viewed intuitively on the large screen, improving work efficiency.

## 2.1 Large Screen Monitoring Content

### 2.1.1 Fixed Studio Monitoring Screen

The monitoring content for each frequency includes two pages. The first page comprises HD camera feeds from the studio, which can be used to view operation replays of mixing consoles and other equipment in each studio (recorded and played back by Hikvision video recorders), main link level/phase meters, backup link level/phase meters, off-air received signals, return signals, status of delay unit 1 and delay unit 2 (green lights indicate normal operation), four-to-one selector status, comparison alarms, mixing console temperature, and cabinet humidity. The second page includes HD camera feeds from the studio, fader status for six faders (DJ1, DJ2, hotline, main workstation, main CCTV feed, backup workstation), EA online status, EA power status, four-to-one selector online status, four-to-one selector power status, four-to-one selector clock monitoring, switch status, temperature and humidity of the delay unit cabinet, and temperature and humidity of the workstation cabinet. [Figure 1: see original paper] shows the fixed studio monitoring screen.

### 2.1.2 Link Diagram

The link diagram displays the entire channel's audio chain and equipment alarms at key nodes. All channels share the same format, with a total of sixteen pages. Audio color bars include: return 1, return 2, four-to-one selector, bypass, main matrix input, one-to-four input, four-to-one selector output, main audio distribution output, backup audio distribution output, backup matrix output, pre-delay main path, pre-delay backup path, and off-air reception. Equipment includes EA devices and four-to-one selectors, among others. When a link malfunctions, the corresponding link turns purple, the system pops up an alarm box displaying alarm information, and an audible alarm is triggered.

### 2.1.3 Color Bar Chart and Cabinet Diagram

The color bar chart displays: studio input to four-to-one selector color bars for each channel, main audio distribution output signal color bars, FM reception color bars, AM reception color bars, and relay signal color bars. Among these, the 16 main audio distribution outputs are connected to EA1-EA4 in the master control room via the XLR interface board of the ACE cabinet, while a total of 24 relay signals are connected to EA13-EA18 in the master control room via the XLR interface board of the ACE cabinet. The cabinet diagram consists of three pages: the first page displays equipment including four-to-one selectors, EA devices, and switches (equipment turns red when alarming); the second page shows optical transceiver status, HARRIS audio distribution status, etc.; the third page displays temperature and humidity status at various monitoring points. Specific alarm information is shown in the information box. The cabinet diagram is shown in [Figure 2: see original paper], and the color bar chart is shown in [Figure 3: see original paper].

## 2.2 Slow Recording

Radio stations use slow recording systems to document broadcast operations, aiming to monitor broadcast quality, facilitate timely playback when issues arise, assist in problem identification, provide materials for broadcast content review, and serve as references for content and incident analysis. The system features high audio quality, convenient retrieval and query capabilities, and automation. It supports segmented recording, allowing users to query and retrieve specific audio segments as needed for playback and download. Additionally, audio waveforms are displayed during playback, enabling intuitive problem identification. Slow recording server 1 and server 2 each have two sound cards with eight XLR inputs per card. The two servers respectively collect audio from 16 channels of the main and backup audio distribution systems. Each machine runs a slow recording service program and a forwarding program, while a slow recording client runs on the monitoring station. After recording, the client enables playback and download. The client is located on the console in the master control duty room.

## 2.3 Backup Broadcasting Station

Backup broadcasting is a crucial component of safe radio broadcasting. There are two backup broadcasting computers running monitoring clients with four-to-one selector controls. Each backup workstation has controls for six channels: Backup 1 handles Rural, Music, Health, Crosstalk, Direct 10, and Novel channels; Backup 2 handles Traffic, Binhai, Economics, News, Arts, and Lifestyle channels. The four-to-one selector control displays three input paths: bypass, main matrix, and one-to-four, as well as internal filler music audio levels and color bars. Outputs include digital and analog output audio levels and color bars. The four-to-one selector can be remotely controlled—for example, manually selecting which input to use, controlling whether automatic switching to backup is enabled, and controlling switchback—thereby achieving uninterrupted broadcasting. [Figure 4: see original paper] shows the backup broadcasting station control interface.

## 2.4 Monitoring

Monitoring is divided into three categories: EA collection monitoring, four-to-one selector monitoring, and off-air monitoring. For EA collection monitoring, a Dante virtual sound card captures signals collected by EA, which are then encoded by AudioStreamer and monitored through the monitoring AudioStreamer. Four-to-one selector monitoring is achieved directly via the multicast network port of the four-to-one selector. Off-air monitoring involves AudioStreamer encoding signals collected by the off-air reception card, which are monitored through the monitoring AudioStreamer. The client runs on the console in the master control duty room, with a corresponding touchscreen display. Various required monitoring sources are integrated into a single monitoring operation

interface, with different signal sources abstracted as corresponding blocks on the monitoring interface. Clicking a block on the monitoring interface enables listening to that source, while simultaneously displaying the current program name and whether it is live or relayed. The overall layout is intuitive, clear, and easy to operate.

## 2.5 Alarm Workstation

The alarm workstation centrally displays all alarm information across multiple pages. The front pages contain information for each channel, identical to the large screen content, while subsequent pages show temperature and humidity information for various points and equipment alarm information. When faults occur, rapid response and timely handling are possible. Through the alarm workstation, operators can grasp the working status of all equipment. The alarm workstation channel information is shown in [Figure 5: see original paper], equipment status in [Figure 6: see original paper], and temperature and humidity information in [Figure 7: see original paper].

## 2.6 Alarm Threshold Settings

Regarding alarm thresholds, each client can configure different alarm thresholds and corresponding conditions. Parameters such as level threshold, phase threshold, low-level alarm duration, phase reversal alarm duration, level difference upper limit, level difference alarm duration, fault recovery time, scheduled reminders, log database writing, comparison alarm thresholds, and automatic page control can all be configured. Alarms can be set for values below the lower limit or above the upper limit, enabling immediate awareness of alarm information when problems occur.

## Conclusion

In summary, the intelligent auxiliary system plays a vital role in ensuring safe broadcasting, stable equipment status, and efficient system operation. The environmental detection system enables duty personnel to understand equipment environmental conditions anytime and anywhere through monitoring of equipment rooms and critical equipment areas. The large screen allows intuitive viewing of studio equipment status, link diagrams, color bar charts, and cabinet diagrams, improving work efficiency and facilitating rapid problem identification. The slow recording system documents broadcast operations, enabling timely playback and problem identification when issues arise. The backup broadcasting station achieves uninterrupted broadcasting by remotely controlling the four-to-one selector, including functions such as automatic backup switching and switchback control. Monitoring covers EA collection, four-to-one selectors, and off-air signals, integrating various monitoring sources into a single operation interface through the client. The alarm workstation provides comprehensive alarm information, enabling timely response when problems occur. This paper

has introduced several aspects including the environmental detection system, large screen monitoring content, slow recording, backup broadcasting stations, monitoring, alarm workstations, and alarm threshold settings. It is evident that the intelligent auxiliary system significantly enhances safe broadcasting efficiency and overall work effectiveness. The entire system operates stably with convenient emergency handling, providing reliable technical assurance for safe broadcasting at Tianjin Radio and Television Station.

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

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