Research on Optimization Design to Remote Monitoring System of Medium Wave Transmitter Room in Radio Station

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Abstract. With the development of technology and the increase of manpower cost, more and more medium wave transmitting stations begin to implement unattended machine room. Based on the analysis of the monitoring system of the wave transmitter room in the conventional broadcast, this paper puts forward the corresponding optimization strategy, which effectively improves the management level, management efficiency and emergency response speed of the medium wave transmitter room.

Introduction

Due to its wide range of transmission, wide range of transmission, fast speed of transmission, strong penetration ability, low cost and convenient reception, Zhongbo Broadcasting has a large number of listeners in rural areas and in peri-urban areas. According to the establishment of a medium-wave launch pad in each administrative division at the county level and above in China, it is estimated that there will be about 3,200, although some computer rooms have partially implemented video monitoring, environmental monitoring, anti-theft alarm and fire control systems¹. The system operates independently. Even each system needs independent managers, and it is impossible to achieve multi-system integrated monitoring and centralized management; At the same time, each program of the medium-wave launch pad of radio and television broadcasts more than 20 hours a day. The staff on duty in the computer room works in an environment with high decibels and high electromagnetic radiation, which is not conducive to physical and mental health. The staff has high requirements for the operation of equipment and high work intensity; In addition, due to the significant increase in labor costs and the loss of skilled personnel, launch pad equipment control urgently needs to achieve unattended, remote monitoring and alarm.

In general, the monitoring system can be divided into the following three generations of products²:

The first generation of systems was mainly based on surveillance. Its system is mainly based on various types of surveillance data acquisition and video signal transmission, and relatively independent devices and circuits are configured with their own monitoring devices. Some devices can realize data audio and optical alarms. The data and surveillance signals collected by these systems are often local and cannot be separated from the staff and cannot really significantly reduce the maintenance workload.

The second generation system uses dry node alarm function. The collector connects various power and environmental sensors and monitoring points for data acquisition. The OMC is connected to the LSC, and the monitoring data is the switching amount, which can achieve remote communication function. Monitoring information one-way uplink transmission, generally in the equipment of non-important station use dry point monitoring subsystem. Since the dry node alarm
function can only be used to determine whether the device is normal or not, it is impossible to determine the specific fault nature and severity, and the actual operation and use effect cannot reach the expected goal.

The third generation system is to establish an intelligent network monitoring platform to detect the operating status of all equipment in the computer room according to requirements. It has automatic alarm analysis and fault location functions, and provides corresponding emergency countermeasures and automatic control according to the abnormal conditions between forecasting devices. At the same time, it supports mobile phone monitoring[4] and short message alarm functions, making it possible to monitor the computer room remotely. At present, the research of China's monitoring management system is in the third stage, intelligent remote monitoring management is the focus of research.

The concept of the Internet of Things comes from the 1999 MIT Auto-ID Laboratory[5-6]. Its core is perception, interconnection, and intelligent processing. It applies the Internet of Things technology to the remote monitoring management of the medium-wave transmitter room and can realize intelligent monitoring. Management system. That is to say, it can simulate and replace human thinking to some extent to carry out certain analysis and control work, and has certain advantages in ensuring the safe operation of equipment and monitoring of computer room. For example, when the power supply and air conditioning fail, the monitoring management system can detect the failure in time and notify the user; According to the past failures of the system statistics can be made, the optimization recommendations are obtained, which can automatically adjust the power supply and air conditioning equipment according to the actual situation.

Problems and Solutions in Remote Monitoring System of Medium Wave Transmitter Room

Basic Function of Remote Monitoring System of Medium Wave Transmitter Room

The remote monitoring system[3] of the radio transmitter room in the radio station usually has the following functions:

1) Establishment of Competencies
It has different permissions according to different user identities, restricts personnel to various operations of the launch system, and avoids the impact of irrelevant personnel misoperation on important launch work.

2) Easy to operate
With a simple human-computer interaction interface, signal source switching, transmitter status query, master transmitter switching and other operations through the mouse and menu, mobile phone, etc..

3) Online monitoring
The availability of equipment for online monitoring of transmitters and signal sources, the display of detected data values in real time, the warning of parameters exceeding standard values or abnormal changes, and the recording of the opening, closing time and cumulative working time of equipment such as transmitters.

4) Control of transmitter performance
According to the specific broadcast schedule, the power can be turned off regularly, and the equipment can be automatically reversed in the event of a failure, so as to ensure the safe broadcast of the medium wave program.

5) Online fault diagnosis
When abnormal data is detected or a device fails, the system can determine the site of the failure, display the parameters of the faulty equipment and related information, and automatically send it to the shift staff. At the same time, emergency treatment is performed according to the system diagnosis results. For example, automatic switching of signal sources, inversion between host and backup, etc.

6) Fault Warning
Alert the abnormal conditions of various monitoring templates, such as voice alarms, light flashing alarms, etc., including mild abnormal data and mild faults.
7) Automatically generate reports
With the ability to automatically generate reports and copy tables, the data and information detected by the system are automatically generated through a pre-set report form.

**Problems and Solutions in Remote Monitoring System of Medium Wave Transmitter Room**

At present, most of the remote monitoring systems in the middle wave transmitter room have the following problems to some extent. The corresponding solutions are given here.

1) Monitoring system is prone to misjudgment of communication failure as launch equipment or power equipment failure

Many newly purchased medium-wave launch equipment and computer room power equipment operate MTBF (average no-fault running time) for more than 100,000 hours, and the performance is relatively stable. On the contrary, communication and data transmission are the weak points of the monitoring system. Therefore, in the control system design, we need to add a self-diagnosis function. After the failure occurs, we first determine whether the fault is caused by the failure of the monitoring system itself or the failure of the monitoring equipment, which is conducive to accurately finding the cause of the failure.

2) The monitoring system has many monitoring points, many data, and many reports, which does not facilitate fault analysis

Many monitoring systems pursue more monitoring points, resulting in a large amount of data redundancy, which not only adds many unnecessary monitoring equipment, but also does not facilitate the detection, analysis and timely handling of failures. For this reason, in the design, there is a choice to delete those high-precision, long MTBF, stable running control points or monitoring equipment, retain some components with high error rate, short MTBF time, and add new devices. Control point. For example, the system's monitoring of smart devices is still relatively stable, but some monitoring signals transmitted using outsourced sensors and transmitters have a high error rate (related to the high failure rate of the components themselves), which is easier to detect through monitoring. Fault, timely processing.

3) Monitoring system frequent false alarm, increased staff psychological pressure and work intensity

As the radio frequency signal broadcast by the transmitter is sampled through the radio frequency cable, it enters the quality assurance system, demodulates, and the computer completes the circular monitoring of the broadcast program. The quality assurance system detects important parameters such as power, frequency, and tune system, and acoustic and optical alarms when abnormal. Due to software design reasons, the accuracy of the BER monitoring is relatively high, and as a listener, the intensity and quality of the sound are certain tolerances. For this reason, we set a certain threshold value of the monitoring index according to the experience value, which can greatly reduce the alarm amount.

4) The huge amount of data in the monitoring system affects the speed of memory reading and writing and the speed of network transmission

With the continuous expansion of the scale of the monitoring equipment, the number of monitored equipment and monitoring points is constantly increasing. There will inevitably be a large amount of data to be processed, distributed, read and written into the database. Such a huge amount of data puts forward higher requirements for network bandwidth and server carrying capacity. Considering that the computer room environment image is almost an immutable image, unlike the environment where banks, traffic, etc. require high real-time image requirements, the data flow and data storage are reduced by reducing the number of transmission frames per second and image resolution of the image system. On the other hand, the two mechanisms of polling and interruption are used in data collection. In the normal operation of the system, the system adopts the method of polling when the data changes little, and reports the data every time or sends a query command at the network management center before reporting the data in real time; At the same time, the system reports the data in a timely manner in the event of a mutation in the operating data of the equipment. This not only reduces the data flow in the bus but also ensures that important fault data is not omitted.
5) Monitoring system focuses on statistical classification and lacks pre-analysis function

The general monitoring system mainly has the display equipment fault process management, statistics and classification of historical data, and objective evaluation of equipment operating parameters with detailed analysis reports, including the printing and archiving management of historical data and analysis reports and other data. However, there is no automatic pre-analysis function. Here, using the idea of big data\[7\], by analyzing and collating historical data, we can find out in advance the possible safety hazards in power equipment, detect faults in advance, and take corresponding treatment measures to reduce the chance of failure. That is, what is often referred to as "pre-diagnosis" and "pre-warning." For example, according to the record and statistical analysis of battery charging and discharging voltage, automatically detect backward batteries, advance notice of maintenance content, etc.; On the other hand, when multiple alarms occur, the system can analyze the main alarms and can also count the recorded historical fault information so that when a new fault occurs, The system can provide basis and solution for fault diagnosis and fault management based on previous fault management experience. Not only can the maintenance personnel be notified in a timely manner, but also the possible causes of the failure can be listed and corresponding solutions can be proposed. The fault management process of the monitoring system is shown in Figure 1.

![Figure 1. Intelligent fault processing process for surveillance systems.](image)

**Design of Remote Monitoring System for Radio Broadcast Room**

Combined with the idea of 2.2, the system uses the Internet of Things related technology to implement the internal network of radio transmitter and computer room monitoring facilities, and can provide remote monitoring services to authorized managers. The main design content includes four subsystems: equipment monitoring subsystem, signal monitoring subsystem, power environment monitoring subsystem, computer room security monitoring subsystem. Among them, the equipment monitoring subsystem is mainly to discover the equipment failure of the transmitter system, ensure the normal operation of the launch system, and issue alarm information in time to facilitate the timely solution of the fault problem, and at the same time provide the "pre-diagnosis" function; The signal monitoring subsystem mainly monitors the voice quality of broadcast programs on the basis of self-diagnosis, and realizes abnormal monitoring of indicators; As the performance of power equipment is relatively good, the power environment monitoring subsystem mainly realizes the distribution status monitoring node monitoring through dry node technology; The monitoring subsystem of the computer room mainly broadcasts related key parts of the computer room through multi-point cameras to monitor.
The remote monitoring system of the radio station's wave transmitter and unmanned computer room constructs a three-tier architecture of front-end signal acquisition and processing, signal aggregation and transmission, and remote monitoring. The topology is shown in Figure 2.

Figure 2. Topology diagram of remote monitoring system.

Summary

The purpose of this study is to analyze and develop the monitoring system of the unmanned computer room of the medium-wave transmitter. Although the monitoring management system has a relatively large investment, with the improvement of manpower costs and the improvement of the performance of hardware and equipment and the reduction of the price, the system is used. Intelligent monitoring, Will effectively save the overall maintenance costs of the computer room and improve the efficiency of equipment utilization. From this point of view, the intelligent monitoring of the middle wave transmitter room, as a new strategic industry, has a broad industrial prospects.

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References

[1]Liu Li, Chen Zhoulieshun, Lisuhui, talk about the need for monitoring of the transmitter room in China Wave, China High-tech Zone, 2018 (9)


[4]Smartphone operating system, https://baike.baidu.com/item/%E6%99%BA%E8%83%BD%E6%89%8B%E6%9C%BA%E6%93%8D%E4%BD%9C%E7%B3%BB%E7%BB%9F/5833789?fr=aladdin
