Intelligent Monitoring System of Electronic Equipment Based on Wireless Sensor

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Abstract. Aiming at the problem of poor stability of the intelligent monitoring system for electronic equipment operation status, an intelligent monitoring system for electronic equipment operation status based on wireless sensors is designed. Optimize the system hardware structure, build an online monitoring and analysis platform based on wireless sensors, and optimize the system software functions. This paper presents a mathematical model for online monitoring of electronic equipment operation status based on wireless sensors, and improves the conventional model. The dimension information table is compressed by encoding and stored in the fact table to reduce the storage overhead. The test results show that the performance of the intelligent monitoring system of electronic equipment running state based on wireless sensors is significantly better than the traditional methods.

Keywords: Wireless Sensor · Electronic Equipment · Monitoring System · Running State

1 Introduction

At present, the domestic research on the operation status monitoring of electronic equipment is mostly focused on offline mode, while online monitoring is relatively small, and some detection functions are realized through virtual instruments, which are only suitable for local detection and cannot complete remote monitoring. In view of the above problems, it is of practical significance to propose an online monitoring system for the operation status of electronic equipment.

Literature [1] carried out research on online non-contact comprehensive temperature monitoring system that does not affect the safe operation of high-voltage switchgear, transformer and other electrical equipment to effectively ensure the safety of electrical equipment operation. Monitoring based on omni-directional scanning technology can not only monitor the monitored electrical equipment globally, but also focus on the bus connection points, cable joints and other parts, and can also improve the effectiveness of the monitoring system and the reliability of electrical equipment operation, however, the signal monitoring and abnormal diagnosis functions of the system need to be improved.

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Literature [2] designs a wireless network-based remote monitoring system for the status of electrical equipment. The system collects the status signals of electrical equipment remotely through wireless sensor networks, and de-noises the signals, then extracts the features from the status signals of electrical equipment, and introduces machine learning algorithm to fit the relationship between the features and the status of electrical equipment, and establishes a monitoring model for the status of electrical equipment, so as to obtain the status results of electrical equipment. Finally, the monitoring results of electrical equipment status are sent to the management personnel through the Internet, and the remote monitoring system of electrical equipment status is simulated and tested. The results show that the system can carry out high-precision remote monitoring of the status of electrical equipment, but the corresponding solution cannot be given in time when the system has a BUG.

Literature [3] mainly studies the application of intelligent sensors in the monitoring of electrical equipment, describes the characteristics of electronic sensors, and the application of electronic sensors in the detection of electrical equipment, including data transmission, camera monitoring, information display, automatic control, as well as the application of engine control, safety system, navigation control, and drive system in the intelligent automobile.

Based on this, this paper briefly designs an intelligent monitoring system for the operation status of electronic equipment based on wireless sensors, hoping to optimize the online monitoring performance.

2 Intelligent Monitoring System for Electronic Equipment Operating Status

2.1 System Hardware Structure Configuration

The hardware design of the system adopts B/S architecture as the application layer, the cloud computing platform is added to the whole architecture to open cloud services for the monitoring system, integrate the equipment to be monitored according to the distributed layout, and complete the unified management of multiple transactions. Among them, it is necessary to complete the sharing and exchange of data in real time among the application devices, and make equivalent connections between mainstream SQL Server motherboards, MYSQL converters and Oracle modules to ensure the reliability and security of output information. A distributed intelligent system for efficient monitoring is established, and the internal network layout is divided into three levels. The first layer is the management application layer, the second layer is the data transmission layer, and the third layer is the field device layer. The specific layout style is shown in Fig. 1:

The wireless sensor network nodes in the system are composed of five parts: sensor module, processor module, wireless communication module, interface module and power management module, as shown in Fig. 2.

The sensor module is responsible for the collection and data conversion of information in the monitoring area: the processor module is responsible for controlling the operation of the entire sensor node, storing and processing the data collected by itself and the data sent from other nodes, including data security, communication protocols,

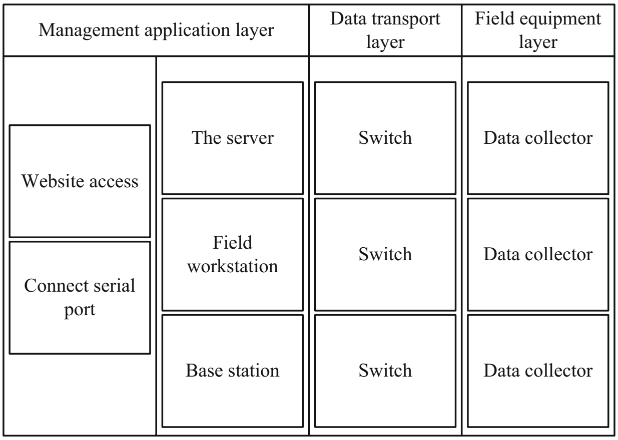

Fig. 1. Overall structure of the internal network layout of the system

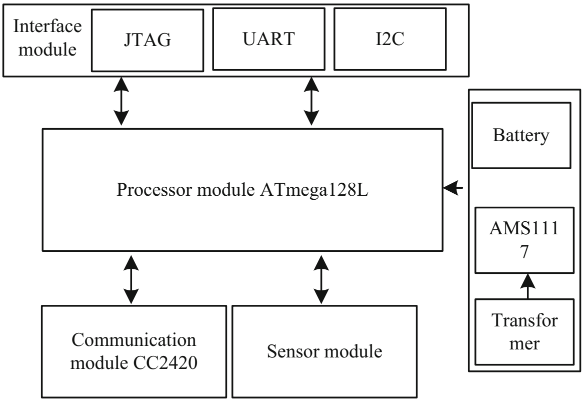

Fig. 2. Hardware design module diagram of wireless sensor network node

synchronous positioning, power management, task management, etc.; The wireless communication module is responsible for wireless communication with other sensor nodes, exchanging control messages and receiving and transmitting collected data; the power management module provides all power required for the operation of sensor nodes. The traditional status monitoring platform mainly includes the following three parts: data acquisition layer; data storage and analysis layer; data access layer. Among them, the data acquisition layer transfers business data such as production management and monitoring information to the data warehouse in real time through processes such as extraction, transformation, and loading. The data storage and analysis layer selects conventional models, ancestor data, and uses OLAP to read business data in the data warehouse. The functions of the data access layer are mainly to provide data mining and statistical queries for staff and users. It should be noted that the traditional condition monitoring platform mainly uses the conventional snowflake model or star model to organize data, which has poor scalability and high cost, which is not enough to meet the storage and optimization needs of massive power data. Constructing a new condition monitoring platform using the technology and big data technology, see Fig. 3

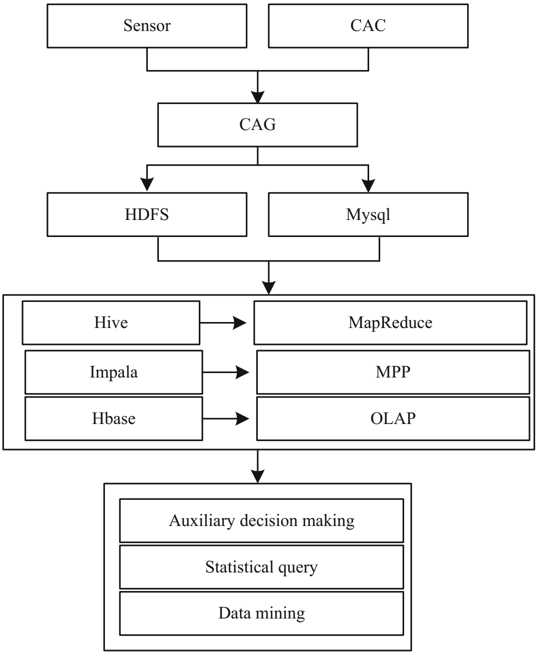

Fig. 3. Condition monitoring platform

The main work of the data acquisition circuit is to collect and process the power generation parameters and environmental parameters of electronic equipment and transmit the processed data frames to the terminal node, including the current and voltage generated by electronic equipment, the temperature, humidity, wind speed and irradiance parameters of the current environment. Relevant parameters of various sensors are shown in Table 1:

The input signal of the sensor is mostly voltage output, so A/D conversion is required to convert the voltage signal into a digital signal. There are many A/D conversion channels required in the acquisition terminal, so STM32F103ZET6 is selected. It has three 12 bit analog-to-digital converters, 21 input channels, and 112 multi-functional 1O ports, which can fully meet the needs of the monitoring system. As shown in the table, the upper limit of the sensor's output signal is 5 V, while the upper limit of the A/D port's voltage conversion is 3.3 V, so it is necessary to reduce the voltage of the sensor's output signal. The RS232 serial port module is designed to realize the communication between Zigbee coordinator and 3G module. The circuit adopts the MAX232 drive level conversion chip of Maxim's company. The RS232 standard generally adopts a 9-wire system, namely DB9 (nine-pin serial port). MAX232 is mainly composed of four parts: charge pump circuit, RS232 driver, RS232 receiver and power supply part. The charge pump part is

Table 1. Sensor related parameters

Sensor type	Measuring range	Output signal
Current transformer	0–90 A	0.6 V
Voltage transformer	0–320 V	0–6 V
Irradiance sensor	0–1600 W/m2	0–2.6 V
Temperature and humidity sensitivity	−40 ℃–80 ℃	digital signal
	0–100%RH	
Wind speed sensor	0–32.5 m/s	0.5–2 V

responsible for generating the level in accordance with the RS232 communication standard, this part is composed of 1–6 pins of MAX232 plus four capacitors. On the basis of studying the single operation status monitoring system of power equipment in the past, a specific implementation scheme of the operation monitoring system based on the current big data technology is proposed. The functional structure of the system mainly includes multiple monitoring sets, node performance monitoring, operation monitoring and early warning modules. Monitoring is accomplished through agents and monitoring plug-ins. These plug-ins include data acquisition modules, data processing modules and data transmission modules, as well as monitoring plug-ins (Including data receiving module and visualization module) [4, 5]. The functional structure of the system is shown in Fig. 4.

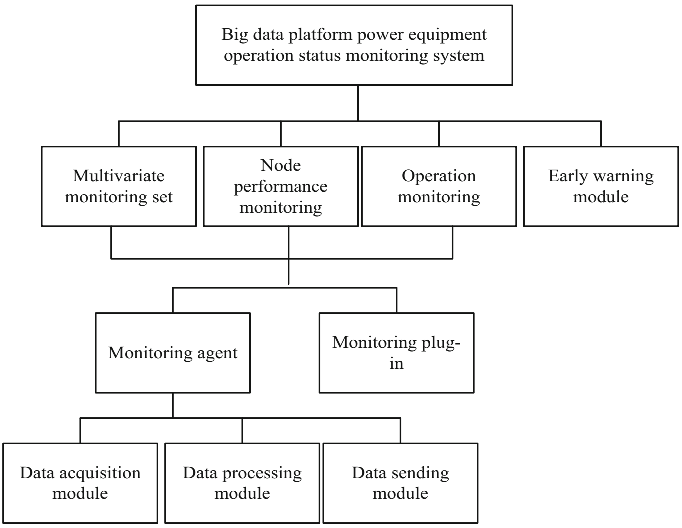

Fig. 4. Functional structure of hardware equipment of the system

The field equipment layer mainly uses the data collector at the basic level to collect the data of the field equipment, and needs to upgrade the field electricity meter. The field device layer collects the real-time data through the power data collector and transmits it to the collector via RS485 bus. The data transmission layer uses the concentrator to centrally process the received data and transmit it to the server through TCP/IP. The user can log in to the designated management account through the PC to access, manage and monitor the data of each monitoring point. The management application layer is mainly a human-computer interaction interface, providing users with various application functions.

2.2 System Software Function Optimization

In realizing the monitoring of the operation status of power electronic equipment, it is necessary to use Web-related technologies to complete the work of real-time monitoring of the work of power electronic equipment, and at the same time, it can provide analysis of the corresponding abnormality through the system. In-depth analysis and application of technology, the more typical Web service technology, which has strong practicability, and can meet the system's demand for Web services in the early stage of system planning. In addition, the technology is frequently used in software development, has many powerful functions, and integrates a number of practical programmable applications, which can meet the needs of any development environment, meet the open XML standards, and provide distributed and interoperable applications [6, 7].

Based on the analysis of the characteristics of the wireless sensor network monitoring system, a wireless sensor network based monitoring system for the running state of electronic equipment is designed. The system is composed of two parts: a field acquisition unit and a remote control unit. The field acquisition unit includes a reduced function node (RFD) sink node (Sink) and a gateway. Among them, RFDs only collect data without routing, and different RFDs cannot communicate with each other; The sink node is responsible for collecting the data sent by RFD and selecting the most suitable route to send the data; The gateway sends the received wireless signal to the remote control unit through the wired network. Remote control consists of router, data storage server and remote control terminal. The router coordinates the communication between different on-site acquisition units and the remote control terminal; the data storage server not only collects and stores the data of different networks, but also provides backup for the data of each individual network, which strengthens the reliability of the network system; the remote control terminal is an engineering technology personnel provide real-time data and issue control commands to the network. The existing wireless sensor is used to connect the field acquisition unit and the remote control unit, which ensures the reliability and timeliness of the wireless sensor. The overall design scheme of the online comprehensive monitoring system for equipment operating status based on the integration of wireless sensor information is shown in Fig. 5.

The system is divided into field layer, platform layer and presentation layer. The field layer takes the integrated monitoring device of electronic equipment as the core to realize the collection, analysis, display, control, alarm and other functions of various monitoring information of electronic equipment; The platform layer is the coordination and dispatching center of the whole system, which is composed of a variety of microservices to realize the collection and storage of field layer data and the interaction with presentation layer data; The presentation layer is mainly used to receive user requests,

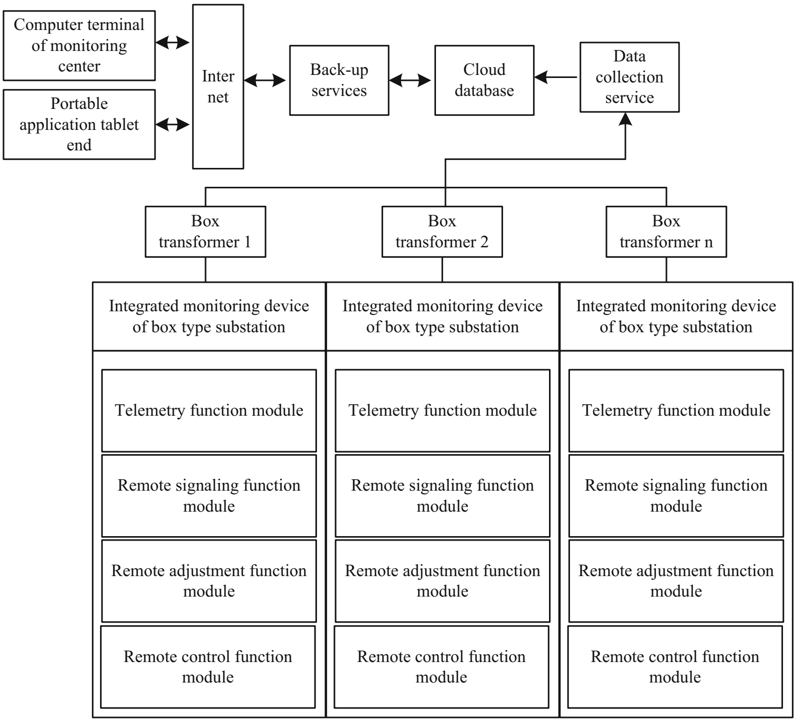

Fig. 5. The overall design scheme of the online integrated monitoring system for the operation status

respond to data display, and provide users with interfaces to interact with machines [8]. Based on multiple deployments and system functional structures, workflow can be divided into performance monitoring workflow and job operation monitoring workflow, as follows: performance monitoring procedures include multiple monitoring sets, performance performance monitoring and node performance monitoring, and various indicators can be monitored through performance plug-ins, such as monitoring network services and monitoring system host resource operation. If Icings has no monitoring function, all monitoring needs to be completed by installing plug-ins. The plug-in will feed back the monitored results to icings, and analyze these results in the form of Web-page text for users to view. At the same time, the plug-in also realizes fault warning effect. Icings use the NRE to obtain information about the performance of the monitored hosts. NRPE includes two parts: the inspection part, which is located on the monitoring host; the acquisition part, which is arranged on the terminal power equipment to collect information. Its overall flow chart is shown in Fig. 6.

Based on the working principle of wireless sensor, intelligent operation of equipment is realized through remote collection and centralized processing. But in the long distance transmission of signals, noise signals will inevitably be introduced. The noise source may be the fixed frequency noise generated by the operation of the generator, or it may be the white noise coupled with the transmission line [9, 10]. No matter what kind of

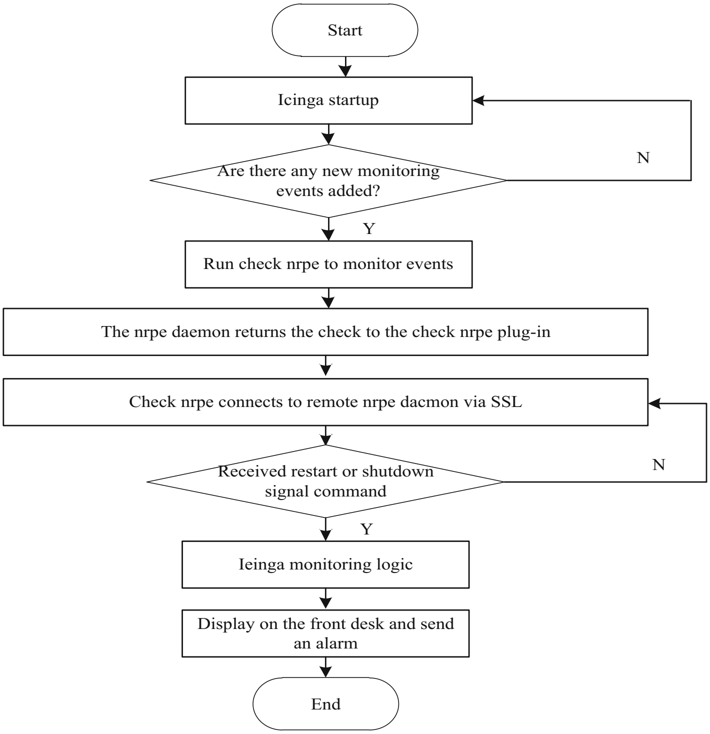

Fig. 6. System performance monitoring workflow

noise, it is not conducive to the high-quality transmission of the signal. If the noise problem is not handled well, it will restrict the operation status monitoring function of the generator set of LSTM neural network. In order to eliminate noise interference, the wavelet algorithm is used to process in the frequency domain to realize signal noise reduction. If $(x) \in L_2(R)$ assumes $L_2(R)$ can be used to describe a square integrable space real number, $\varphi(a)$ is Fourier transform, when ψ can make the following equation true:

$$\mu = \prod \varphi(a) L_2(R) - \int_{-\infty}^{+\infty} \psi(n) g(x) \leq 1 \tag{1}$$

Calling (n) as the base wavelet, it can be deduced from Eq. (1) that the base wavelet must satisfy $\varphi(n) = 1$, so $g(x)$ must have bandpass properties. a and b respectively represent the two load points of the power distribution system; c represents that the two load points a and b constitute an electronic equipment node. A value of 0 indicates the power supply amount that the user does not obtain at this load point. Therefore, its value result is as follows:

$$\begin{cases} \gamma_1 = 1 \\ \gamma_2 = \mathrm{m_b}/\mu(\mathrm{m}_a + \mathrm{m_b}) \\ \gamma_3 = \mu\mathrm{m}_a/(\mathrm{m}_a + \mathrm{m_b}) \\ \gamma_4 = \mu - 1 \end{cases} \tag{2}$$

The calculation process of the working probability of the system node under normal conditions is as follows:

$$\begin{aligned} P(n) &= \sum P(\gamma_1, \gamma_2, \gamma_3, \gamma_4) \\ &= \mu \sum P(\gamma_1, \gamma_2, \gamma_3, \gamma_4) \sum_{\mathrm{b}} \left[\mathrm{P}, \gamma_1 = 1|\gamma_2, \gamma_3, \mathrm{P}(\gamma_4)\right] \\ &= \mu \sum \mathrm{P}(\gamma_1, \gamma_2, \gamma_3, \gamma_4)\left[\mathrm{P}, \gamma_1 = 1|\gamma_2, \gamma_3 = 0, \mathrm{P}(\gamma_4 = 0)\right] \end{aligned} \tag{3}$$

According to the network model shown in the formula, it conforms to the principle of reliable operation of electronic equipment, and the reliable power supply performance of the power distribution system can be monitored through wireless sensors. Under normal circumstances, the ID3 and C4.5 algorithms are used to find the most suitable segmentation threshold, and then provide a basis for the power consumption information collection, operation and maintenance monitoring system. When the ID3 algorithm is executed, it can only process split data, tend to have more attribute values and discrete data. Compared with this algorithm, the C4.5 algorithm has no information gain feature in attribute selection, but calculates the information gain as a standard. Information gain is defined as:

$$gain\_ratio(Z) = \frac{gain(Q)}{split\_\inf(AZ)} - P(n) \tag{4}$$

Use the quick sort method to sort the data attributes, and finally calculate the information gain to determine the local threshold. The specific calculation steps are as follows:

(1) Arrange the data set Q in ascending order according to the value of the continuous attribute gain Z, assuming that the value sequence of the sorted attribute value Z is: $\{A_1, A_2, \cdots, A_n\}$, where $n = |AZ|$.

(2) For all A_i and $1 \le i \le \mathrm{n} - 1$, divide Q into two subsets: $Q_1 = \left\{A_j|_{A_j \le A}\right\}$ and $Q_2 = \left\{A_j|_{A_j > A}\right\}$ according to the value $A{=}(A_\mathrm{i} + A_\mathrm{i} + 1)\big/2$, and calculate the information gain *GainA* after division.

(3) Find the largest A in *GainA*, and record it as the local threshold $A_{\max}$.

(4) Find the threshold value closest to $A_{\max}$ in $\{A_1, A_2, \cdots, A_n\}$, and divide the threshold value to complete the discrete differentiation of Z. The algorithm can be used to classify and analyze the characteristics of power supply units, user groups and distribution stations; On the basis of data statistics, the declared capacity information of newly installed users shall be recorded, and the power consumption information shall be increased or decreased in time to realize the real-time monitoring of power consumption information acquisition, operation and maintenance.

Aiming at the state information acquisition and processing system required by the combination of traditional power electronic equipment and embedded technology, it can analyze and diagnose the implementation running state of power electronic equipment. The implementation and operation status information data of the equipment is collected, and the information data collected in real time is transmitted in time, and then the system can realize the follow-up information diagnosis and analysis operations. The information data collection and information data transmission included in this system are established. It is realized on the basis of wireless sensor technology, which is divided into two aspects: information collection and information transmission. In the information collection part, the parameter terminal node of the electronic equipment needs to be detected. The specific software operation process is shown in Fig. 7.

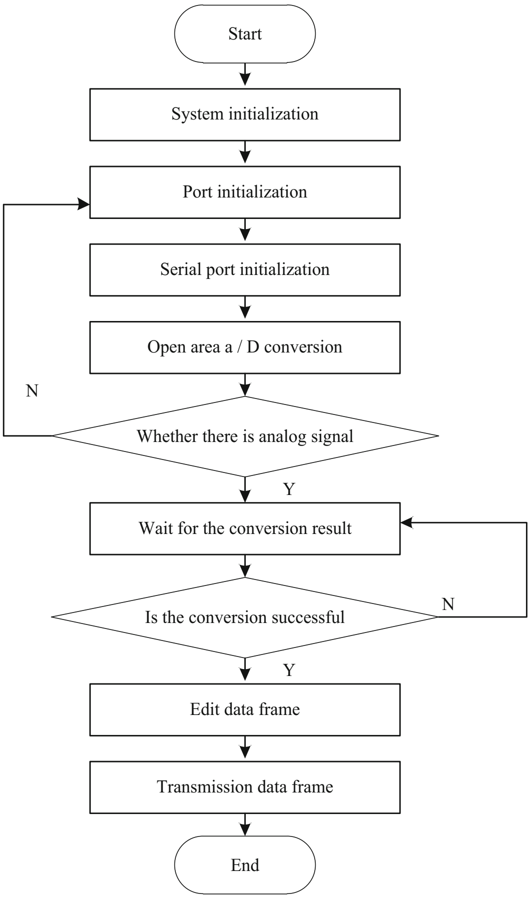

Fig. 7. Monitoring terminal software design process

From the above workflow, we can see that the main program of this system will determine the system configuration information after startup, and initialize the system modules. At this time, various instructions can be configured, and when the configuration is completed, specific configuration instructions will be executed. If no configuration is made, the system will work according to the initial configuration of the system. In a specific working mode, it communicates with the information acquisition device of power electronic equipment, acquires the real-time operation status information data of specific equipment through the power electronic equipment end, and transmits the information to the system server. In the controlled mode, the status information is collected and transmitted through the collection instructions sent by the server, and the server is responsible for sending specific information interaction instructions.

2.3 Realization of Intelligent Monitoring of Electronic Equipment Operation

The field layer is a collection of electronic equipment distributed in different physical locations based on the Internet of Things connection. Each electronic equipment is installed with a comprehensive monitoring device to realize the monitoring of various electrical quantities, Monitoring and intelligent control of non-electrical quantities and switch states.

The platform layer is a set of management analysis software and data collection deployed on the ECS, which is the coordination and dispatching center of the whole system and consists of a variety of microservices. In addition, the background service can accept the control command from the presentation layer to control the electronic devices on the field layer in the way of 4G communication; The SQL Server cloud database is used to store various types of monitoring data of various electronic devices at the field level, including user table, electronic device information summary table, electronic device model information table, and storage table of various monitoring information corresponding to each electronic device. The physical model of the database is shown in Fig. 8.

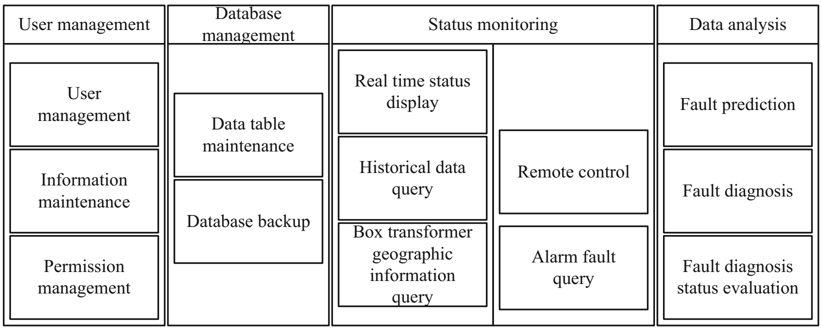

Fig. 8. Presentation layer HMI software functions

Users in the user table can be divided into administrator-level users and ordinary users. Administrator-level users can maintain the database, including adding/deleting users, assigning user rights, adding/deleting electronic devices, and creating corresponding monitoring information storage tables/delete etc. Ordinary users can query and control the information of electronic equipment within the scope of authority, and the scope of user authority is specified by the code list in the code field of electronic equipment. The presentation layer is mainly used to receive user requests, respond to data display or realize remote control of electronic equipment on the field layer, and is a man-machine interface for users to interact with the integrated monitoring system. The presentation layer provides two human-computer interaction modes: the monitoring center computer terminal and the mobile application tablet terminal. The computer side is a Web application based on the browser/server (BS) structure developed by Jave Script 5th Generation Hypertext Markup Language (HTML5) and Cascading Style Sheets (CSS); The tablet end is an application (App) developed based on the Jave language, which is installed in the tablet computer or mobile phone to facilitate the operation and maintenance personnel to carry and maintain at any time. In terms of functions, the computer side has added two items of database maintenance and user management compared with the tablet side, and only users who log in as system administrators have the right to operate on these two items. Ordinary users can only browse information and perform remote control with limited permissions. The specific functions are shown in Fig. 9. Taking the state monitoring of electronic equipment as an example, considering the large amount of electronic equipment state monitoring, set up a state monitoring main IED for one electronic equipment, and set up a state monitoring main IED for one electronic equipment, and for the dissolved gas monitoring in oil, partial discharge monitoring, electronic equipment on-load voltage regulation tap The functions of switch monitoring and winding hot spot temperature monitoring are respectively set up with sub-IEDs, and the main IED realizes the functions of data collection and preliminary diagnosis of each sub-IED. Therefore, for the condition monitoring system, the bay layer mainly includes electronic equipment/reactor condition monitoring main IED capacitive equipment/metal oxide arrester condition monitoring main IED, circuit breaker/GIS condition monitoring main IED, etc. to realize the relevant monitoring data of the equipment summary, processing, comparison, early warning and other preliminary self-diagnosis functions. In addition, according to the monitoring state quantities covered by the monitoring system mentioned above, the bay layer should also deploy the environmental monitoring IED to obtain the relevant temperature and humidity information: deploy the measurement and control IED, and obtain the comprehensive analysis of the relevant power information.

The master station layer mainly includes the master station monitoring unit, remote diagnosis, decision support and other application systems. The monitoring unit of the master station gives a comprehensive evaluation of the current health status of the equipment by analyzing the status monitoring data of the whole network. While the data analysis and evaluation results are released throughout the network, they can also be transmitted to remote diagnosis, decision support and other application systems to provide a basis for equipment risk assessment and maintenance strategy formulation.

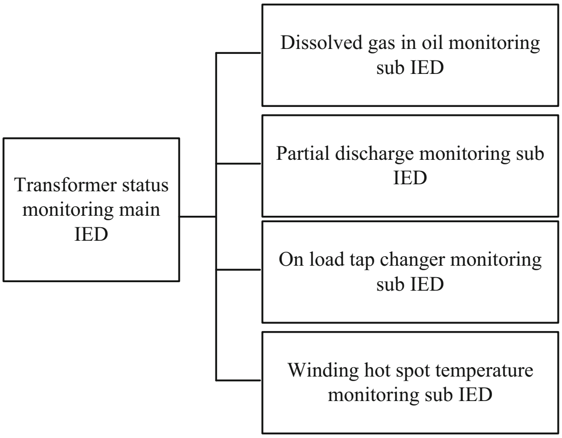

Fig. 9. Transformer Status Monitoring IED

3 Analysis of Experimental Results

In order to prove whether the intelligent monitoring system designed this time can complete the real-time monitoring of the fault under the running state of the distribution electronic equipment, solve the problem that the long-term information in the fault area cannot be covered, and ensure the normal power consumption of the non-faulty equipment, the method of comparative experiment is used to carry out verify. In order to ensure the authenticity and reliability of the experimental results, the MATLAB software is used to process the experimental data and obtain standardized data results.

The main part of the hardware configuration of the system test is the network content, which mainly includes the selection of Huawei Fecal RH2288V2 server or a storage server of the same level as the server. The hardware on the client side is mainly PC, its CPU needs to reach 4 cores, the minimum frequency needs to be 2.7 GHZ, the hard disk space needs to be at least 500G, and the computer memory is DDR48G memory. The server operating system is based on linux 3.5.1. The relational database management system is oracle 0.19 commercial version. The server system has VM and VPN support and services. The operating system of the client side is Microsoft Windows, and the browser needs to use the browser with IE10 core. The platform used for information acquisition and transmission of power electronic equipment is required to adapt to the basic requirements of Datasocket library and basic C language library in terms of performance test. By allowing more users to access the system and process some work processes, the system's reaction efficiency is evaluated and the expected process processing efficiency is evaluated. The system performance is calculated and analyzed based on the actual data obtained from the evaluation. If the calculated data can meet the corresponding standards, the system performance test is passed.In the system performance test, it is necessary to inspect the operation stability of the system, and at the same time, it is necessary to analyze the data and information standards obtained in the test process to see if it can meet the test standards, which is used to judge the perfection of the system development. Set the system to run continuously for 12h at rated 150k. By collecting the temperature change value of the load electronic equipment in different states, set the operation data to be collected every 30min. The results are shown in Table 2:

Table 2. Transformer temperature changes under different complex loads (unit: ℃)

Interval	1.0 load	1.5 load	2.0 load	3.0 load
30 min	43.7	45.3	48.2	53.5
60 min	47.5	51.5	55.6	60.5
90 min	52.6	56.3	61.3	70.3
120 min	58.5	68.2	67.6	79.5

According to the table, the operating temperature of electronic equipment is collected when the load is increased by 0.5 times. Basically, the temperature changes with the load. As the winding hot spot temperature of the transformer can limit its load capacity, once exceeding its internal temperature, it will accelerate the aging of electronic equipment materials, reduce the effective utilization efficiency of electronic equipment, and lead to power interruption of the entire line. Input the electronic equipment data collected by each group into the monitoring system, and monitor the actual ambient temperature and hot spot temperature of the electronic equipment under the 24-h uninterrupted operation condition. In the actual measurement and data collection process of electronic equipment operation, it is ensured that the monitoring system can accurately record working condition information, understand the safety indicators of electronic equipment circuit operation under different states, and comprehensively evaluate its main influencing factors to ensure that under the monitoring system. Real-time data sharing can be achieved. When the load is large, the hot spot temperature of electronic equipment exceeds 65 °C, and equipment failure will occur at this time. The application effect of each group of

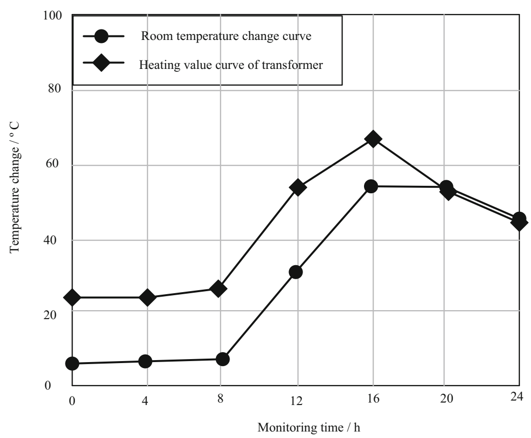

Fig. 10. System monitoring results of this paper

monitoring systems under different room temperature conditions is shown in the Fig. 10 (Fig. 11).

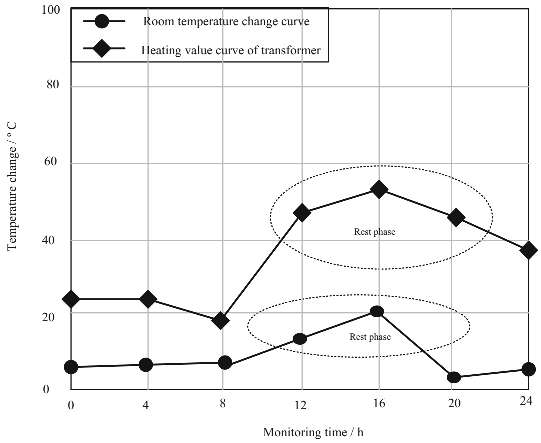

Fig. 11. Traditional system monitoring results

It can be seen from the figure that the statistical value of the two groups of traditional monitoring systems does not show a similar change curve with the change of room temperature. When the electronic equipment reaches the extreme value of the hot spot temperature, it cannot complete the early warning at the first time, so that it can continue to work in a high temperature environment, which is likely to cause damage to the equipment. The above monitoring data can prove that the monitoring system designed in this paper can complete the monitoring of electronic equipment with different loads under the condition of transformation, find out the fault location in time, and protect the long-term operation of power distribution equipment. Relevant functions of the developed system were tested, including four functional components: login monitoring module, signal acquisition, signal processing and analysis, and abnormal diagnosis. The results are as follows Tables 3 and 4):

Table 3. System login module test

Test title:	Testing procedure	Expected results	Test result
Complete the verification of the entered user name and password	Enter user name and password; Click the login button	If the user name and password are correct, you can jump. If the password is wrong, an error message will be returned	Meet the expected design

Table 4. System running status monitoring functions

Test title:	Testing procedure	Expected results	Test result
Test whether the communication is connected normally	Enter the account name and password to log in; Click power transformer monitoring; View connection status	Successfully logged in	Meet the expected design
Normal display of monitoring signal	Enter the account name and password to log in; Click power transformer monitoring; View the monitored waveform	Successfully logged in	Meet the expected design

According to the above functional test results, this paper improves the existing design problems, mainly repairs the bugs existing in the system functions, and then tests the performance of the design system. The corresponding performance test results are shown in Table 5:

Table 5. System performance test results

Test content:	Test indicators	Test result	Expected results
response time	Average response time of processing application	1.9 s	< 4 s
	Maximum response time for processing application	3.3 s	< 5 s
	Average time of application submission	1.8 s	< 6 s
CPU utilization	Maximum server CPU usage	65%	< 70%

The system implementation is tested, and the test environment and method are described. The system login, signal monitoring, feature extraction and abnormal diagnosis modules are tested respectively. The results show that different functional modules can work well. Then collected and counted the number and type of system bugs during the three-month trial run. The corresponding solutions are given for different types of BUGs, thus ensuring the long-term stable operation of the system.

4 Conclusion

In this paper, an intelligent monitoring system for the running state of electronic equipment based on wireless sensors is designed. Considering the disadvantages of traditional systems such as cumbersome connection and large redundancy, it is improved. The experimental results show that the storage overhead of the system in this paper is greatly reduced, which is suitable for large-scale cluster computing and has high optimization performance. Although the system designed in this paper contains visualization modules, the research on human-computer interaction has not been carried out in depth. Next, we will focus on improving the human-computer interaction performance to improve the system designed in this paper.

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