The Study on Network Detection Mechanism of Multi-zone Computer Room Simultaneous Transmission

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Abstract: Based on the actual needs of multi-zone computer room network management, the simultaneous transmission fault and ambient temperature are taken as the main environmental parameters. The upper and lower computer design schemes are combined with the computer, network and single-chip technology to design the network simultaneous transmission faulty automatic protection system for detection. When the environment parameter is abnormal, the server cluster is automatically shut down, and when the environment parameters are restored to normal, the normal service function of the server cluster is automatically restored. At present, the software and hardware design of the system has been completed, and the automatic protection function for detecting the simultaneous transmission of the multi-zone computer room has been realized. Through practical application, good results have been achieved.

1. Introduction
In the computer experiment teaching center of universities, the server cluster is the core node, carrying the functions of teaching and scientific research services, and working uninterrupted throughout the year. To ensure reliable operation, in addition to the factors of the device itself, the operating environment is essential. The two most important factors in the operating environment are grid power and ambient temperature, because abnormal power outages can cause server data to be lost, and high temperatures can cause server equipment to be damaged or even damaged. Therefore, in the operating environment of the server cluster, the multi-zone computer room network high-power UPS power supply and precision refrigeration air-conditioning are necessary supporting equipment. However, in practical applications, some unexpected factors can still cause server data loss or even equipment damage. When the power grid is abnormally powered off, the server cluster has UPS power supply still working normally, but the air conditioner is an inductive load, and the UPS power supply cannot supply power to the air conditioner, so the air conditioner also stops working when the power grid is out of power. At this time, the heat generated by the operation of the server cluster causes the temperature of the operating environment to rise rapidly. If it cannot be detected and disposed in time, the high temperature eventually causes the server system to collapse, causing data loss or even equipment damage. Once the air conditioner fails, the situation is the same. Therefore, when the power grid is abnormally powered off or the air conditioner fails, how to protect the server cluster equipment and prevent data loss has important research significance.

2. Current situation and existing issues
Currently, the main method for monitoring the server cluster is to use the engine room power and environment monitoring system. This kind of technology is based on the GSM alarm system. When the parameters such as the ambient temperature, humidity, and grid voltage of the equipment room exceed the set range, the alarm system form of SMS is sent to the manager so that the manager can find and dispose of the problem in a timely manner. The SMS alarm mode is essentially the management mode of “wireless alarm + human security”, but for the computer experimental teaching center of colleges and universities, the size of the server cluster is relatively small (less than 100 units), and these rooms are unattended, so this The monitoring method itself is not perfect.
Mainly shows in the following parts:

(1) At some time in the evening, especially after 24:00, alarm messages may be ignored because everyone is sleeping soundly, even if technical managers have received them.

(2) In the case of two-day weekend and holidays, technical managers may be far away from the location of equipment. Therefore, the problem is difficult to be dealt with in time when receiving alarm messages. Especially during the winter and summer holidays in colleges and universities, this problem is the most prominent.

(3) It may cause great economic losses. Generally, network server cluster in multi-zone computer rooms, switches, routers and other equipment are intensively installed in the central computer room. These core equipment not only runs various key business [1], but also in a generally high value. Once the above abnormal situation occurs, the equipment will be damaged if the problems couldn’t be handled in time. Its impact will be great and the losses are often heavy.

The above problems cannot be solved by SMS alarm technology which based on GSM.

3. Systematic Design

3.1 Goals of the design

Aiming at the practical problems existing in the application of server cluster, an automatic protection system of server cluster based on environmental parameters is designed. Through the real-time monitoring of environmental parameters (power grid voltage and environment temperature) of the server cluster operation, when the parameters reach the set upper limit, the server cluster can be stopped automatically to protect the security of the equipment under the condition that the number of network servers’ data in multi-zone computer room is guaranteed safely. When the environment parameters return to normal, the design system will automatically open the server cluster and restore its service function. That is to say that the automatic management and protection function of server cluster are realized.

3.2 Technical scheme of systematic design

The system adopts the design scheme of combination of lower computer and upper computer. The upper computer is composed of a monitoring and controlling system for server running in the clustered environment, and the lower computer includes data acquisition and control system, temperature sensor, power grid voltage sensor and relay set. The function of the upper computer is to receive the data collected by the lower computer and have an analysis. When the data reaches the threshold of the systematic design, it will give an instruction on closing/opening the server, stopping/restoring its service function, and sending the server power cut/open instructions to the lower computer. The function of the lower computer is to monitor the environment temperature and power supply voltage of the server cluster in real time, and send the collected data to the upper computer. At the same time, it receives the power control command sent by the upper computer to cut off or restore the power supply of the network server cluster in multi-zone computer room.

The diagram of the design system is as follows:

![Fig. 1 The design system](image-url)
3.3 The design of the lower computer

The lower computer is designed with single-chip microcomputer technology and sensor technology, including data acquisition and control system, temperature sensor, power grid voltage sensor and relay set.

(1) Data acquisition and control system. Its main function is to transmit the data collected by temperature sensor and power grid voltage sensor to the upper computer in real time, and receive the instructions from the upper computer to control the closure/disconnection of relay set, so as to realize the control of power supply of the network server cluster in multi-zone computer room. Since SOC single-chip microcomputer integrates almost all the digital and analog interfaces and functional components needed to construct the data acquisition and control system in a chip, and has a micro-controller fully compatible with the MCS-51’ inner core and instructions, the C8051F340 of Silicon Laboratories Company in American is selected for the systematic design to realize data acquisition and control. C8051F340 uses the patented CIP-51 micro-controller core of Silicon Labs, which has some functional circuits like on-chip power-on reset, voltage regulator, watchdog timer and clock oscillator. The on-chip system can work independently. CIP-51 adopts a pipeline structure, which greatly improves the speed of instruction execution compared with the standard 8051 structure. FLASH memory has the ability of reprogramming in the system, and user’s software can control all peripherals completely. Therefore, the single-chip microcomputer with C8051F340 as the core can better realize the expected function of the system and effectively improve the efficiency of its development.

(2) Grid voltage sensor. The purpose of monitoring the power grid is to determine whether the power supply is normal. The system design uses DC +5V regulated power supply as the grid voltage sensor, and determines the two states of “normal power supply and power failure” of the grid by detecting the output voltage “+5V, 0V”.

(3) Temperature sensor. The purpose of temperature collection is to determine whether the air conditioner is working normally by detecting the ambient temperature. DS18B20, produced by Dallas, USA, is selected as the temperature sensor. It is a programmable single-bus digital thermometer that can realize bidirectional communication with the microprocessor through only one line [3], with wide temperature range and high precision.

The system is designed with external power supply of +5V, and the DQ end of DS18B20 is connected with the corresponding port of C8051F340 to realize real-time temperature collection.

(4) Relay group. The design system uses normally closed relay, which uses the ULN2003 high-voltage and high-current Darlington transistor array drive circuit to accept the commands issued by the C8051F340 microcontroller to realize the control function of the server power supply.

3.4 Upper computer design

The upper computer USES an IBM server and is powered by UPS power supply. Under various foreseeable abnormal circumstances, the upper computer always maintains normal working state. It is connected to the lower computer through the RS-232 bus and connected to the multi-zone computer room network server cluster through Ethernet.

(1) Function description of upper computer.

Using the developed and designed server cluster operating environment monitoring and control system, the upper computer IBM server obtains the real-time monitoring data uploaded by the C8051F340 from the RS232 serial port by serial communication standard. When abnormal data is received and the set threshold value is reached, control command is sent through Ethernet to stop the work of the multi-zone computer room network server cluster.

At the same time, the command is sent through the RS232 serial port, and the relay group is controlled to cut off the power supply of the server cluster. When the environment parameters of the real-time monitoring are restored to normal, the power of the server cluster is restored first, and then the server is started to be sent through the Ethernet to restore the normal network service function, thereby achieving the purpose of automatically managing and protecting the server cluster.

(2) Design of upper computer system. First, group the server clusters. In order to ensure data...
security and simplify system design, network server and network equipment in multi-zone computer room are divided into three groups. Among them, the first group is a proxy server without data application, the second group is a database and platform application server, and the third group is a network device such as a switch. The first group and the third group of devices have no data security risks, and can adopt a relatively simple control method. The second group of devices is the most complex. There are various servers such as databases, information platforms, and high-performance computing platforms. There are Windows, Linux, SQL Server, Oracle and other systems and applications. These servers have high requirements on data security, and must operate in strict on and off order and process. For high-performance computer platforms, the startup process is “start IO node to start Console node to start each computing node”, and the shutdown process is “close each computing node and close Console node to close IO node”. In the process of system design, the service functions of each server are differentiated, and the design procedures are strictly in accordance with the management process to ensure data security.

The system development uses C language design, C8051F MCU development uses Keil’s uVision debug development environment, the software design process of the whole system is shown in Figure 2.

![Software Design Process Diagram](image)

**Fig.2 software design process of the whole system**

For the server, first stop its service function, then normal shutdown, and finally cut off the power
supply. Since the control commands are passed over Ethernet, the network device is finally down. At this point, the protection function of the multi-zone computer room network server cluster is completed. After the entire server cluster and network equipment are shut down, the UPS power supply only maintains the normal operation of the upper computer and the lower computer. After the power grid returns to normal, the air conditioner will start to work automatically. When the ambient temperature reaches the set condition (25 degrees), the power supply of the equipment in the machine room will be restored, and the network equipment will be started first. Since the startup of devices such as the core switch takes 5-10 minutes, the server cluster is started after 15 minutes of delay, and the normal service function of the server cluster is restored.

At present, the software and hardware design of the system has been completed, and the expected purpose has been achieved, and the fully automated management function has been realized. After more than two years of practical application, very good results have been achieved.

4. Conclusion

The server automatic protection system based on environmental parameters realizes the automatic management of the whole process of “monitoring, analysis and control”, without manual intervention, and can be disposed immediately when an abnormality occurs, with high efficiency and good practical effect. The design system is applicable not only to the multi-zone computer room network server cluster of the computer experiment teaching center of colleges and universities, but also to the network room of similar or small scale, and the cost is very low.

References

