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Analysis on the Method of PLC Remote Monitoring and Fault Diagnosis

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Abstract: In the industry 4.0 era and under the framework of China's "Smart Manufacturing 2025" plan, efficient modern manufacturing equipment plays an important role in production. In order to ensure the safe and stable operation of production equipment, it is necessary to troubleshoot the fault in the first time. This paper discusses the method of remote monitoring and fault diagnosis based on PLC.

Keywords: PLC; Remote Monitoring; Fault Diagnosis; Advantages

1. Development of PLC remote monitoring and fault diagnosis methods

This technology of remote monitoring and fault diagnosis is a method with new modern equipment, which integrates the network technology, advanced and reliable electronic technology, and fault diagnosis technology with more and more accumulated experience. With the continuous development of communication technology and electronic information technology, the design, research and initial application of remote monitoring and diagnosis for industrial equipment are emerging all over the world. The mode of combining fault detection and remote control has the following development periods.

1.1 Manual off-line monitoring and diagnosis

Since the semiconductor and with the miniaturization development of transistor, integrated circuit has instantly become hot property and led the progress of The Times, which led to the update iteration of two modern electronic technology and computer technology. So as a monitoring device, the main digital signal processing and analysis technology has a breakthrough, which provides the theory support for updated technology.

In the later period, equipment failure mainly relies on experienced equipment maintenance personnel to carry out manual inspection of equipment using analytical instruments. In this way, monitoring instruments are only auxiliary tools, and the experience of monitoring personnel has a great impact on the accuracy of diagnosis. This not only takes time and effort, but also delays the normal operation of equipment and production lines. At the same time, the manual inspection of the fault and the maintenance to a large extent depend on the experience of the maintenance personnel, while the difficulty of maintenance depends on the complexity of the equipment.

1.2 Single centralized online monitoring and diagnosis

The online centralized monitoring and diagnosis technology based on computer includes signal processing,

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condition monitoring, fault diagnosis and so on. All device controls, such as switching information, are transmitted to the computer. However, independent analysis of diagnosis results, single engine system resources are independent, that is different equipment of the diagnostic system can not communicate with each other and be applied. The impact of lack of information on the diagnostic system of the scope of application and flexibility, operability and independence greatly limited its scope of application.

1.3 Remote monitoring fault diagnosis based on LAN

According to the characteristics of device function distribution and geographical distribution, the devices distributed in each LAN independently and performing certain functions are interconnected to achieve the collection of shared resources, the co-working of multiple devices, the monitoring of diffusion screening, and the unified operation of devices. These systems need to build system backbone, branch LAN networks, industrial communication networks, field detection equipment, communication systems, and so on.

With the high-speed, complicatd automation development of modern equipment, misdiagnosis of modern devices becomes very common. The technology of monitoring and diagnosis of equipment condition is comprehensive with a wide range of knowledge. So there are higher demand on the diagnosis technical personnel's quality. Once there are cases beyond their knowledge, they are often unable to deal with them.

2. Characteristics of PLC remote monitoring and fault diagnosis methods

According to the analysis of the development trend of PLC remote monitoring and fault diagnosis methods, the research on remote intelligent fault diagnosis system technology of complex equipment is developing towards the direction of information, agility and intelligence.

2.1 Information

A large number of modern information technology is used, which is incorporated into the new system of modern information strategy, and the network system is adopted to avoid blind diagnosis and hinder the realization of fault diagnosis system. In the field, if the diagnosis center cannot solve the problem that needs help to make the whole diagnosis process effective and order, modern information technology can unify the pattern and eliminate the time and space barrier.

2.2 Agility

With strong real-time, the controller can use the diagnosis result to take action immediately, avoid the serious consequences caused by the rapid increase of accidents, and greatly improve the utilization range and utilization rate of maintenance resources.

2.3 Intelligence

Many artificial intelligence technologies and various intelligent methods are effectively integrated. In order to make the hardware in good condition, it is necessary to fully consider the system failure, make the system to withstand some error, sometimes, change management strategy, and make the system to continue to run safely and reliably. More effective diagnostic function can make full use of the controller's control information to diagnose, simplify the communication process and diagnosis logic, and accurately position fault.

3. Function composition of PLC remote monitoring system

3.1 Manufacturing equipment field layer

Production areas include CNC machine tools (mechanical centers), automatic production lines/processing tools, industrial robots, automatic workshop storage and transportation equipment, data acquisition equipment and specialized execution equipment, which can be operated centrally or independently of the network.

3.2 RDSP real-time data service platform

The communication management between network and control network is the core of remote control system. RDSP provides the interface of multiple field devices, integrates the information of different regulator isomers, forms the high-level data interface, and provides real-time and historical data.

3.3 Centralized control function

It can real-time display the production mode and production situation in the production workshop. Parameters that reflect the current state of the equipment, such as vibration, temperature, pressure, flow, smoothing time, etc., control the characteristic signals related to the state of the equipment. Parameters are used to extract useful signals from performance signals and perform necessary alerts and network protection.

3.4 Basic feature set

3.4.1 DOS (Diagnosis Operation System) based on boot model

The diagnostic operation is as follows. Under certain conditions, it has been proved that the unified or simple intelligent diagnosis method is correct. The efficiency should be reasonably chosen by fuzzy neural network, and integrated into the information domain and three data domains to form intelligent diagnostic services guide, leading to the end of the fault diagnosis process. If the enterprise's own knowledge base and reasoning can not solve the problem, it can ask distributed diagnostic center for further diagnosis.

3.4.2 Remote monitoring service (WebHMI) based on Web and WinForm

Remote observation is the basis of remote fault diagnosis. Through the HMI website, the diagnosis experts have a comprehensive real-time understanding of the website. It can provide management decisions, on-site monitoring and real-time production information through the information network, and relevant departments and partners can easily understand the production situation.

3.4.3 Distributed Diagnosis Operation System (DDOS)

Many expert systems or multidisciplinary diagnostic functions allocate and coordinate diagnostic functions, and organize diagnostic methods and knowledge base. DDOS completes coordination, organization and evaluation.

3.5 Extended feature set

(1)Data conversion interface: Many functions, like production process management, workshop management, production process optimization, quality control and cost control, require real-time data support to meet the needs of other applications. In MES/ERP/CAD and other organization management system, the transparency of real-time information exchange in the United Nations system includes data and information conversion tools, complete format conversion, and adjusted report and data between enterprise operating systems, to ensure the integrity and consistency of various statements as well as the control and management of enterprise information.

(2) Intelligent application of data retrieval: Comprehensive statistical data, database, model recognition, fuzzy mathematics, roughness, machine learning, *etc.*

(3) Equipment management and maintenance: The whole process of equipment from installation and debugging to maintenance, processing and update should be updated. A complete technical data file should be established to conduct detailed statistics on equipment failure, including the date of equipment occurrence, explanation of the failure in detail and repair methods. According to the statistical analysis of the fault, the rule of failure is determined, the potential cause of the accident is found out, and the best preventive maintenance rules of equipment is formulated.

(4) Knowledge management and maintenance: Fault detection knowledge is the foundation of fault diagnosis system. The quality and quantity of knowledge determine the diagnostic capability of the system. It is an important factor to acquire, integrate and update the knowledge in the base of the system to realize continuous learning and innovation.

(5) Special analysis tools: Various diagnostic tools are based on signal analysis, time-domain analysis, frequency-domain analysis and a large amount of operation information. The information contained in the vibration signal is an indispensable aspect in the diagnosis process.

(6) Multimedia literature service: A learning organization and society determine that the skills of employees in the diagnosis process need to be constantly improved. Making full use of existing technology and educational means to improve maintenance quality, correct maintenance, and timely forecast and troubleshooting of personnel and equipment failures are key factors.

(7) Platform system security management: Since diagnostic equipment and related resources are publicly available on the Internet, it is particularly important to take into account the self-protection mechanism of expected diagnostic equipment and appropriate security policies to ensure safety and reliability. This feature provides the necessary support to securely disseminate information about federated devices, security management, and user rights management on a real-time/historical basis.

4. PLC fault diagnosis

4.1 Diagnosis method based on signal processing

This method is an early diagnosis method. It is suitable for objects with a large number of signal characteristics. The methods of extracting vibration and noise information include time interval, frequency range, amplitude, *etc.* The main methods of signal processing are correlation analysis, envelope analysis and spectrum analysis. Fractal analysis is a new time-frequency analysis method developed in recent years. It has a good opportunity to automatically adjust the local characteristics and signal time, and to conduct multi-dimensional focused analysis. These unified methods of specific object diagnosis, such as mechanical equipment, process flow, can better describe the extracted state and classification characteristics, but flexible native application system can only be carried out in a larger scope.

4.2 Equipment failure mechanism and failure model research

Based on the analysis of the function, principle and structure of the diagnosis object, combined with the experience of experts in establishing the knowledge base of diagnosis, this paper puts forward that the diagnosis process, fault mechanism and model based on intelligent reasoning are universal methods. Fault mechanism, fault mode, nonlinear diagnosis theory, advanced signal processing technology and fault mathematical model are studied. Starting from global production process, process simulation focuses on the relationship between changes.

4.3 Fusion of diagnostic methods

Various artificial intelligence diagnostic algorithms are also being developed for information about the status of diagnostic equipment systems. In the diagnosis of specific problems, extensive research and application practice have proved that the combination of expert knowledge and artificial intelligence is an effective method to diagnose equipment faults. Another approach is to develop a diagnostic system that combines knowledge and resources to inherit the results and progress of diagnostic services.

4.4 Method based on artificial neural network

Artificial neural network fault diagnosis is divided into two stages: the first stage is the learning stage, that is to choose the appropriate method. Network structure and size, by adopting a certain learning algorithm, can reflect the system's dynamic characteristics. Errors in the simulation may occur, affecting the interference. The corresponding status is coded as a variable into the neural network (the expectation output is output sample, which trains the neural network and determines the nerve force value in the training match). The second stage is the stage of fault diagnosis.The neural network trained in the memory is restored. For a given input, the corresponding output is obtained, and the fault is easily determined from the fault code output.

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