

Research of Remote Monitoring System Base on Internet of Things Technology

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ABSTRACT

Air compressor equipment is one of the most power consumption in industrial equipment, compressor operation control strategy for energy saving has been the focus of attention of manufacturers and users, Under restriction on professional knowledge of compressor, the user cannot real-time through the effective allocation of equipment operating parameters to improve efficiency of compressor, remote monitoring system of air compressor is based on wireless communication network and public mobile communication network construction.. Long distance controlling and equipment failure warning and on-line monitoring and automatic data analysis and processing and intelligent statistical report was applied in system. Customer service centers or manufacturers experienced expert serving for customer by audio and video, provide timely alarm, remote fault diagnosis and repair service by real time control of the working state of equipment and operation parameters. Based on analysis of historical operation data mining provides intelligent preventive maintenance and spare parts management service. It can make equipment security and high efficient and low consumption and stable operation, reducing the cost of operation and maintenance of compressor, improving service levels for customer.

Keywords

Internet of things technology; Data Acquisition; remote monitor and control; Control System;

1. INTRODUCTION

The Internet of things can be divided into three layers structure from top to bottom^[1]: the perception layer, network layer and application layer. The Internet of things involves information acquisition technology, embedded technology, wireless communication technology, positioning technology, security technology, software and services, data mining and cloud technology, energy technology. At present, the Internet of things technology and equipment of remote and intelligent maintenance service is one of the most popular manufacturing and the most rapidly growing field at home and abroad. The Internet of things technology has been widely applied and has good results in the field of foreign industrial remote monitoring equipment. The domestic household electrical appliances industry is also promoting products services which based on the Internet of things technology. Industry software vendors have also launched equipment intelligent management system. Remote monitoring system based on internet of things technology is also means that install remote data acquisition and control module in air compressor control cabinet. It can remote monitoring and

control air compressor in order to expanding the product after-sales service mode, improving the service level of the products, to create enterprise efficient service system. The enterprises will promote advanced manufacturing to high-end manufacturing services and the enterprise will have value profit model which added by strong product.

2. THE REMOTE MONITORING SYSTEM

2.1 The system function module

Real time data acquisition technology is based on Internet of things. the core components of ARM9 high performance embedded processor of air compressor control cabinet is responsible for collecting data of sensor. ARM9 high performance embedded processor based on real time operation system as the platform which Integrate TCP/IP and UDP protocol^[2].It hasa terminal access control, terminal control and monitoring, application system access and data routing function. Terminal access and access control realize the terminal access management and keep connection and flow control function by remote monitoring system. terminal monitor is to realize remote monitoring system terminal status, terminal report, fault management, query and configuration of terminal parameter, terminal remote wake up system startup boot, key parameters consistency verification and terminal operation task management functions. The air compressor equipment is a preventive strategy of intelligent maintenance under the internet of things. Through the analysis of the air compressor equipment operation and maintenance cost model, researching effects for different fault types of equipment maintenance cost. The optimization objective is to minimize the total cost rate. Constrained resources and the reliability of the equipment maintenance, the optimization model is established under complex environment based on multiple criteria for equipment maintenance strategy^[3]. The model realize intelligent decision model of equipment maintenance strategy. Strategy evaluation method of maintenance equipment which based on analytic hierarchy process has support equipment maintenance strategy, getting the best maintenance time and scheme.

2.2 Topology monitoring system

According to user needs, we establish the internet of things network topology. Network use the way of bus communication which is high performance, enhanced the data transmission rate to meet a large number of high-speed data transmission requirement. The system can be convenient through the Internet to achieve data sharing, and also can easily collect data to the server hard disk's manufacturers, for data mining of analysis and processing. Remote monitoring system of network

access to the gigabit router and gigabit router by the internal WEB server interface to access Wan. Gigabit router set a different subnet to ensure that each WEB server, database server and SCADA application server are independent of each other. WEB server is built to communicate with database server, SCADA application server and database server.

2.3 Model control monitoring system

Air compressor failure mode and researching of failure consequences always use FMEA (Failure Mode and Effect Analysis). FMEA can analysis air compressor equipment potential failure modes within the scope of the system, according to the severity of the classification or determine the failure impact on the air compressor. To provide supporting for equipment fault diagnosis, on the other hand, it can be used to improve the performance of air compressor products and new product development.

Knowledge management of fault repair solutions is based on the fault code, the fault reason, solving method, spare parts materials, tools, maintenance skills, working hours, and information for effective organization. Building the equipment intelligent fault diagnosis expert system of air compressor by expert knowledge which is based on AC-FMEA, The optimization reliability model is established under complex environment based on multiple criteria for maintenance strategy. The model realize intelligent decision model of equipment maintenance strategy. Evaluation method of maintenance equipment which based on analytic hierarchy process has support equipment maintenance strategy, getting the best maintenance time and scheme.

3. THE MODULAR DESIGN OF MONITORING AND CONTROL SYSTEM

3.1 Design of component application software system

The system adopts modular component development method modular, the main modules include data acquisition module, data management module, fault diagnosis and intelligent service module, manufacturers management, terminal customer management module, security management module, report module, user management module.

3.2 Data acquisition module

Acquisition data of monitoring and control system including air pressure, exhaust temperature, running time, load time, oil filter time, air filter time, lubricating oil time, dryer run or stop, stop running, loading and unloading, stop running for using empty machine too much time, coil temperature, stator temperature, total running time, host phase current, fan phase current, high of bleed pressure, fan fault current, purolator clogging, oil filter clogging, air filter clogging, the main motor current fault, phase error, exhaust temperature pressure sensor failure, exhaust temperature sensor failure, shortage of water and other information. Data acquisition of air compressor is composed of the following three ways: the embedded controller data collection, data acquisition based on sensors, data acquisition based on OPC heterogeneous.

Embedded data acquisition controller supports varieties of communication protocol. To realize the communication with

multiple sensors can be different manufacturers or type. Monitoring software platform and embedded controller based on Internet of things technology and MODBUS^[4] protocol, The full duplex mode of data collection and transmission is used.

The sensor signal data acquisition, the integration of many kinds of sensor network technology is the core of internet of things^[5]. It based on technology of sensor and depended on communication technology which has the advantages of good network adaptability. The sensor is based wireless sensor networks. Sensor was used in this study which includes air compressed duct sensor, duct flow meter and pressure gauge of flow sensor. Venturi vortex type gas flowmeter has a combination of flow, pressure, temperature sensor and an intelligent flow totalizer.

The heterogeneous data acquisition system based on OPC, OPC technology uses standard interface which meet the requirements of industrial control. OPC technology can make software have highly efficient and stable data access to hardware devices. The system application software can change information flexibly and greatly improve interoperability and adaptability of fieldbus control system. The system application software also be used to solve the system of data acquisition of multiple heterogeneous air compressor system and properly deal with communication between hardware and application software, improving couple degree of equipment standardization.

3.3 Monitoring data management module

The monitoring data management module is foundation of the whole system data, including on-line monitoring and fault early warning. Fault warning is to set the early fault warning, fault analysis, fault type, fault cause symptom and treatment scheme in time for user. Using database system can realize the large capacity real-time data acquisition and historical data storage, retrieval, query, operation, supporting remote user retrieval, query data.

3.4 Fault diagnosis and intelligent service module

Analyzing monitoring data of transmission, which is based on reasoning of fault diagnosis knowledge and the professional knowledge of service personal, Fault data of compressor running process can be identified and diagnosed by FMEA. At the same time, we should set up intelligent equipment maintenance service system on the public monitoring center management platform, to provide remote terminal resource management, using AC-FMEA library to support and get the best time and spare parts maintenance plan.

3.5 Factory management module

Functions include distribution management of user management, terminal management, terminal set condition monitoring management, terminal alarm information, terminal historical data query, operation management of the compressor, compressor equipment spare parts management, curve and report summary, remote video.

3.6 Client management module

Client management module Features include: compressor on-line monitor function, compressor alarm function, management of compressor operation, compressor information query and report summary etc. Development of data transmission is based on DTU. The main function of DTU is to transfer data to remote data center through wireless transmission. It is comfortable for some occasions which is difficult to have data acquisition through wire

transmission. Using MDMP protocol as terminal monitoring control and communication protocol of exchanging service, it can realize development of communication module, voice transmission module, SMS module.

4. IMPLEMENTATION OF REMOTE CONTROL SYSTEM

The air compressor control cabinet control software development tool uses Visual Studio 2008. Database system uses SQL Server2005. remote control software is based on ASP.NET. Sensors and embedded device interface uses C++ language. VS2008 is containing C++, C# and other compilers. It provide rich components and development tools^[6]. Remote control system based Web of Things Service Environment (WoTSE) to access Web channel and Web environment. The core part gateway middleware of WoTSE framework can shield the underlying hardware and complexity and heterogeneity of network^[7]. It is convenient to get and manage data of various sensor and system resources through Web way of Service by using various applications.

According to distribution characteristics of customer air compressor, remote monitoring based on hybrid model of C/S and B/S development. C/S mode is used to realize the air compressor control, operation parameter acquisition, data processing, analysis and upload, display operation parameters, abnormal state of alarm and other functions. Each control cabinet manages 5-8 air compressors. Control cabinet can simultaneously support multiple communication protocols. It can communicate with OPC, sensors, PLC, embedded communication equipment. Remote central control and management by B/S mode which based on wireless communication network and the public mobile communication network^[8-9]. The Internet network can view air compressor's operation condition various regions in real-time. Service center or manufacturer's experts can provide effective control strategy according working state and operation parameters of control strategy.

5. CONCLUSION

Remote monitoring system based on Internet of things technology in the air compressor industry is the first and walks in front of the technology of other large equipment industry in remote monitoring field .The remote monitoring system also considers to prevent network congestion which will cause the large amount of data queue, the reliable transmission of the related data transfer and cache technology to avoid the data loss, affect the integrity of the data of air compressor in the running state. The main benefit which brings in

using the remote monitoring is to reduce labor costs and improve product service. Due to characteristic of the huge energy consumption of air compressor product, remote monitoring has brought enormous economic benefits from the point of energy conservation. Through signing the energy management contract with clients, remote monitoring may also find the additional profit model of remote monitoring.

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