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Research and Implementation of PLC Remote Monitoring System Based on Embedded System

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Abstract. This paper mainly studies the mechanical and electrical equipment remote monitoring system based on embedded, because now mechanical and electrical equipment failure can not solve in time, equipment manufacturers hope to use the monitoring system to solve equipment connection, data transmission and monitoring. The data processing and transmission algorithm of the system are determined by experimental comparison. To test and verify the stability of the system, build the test method and test environment, test results meet the requirements of the test, the lack of due to technical limitations and practical work experience, the system still have insufficient place, design and development work on the server side, using embedded devices as a server for data exchange has limitations, the communication protocol is different, also do not have generality, these all need to improve in the future. The remote monitoring system based on embedded electromechanical equipment can be used as a reference for current monitoring system.

Introduction

Mechanical and electrical equipment remote monitoring become an indispensable part of the automation equipment industry, mechanical and electrical equipment maintenance now monitoring is the key to effectively solve the problem, if can pass when the equipment malfunction cannot be a customer timely monitoring program, ask the user where the problem is, so it can help users reduce the time to solve the problem in time, increases efficiency of equipment. For the manufacturer of production equipment, we hope to complete the remote debugging and modification of the equipment program through the monitoring system.

System Structure

Based on the requirement of embedded remote monitoring, this paper designs a remote monitoring system for electromechanical equipment based on wireless network, which consists of three parts. 3G terminals, servers and monitoring clients. The 3G terminal connects the electromechanical equipment PLC and the server for real-time data forwarding. The server is the data processing center of the entire monitoring system and completes all instruction parsing and processing. The client is mainly for user input and output, providing interactive interface, receiving user instruction input, and completing monitoring data output. The whole structure diagram is shown in figure 1:

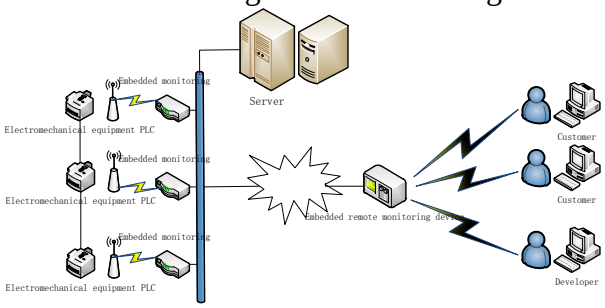

Figure 1. The overall structure of the remote monitoring system

As the hardware part of the monitoring system, 3G terminal connects PLC equipment and server and serves as the communication bridge between them. The 3G terminal is an embedded connection device.

The PLC equipment communicates with the 3G terminal in serial port, and the server and equipment communicate through the transparent transmission of the 3G terminal. In the 3G terminal, it is equipped with USB module, Ethernet module, SD card module, etc. The functions of 3G terminals mainly include: receiving instructions forwarded by the server, splicing the instructions, and sending the complete instructions to the PLC for processing. The data returned by PLC is encrypted and transmitted to the server through 3G network. Store the operation log of PLC and the customized important data. During the operation of PLC, keep the running status of PLC equipment and relevant logs regularly to help engineers find out the cause of failure. Server as data forwarding and storage center, the 3 g terminal return data stored in the database and processed, and forwarded to the client, the client sends commands forward through the server to 3 g terminal, 3 g terminal does not directly between the client and communication. The server program is the hub of the remote monitoring system, 3 g terminal and client data transmission is carried out by the server program forward, and the server and database interaction, some necessary data for storage. After power on the 3 g terminal will connect to the server, the server to add the device, so the client can identify terminal equipment, and be able to communicate with, run the server IP address must be fixed. The client is mainly for the use of engineers, providing engineers with information about all on-line terminal equipment and the operation status of PLC equipment.

Embedded Remote Monitoring System

PLC because of its form a complete set of hardware and software is complete, simple and short cycle of development, able to work in a relatively harsh industrial site stability gradually become the most widely industrial application controller, and become the core of the industrial manufacturing equipment controller, so the operation data of a device, almost to be able to get in the equipment of the PLC, therefore, the remote monitoring system based on PLC, as shown in figure 2.

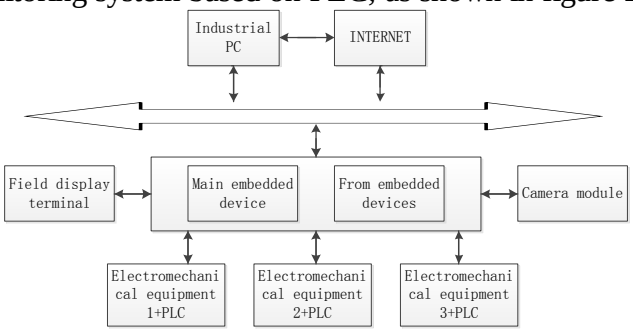

Figure 2. PLC remote monitoring system

Field equipment such as frequency converters, fans, sensors and other industrial equipment often have some kind of field bus interface, through some kind of field bus and the core PLC; In order to keep the system safe and reliable, usually have two sets of PLC in the system, the control of PLC is responsible for the normal production process, and from the PLC to monitor the working process of the main PLC, once the main PLC failure immediately enable from the PLC to control the production process, reduce the possibility of production accident, at the same time, the display terminal for field staff to control equipment, camera module is used for audio and video data collection in the process of remote monitoring

Remote monitoring system based on PLC combines commercial Ethernet and fieldbus, will present the advantages of field bus is widely used with a wide range of popular commercial Ethernet, can build a suitable for the vast majority of industrial field of remote monitoring and control system [1, 2, 3]. Information such as operation status of field PLC and operating parameters that need to be set can be transmitted through remote monitoring system, and the cost is only to expand a usable interface at the PLC end. The perfect compatibility of industrial control machine to PLC solves the compatibility problem of different brand PLC protocols, so PLC data can be easily obtained through industrial control machine. Only by industrial PC, however, read PLC data for remote monitoring system is shown slightly

insufficient, the environment is complex, many PLC can't obtain the data tend to increase the labor costs, such as unable to get the video; And can get some data was cancelled because of the device cost problem, therefore, relatively complete remote monitoring system can not only obtain complete data of PLC, still need to have an independent ability to collect data.

Embedded Monitoring System Software Design

Software design is the key part of the embedded Web monitoring system, the system we need to rely on all the functionality of the software, the software design of this system mainly includes the transplantation of the embedded operating system, the design of the associated device driver and application of transplant and application.

Embedded operating system. The selection of embedded operating system mainly considers the size, cost, response speed, convenience and tailoring of system software code[4]. Embedded Linux operating system has the advantages of small kernel, high efficiency and open source code, which is commonly used in the network TCP/IP protocol has the most complete support, is a very mature network operating system, and its hardware driver resources are very rich[5,6].

Transmission algorithm. In the industrial automation monitoring system, the running state of the equipment is presented through data, and the processing and transmission of data is the key to the normal operation of the system. Because industrial automation systems, high sampling frequency, more monitoring cycle is long, will produce a large amount of historical data, the data real-time transmission and storage can cause certain influence to the system operation and communication, such as communication delays, the need of large capacity storage, system response is slow, etc[7,8,9]. In order to solve the above problems, this paper will adopt the appropriate data compression algorithm to deal with the historical data. Because there are many different kinds of data compression algorithm, the algorithm is differ, ease and complex applications are also different, so we need to common lossy and lossless data compression algorithm research and analysis, to select the appropriate algorithm and improved, and then used in the industrial Web monitoring system.

Through the study of several lossless compression algorithms, the above algorithms are realized by using C language in the built embedded Linux operating system. Unlike lossy data compression algorithm, compression ratio of lossless data compression algorithm is related to the size of the amount of data, in this, mainly from the compression ratio of the algorithm, compression time, decompression time respectively for different size of data files to lossless compression and carries on the analysis comparison. The number of data files saved after lossless compression.The compression ratio is therefore defined as the ratio of the size of the compressed file to the size of the file before compression.

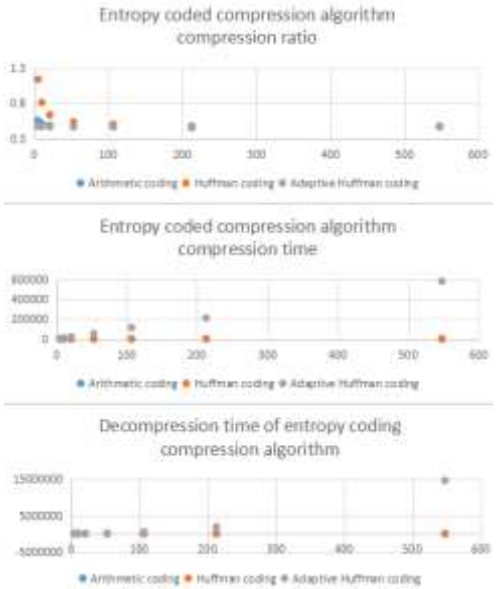

Figure 3. Comparison of three compression algorithms based on entropy coding

Based on the three compression algorithm based on entropy coding of application and comparison, it can be seen that although the adaptive Huffman encoding compression ratio is better than the arithmetic coding and Huffman coding, but because of its algorithm is more complicated, the compression and decompression of the time for a long time, and arithmetic coding on the compression ratio, compression and decompression time compared with Huffman encoding has better performance. In general, the compression algorithm based on entropy coding belongs to the redundancy compression, although can achieve compression effect is very good, but the algorithm computational complexity, low efficiency, not suitable for application in the system.In comparison, the compression ratio of LZW and LZ78 is the lowest, the compression time of LZ78 is the shortest, and the decompression time of LZW is the shortest. In terms of comprehensive compression ratio, compression time and compression time, LZW has the shortest compression ratio and decompression time, and its compression time is relatively short and the compression speed is the fastest.

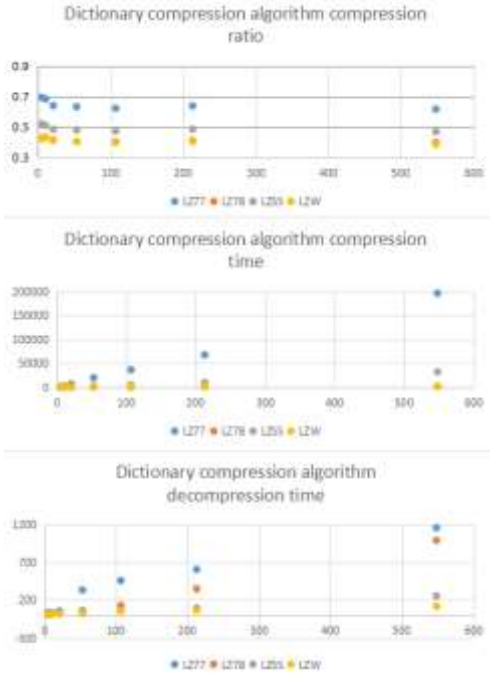

Figure 4. Dictionary - based comparison of three compression algorithms

Remote Monitoring System Test

Remote monitoring system is in order to be able to collect real-time field data, the status of the user to the remote control the working state of the field device through the network for, this system to complete the corresponding functions. Starting from the system requirements, this paper tests the working stability of the whole system through data collection and transmission of the system, compares it with the actual requirements, and analyzes the advantages and disadvantages of the system.

The system will be comprehensively tested from the following aspects: whether the system functions fully meet the requirements; Whether the system has a low failure rate, and has a strong fault tolerance and recovery; Whether there are many invalid processes and repeated processes in the system. In order to test the system performance comprehensively, the test method combining black box and white box testing is adopted. Black box testing, or functional testing of the system, is based on the use of coverage testing. It is on the basis of knowing that the product already has the function, through the test to verify whether each function can be used normally; White box test, which is to test the working principle of the unit under test, involves the details of the software involved, and its test method depends on the design structure of the program. The unit test adopts STM32 for online test. Integration tests are conducted using field tests and log printing.

Summary

The application of embedded network technology to monitor electromechanical equipment can greatly change the operation mode of enterprises, reduce the cost of enterprises, and improve the production efficiency of enterprises. In addition, through the application in the field of embedded data acquisition technology, interactive technology to the network dynamic data and automatic network configuration technology[10], realizes the remote monitoring system of networked and intelligent, equipment digitization and informatization lay the foundation for the future.

This paper presents a scheme of an embedded remote monitoring system which USES the technology is the combination of the existing mature technology, the characteristics of the wireless transmission advantages brought system also brings some risks. System structure of the plan was just a thought experiment, in which there are still a lot of room for improvement, hoping to give some enlighten readers of this article, reference to the advantages of this system, perfect the insufficient, make a better system.

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