

Control System of Remote Distributed Web Based on JAVA

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Abstract—With the advancement of technology and expansion of production scale, production equipments are more and more extensive distribution. Single, independent monitoring system has been unable to meet the growing needs of industrialization and development. Distributed computer network system is based on computer network and allocates more rational system resources. Currently, most of distributed monitoring systems are just running on the LAN, monitoring and control are also confined to the same location. Now we can use Internet to share resources to solve the problem of monitoring small range, provide favorable conditions for the development of remote monitor system, so that we complete the distributed control network status monitoring and diagnose equipment maintenance.

Keywords-Java; Distributed; Web

From the twentieth century's 90s, with the rapid development of science and technology, especially computer network technology and electronic technology, people's work and life have undergone significant changes, while businesses have gradually begun to pay more attention to the measurement and control technology in production. In the early stage, control system only monitors some important instruments' status and use operation panel to do centralized operation. Network control system uses the computer as the main part, coupled with detection devices, the control actuator and the object being monitored (production process). In this system, the computer realizes production process detection, monitoring and controlling functions. Under the control of the network nowadays, it not only requires the ability to control the operation of equipment reliably, but also the assurance of real-time, which puts forward higher requirements on detection and response of the mechanism.

In general, the remote monitoring and control system includes three parts: hardware, software and communication equipments. With the role of network, the distribution range of the equipments in the enterprises is wider and wider, so the collection of data is more and more difficult. How to keep the operational status of equipment abreast has become an important problem we have to consider.

The system's data acquisition program is written by Java serial port technology, remote network monitoring and control sites use JSP and JDBC database interface technology, back-end database use MS SQL Server 2000 database management system.

I. THE OVERALL SYSTEM DESIGN

In generally, the construction of the server and client has two modes: C/S (Client/Server) mode and B/S (Browser/Server) mode. In this paper, we use the B/S mode to realize WEB remote control system. Its features are as following: applications, databases and their related components are centrally located on the server side; The user only need to connect via Web browser. The specific operation, maintenance and management of the system runs in the devices on the system server, which the clients don't need to consider. So the upgrade and maintenance for the software will be more convenient, and the system security can be guaranteed. Customers don't need to consider the hardware requirements when making remote management and the risk can be minimized in a prepared good case.

With the actual situation of production process and the B/S structure mode feature, this system uses the B/S architecture to build remote distributed WEB control system. In the system, we use the three-tier B/S architectures: IE browser, Web server and database server. Firstly, clients send connections and specific instructions to the browser with the help of Web server if they want to remotely observe the equipment. After the Web server receives the command, if the case of permissions allows, it will read the data in the corresponding database server according to the requirements of customers, executing the application, and send the final results to the clients. Clients can see the results in their own browses. The biggest advantage of Web-based remote control system is that it can be adapted to any operating system platform.

The most crucial part of the system is the server. The server is the heart of the whole system, and all operations run around the server. The server can make query, records and other interactive features of the information network with database server as the core, and more importantly, it can complete the remote communication with the controlled devices.

With the network development to the present, it has been able to establish a Web-based remote monitoring and control system on the technical level, which is low cost and easy implementation. It can meet the different forms access to the network with simple operation and easy train, and the most important is that it sets permissions on the server to ensure the security of databases and applications. Especially after the JAVA language which is cross-platform appeared, B/S architecture management software is convenient, fast and efficient. The overall design of the system shown in Figure 1:

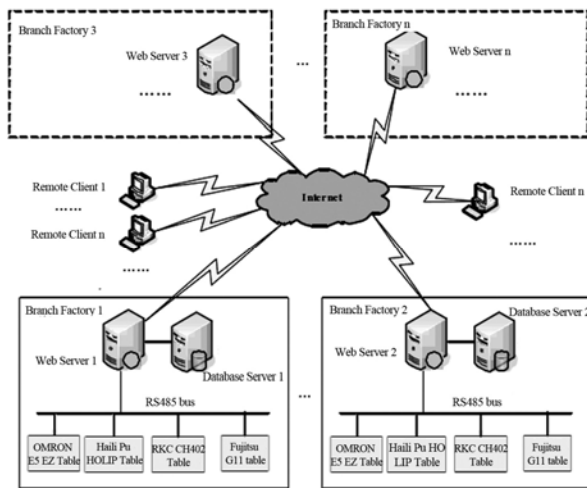


Figure 1. The overall control system design

Web server is placed in the factory production site, with the server software and collection systems installed. First of all, Web servers have acquisition. All enterprises in the production pipeline operations have a specialized collection procedure, so we can ensure regular collection of data sent to the server through the serial buses connected to the server. We can choose the methods can be extended to make sure the number of server's serial ports is sufficient so that it can support a number of operations on assembly lines. Web services enable clients monitor and control the current dynamic state of the equipments after connected to the server wherever can be connected to the Internet, thus it breaks the traditional industrial model.

II. THE DATABASE DESIGN

In this system, we use MS SQL Server 2000 as the database. SQL 2000 is the most widely prevalent database

in society currently, and it is widely used for data storage in software systems. Its performance is better than Access 2003, while its price is far below the Oracle, which makes it cost-effective. It will start a database service thread after loading the SQL 2000, so that it would reduce the system overhead of the running processes of the whole system when all threads are running on the line, and it don't need a thread with a database thread. The main reason is that SQL 2000 fully support for Web system software.

In the monitoring system in general, we need to collect information on the following modules, which are: user information, control information, device parameters and historical information. Then we will introduce each of these modules and describe the specific parameters they included.

User information: This is the module the server must have, which is responsible for connecting users to the server and allowing the server to read and write data in the server. Therefore, we design it with three data items such as: user login name, user login password and user permission. We also set up three levels for the user's permission, which lies from high to low as: managers, operators and viewers. In order to make sure the software can identify them, we were express all these levels by the letters: M stands for managers, O stands for operators, and V stands for viewers. Managers can perform any operation with the data. Operators can add data to the database, but not they can't modify and delete the data. Visitors can only view the data in the database without doing anything to them.

Control information: It records the specific states and parameters of the operations on the pipeline, reflecting the current operation of the pipeline. It mainly includes the information as job numbers of the assembly line, the port numbers used to receive, specific times of collecting data and running states of pipeline operations.

Device parameters: The operations of each device are related to the operation of the entire line, so viewing the operations of the equipment plays an extremely important role for the investigation of the causes of the failures in the assembly line timely. We should especially set data items which parameters include: pipeline job numbers, port numbers for receiving, device numbers, device names, device ages, device types, operations of devices and equipment power supply situations.

Historical information: Historical data plays an extremely important role for testing and troubleshooting. The operations of devices will be continuously uploaded to the server from the start of the device to the stop of the device. The specific time for uploading will be a few seconds to minutes according to the characteristics of each device. It includes serial numbers, assembly line job numbers, port numbers for receiving, data upload dates and operation state information.

In the preservation of historical information in the table, there is a data item as the serial number. The serial number is the decimal value automatically generated by the

database, which is unique in a database, becoming large with the increase of historical information.

III. SERIAL COMMUNICATION WITH JAVA TECHNOLOGY

The programming language of this system is JAVA, as JAVA has great appeal for the preparation of the remote control system software with portability and cross-platform. We have already known from the second part that the server can receive and send data through the serial ports which plays a vital role in the system. there is a special package in JAVA which can deal with serial communication of data packets named Javax.comm. We can easily do read and write operations to the serial ports as long as we call the corresponding class in this package, thus we will reduce the burden on developers. It makes it possible to realize Web-based remote monitoring and control with the existence of this package.

A lot of embedded systems or sensor networks require communication between PC and embedded devices or sensor nodes for their applications and testing. One of the most popular interfaces is serial and parallel RS-232. JAVA port class provides support for the serial and parallel port. RS-232-C is a serial communication standards developed by the American Electronics Industry Association (EIA) combined Bell System, modem manufacturers and terminal computer devices manufacturers in 1970. RS232 is a full duplex communication protocol, which can receive and send data simultaneously.

The communicate between PC and industrial equipment needs to be achieved through the serial port, preferably full-duplex mode, because the monitoring system should not only see the operational status of equipment, but also operate equipments to avoid unnecessary losses sometimes. To read and write the serial port with Java mainly uses its Javax.comm package API. Java is a portable and object-oriented programming language. In practical applications, it can be used in a variety of devices, and according to the specific situation, define the serial port object by the corresponding class from the practical needs, with concrete object, you can read and write it corresponding. In JAVA language, a special method or property to carry out this series of operations are provided. In this article, we describe a simple full-duplex communications through the serial port with JAVA class library, the library greatly simplifies the process of operation of the serial port. It mainly includes three parts: SerialBean.java (interfaces with other applications), SerialBuffer.java (saving received data from the serial port buffer) and ReadSerial.java (reading data from serial port).

Each library also includes specific methods and properties. Table 1, Table 2 and Table 3 details the specific content of the three libraries.

TABLE I. SERIALBEAN METHODS AND FUNCTIONS

Method or property	Function
SerialBean(int PortID)	Construct a specific serial's SerialBean

Initialize()	Mainly responsible for the initialization and opening ports
WritePort(string Msg)	Write a string to the serial port
ReadPort(int Length)	Read a string from serial port
ClosePort()	Close the serial port
PortInUseException	Port is being used to handle exception

TABLE II. SERIALBUFFER METHODS AND FUNCTIONS

Method or property	Function
GetMsg(int Length)	Read a string of specified length from the serial port, Length is the length of the string
PutChar(int c)	Write a character from the buffer, C is the character to be written

TABLE III. READSERIAL METHODS AND FUNCTIONS

Method or property	Function
ReadSerial(SerialBuffer SerB,InputStream Port)	SerB is a buffer to store incoming data, Port is the serial to receive data stream
Run()	Continue to read data from the specified serial port and put into the buffer

Writing serial port operation with Java should initialize port, open port, define serial streams object, then we can write data to serial data stream. It mainly uses SerialBean WritePort method, the concrete operation process shown in Figure 2. Reading operation with java is as following: the serial port object registers a listener object, constantly listening for whether the data transfer is over, if there is data transfer, the trigger events, the data stream from the serial port to read data, and by the computer to handle the data. It mainly uses SerialBean ReadPort method, the specific reading operation shown in Figure 3.



Figure 2. Java write the serial port operation

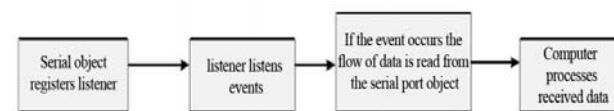


Figure 3. Java read serial port operation

IV. SUMMARY

In this paper, we just use Java technology to make a shallow structure of Web Remote Control of Distributed. We describe the overall design of the system in detail, and the use of the database. We also describe the serial technology that is used. We use many sophisticated tools to develop the system and there are many can be improved. The system's stability and anti-interference at the production site is not introduced, we need to do further study. Remote equipment control system is a complex network system which integrates computer controlled, computer networks, communication technology and many other aspects of technology.

REFERENCE

- [1] Chen Ping, Yue Youjun, industrial control networks and field bus technology, Mechanical Industry Press, 2006.3
- [2] Li Liang, Zhu Shanan, Java-based serial communication, 2007
- [3] Zhou Haitao, Gao Xingsuo, Java-based data collection of serial communication design and implementation, micro-computer information, 2006
- [4] Li Dandan, Shi xiuzhang, SQL Server 2000 Database Training Course, Tsinghua University