Real-Time Information System of Power Plant Based on B∕S Computing Mode

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Abstract:　This paper introduces the system structure and work principle of the upgraded real-time information system in Wangting Power Plant, and then expounds the realization way and function features of this system on B∕S computing mode. The results of field application show the new system has good capability, reliability and expandability.

Key words:　power plant, real-time information system, B∕S mode, DCS

Large capacity and high automation is a developing direction of the coal-fired power plant at present. Distributed control system (DCS) of high parameter units has powerful control capability and can supply a lot of real-time information about units operation at the same time. However, generally DCSs don't connect with each other, and their control operations are limited to the control rooms, so the power plant managers at their offices are difficult to know the current security and economic information about the whole plant operation. Such phenomena are called "information isolated island"[1]. The system reform of electric power industry puts forward higher demand to power plants. Managers urgently need to grasp the live operation information of units to improve overall plant performance and win in the competitive marketplace. In such situations, the importance of the power plant real-time information system (RTIS) is much more obvious. As an important subsystem of MIS, the RTIS transmits the distributed real-time data from field control systems and data acquisition systems to the real-time information system server (RTISS). Managers can view real-time information at any time through MIS network conveniently, which may help them make scientific decisions. This paper introduces the upgraded B∕S mode RTIS and compares it with the previous system through the upgrade project in Wangting Power Plant.

1　Background

Wangting Power Plant is one major older plant of the electric mains in east China. Now there are various control and data acquisition systems. This makes it difficult to collect and process those field real-time data. With the rapid development of the information technology, the previous RTIS hasn't met the need increasingly.

1) The data acquisition program on the gateway computer adopts a passive way, which makes the communication of the whole network very crowded and inefficient, even can jam the network momently. The problem has a negative influence on other systems on MIS network, and lowers the performance of the whole MIS.

2) The RTIS is based on client/server (C/S) mode. In this way, the shortcoming of heavy load, complicated configuration, and great workload for system maintenance and upgrade exists at client because of the difference of the front platform.

3) The real-time information can be only viewed on client computer installed the end-user application program, which doesn't accord with the tide of the opening and exchanging power plant information.

Because the old RTIS has the above shortcomings, it should be reconstructed urgently in order to be in a leading position during the current information construction of the power industry.

2　Computing Mode

As a special application of the Internet, the Web application based on TCP/IP and HTTP protocol popularizes quickly with the recent advant of the Internet technology. In fact, the three-layer brower/server (B/S) computing mode is also a kind of C/S mode. As a special case on Web, it originally derives from the traditional two-layer C/S mode. The three-layer B/S mode structure is shown in Fig.1[2].
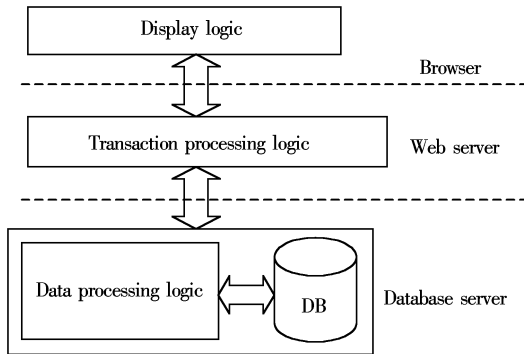
Three-layer B/S mode separates the logic module

Fig.1   Browser/server mode structure

of transaction processing in the C/S mode from the client task and forms another new layer. The load is equably distributed to the Web server, so the client pressure has been lightened greatly. The client only takes charge of displaying the data, acting as a simple mutual tool. The necessary work at the client is to install a browser and other work is done at the server. B/S modes overcome the shortcomings of C/S modes, and can easily have a direct seamless connection with the Internet in addition.

3   System Structure and Realization

3.1   System structure and principle

Because of the deficiency of the previous RTIS, the upgraded RTIS adopts Windows 2000 as the network operation system, the three-layer application software structure (B/S mode) and the unsolicited point-to-point socket communication way. Fig.2 illustrates the system structure after upgrade[3].
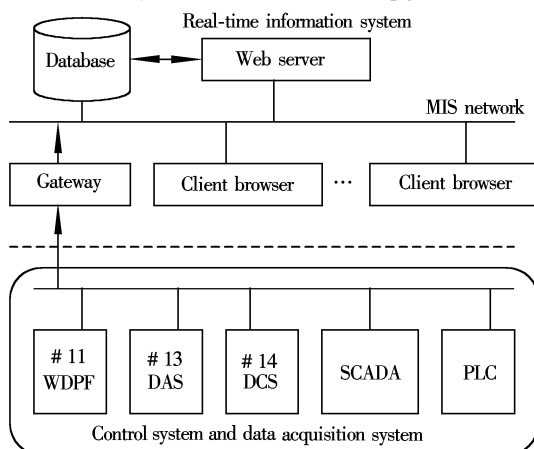

Fig.2   Real-time information system structure

Control systems and data acquisition systems: They are the main information sources for the RTIS, such as DCS. Every data source is allocated one host computer, where software for communication with the MIS is installed. According to the request of the RTIS,

the host computer sends the data to the gateway at intervals of a certain time.

Gateway computers: Two network interface cards (NIC) are separately inserted into each gateway computer. One links to the communication module on the host computer of the DCS, and another connects the MIS network. Each NIC binds an IP address of a different network section. On the gateway computer the program of data acquisition and transmission imports data from corresponding systems. On the other hand with the Socket's communication interface based on TCP/IP protocol the real-time data are exported from the gateway computer in the manner of point-to-point communication. The transmission of the data is in a single direction, which can guarantee the security of DCS.

Database server (DS): It is the core of the power plant RTIS. Real-time data, historical data, alarming data, and SOE data are all stored at the DS, where some application programs are running at the same time. After receiving and classifying the real-time data from the gateway according to their sources, the DS adds new historical records, and updates current real-time records in the database. The calculated economic index is also dumped into the database table. The DS supplies the data service to not only the Web server but also other relevant systems on MIS.

Web server (WS): It offers the information service by mean of WWW to the RTIS users. When a user sends out a request, the WS sets up connection with the relevant DS, and then sends the processed data in the form of Web page to the client through accessing the DS. In this project the DS and the WS exist at the same server physically.

Clients: Only with a browser, users can visit the WS to get information, and then the WS sends the desired result, which will be interpreted in the browser, to end-users.

The data channel is built among those parts introduced above. Through this channel field real-time data are collected and processed, and then stored and displayed on MIS network[4].

3.2   System realization

The RTIS in Wangting Power Plant applies socket data communication approach based on TCP/IP protocol, B/S mode, COM/DCOM, ASP technology, and the Visual Interdev development platform. The network operation system is Windows 2000, and the database chooses the MS SQLServer 2000. VC + + 6.0

can offer an environment to develop COM/DCOM package. With the help of the Visual Interdev, Web applications and Web sites can be established conveniently. As to Web applications, the COM/DCOM package technology offers one application mechanism that can make the package imbed into Web pages to extend the mutual function. ActiveX control, which developed by microsoft by the COM/DCOM rules, is an object linked and embedded technology utilized on the Internet.

For the part of displaying the real-time information, the key program at the client is ActiveX control. There are two types of ActiveX controls in client Web applications. One type is the ActiveX control for displaying information. The other type of ActiveX control is used to acquire data. The former control accounts for displaying analog values, digital values, real-time trends, historical curves and such equipments as valves in the Web pages. As a client DCOM package, the latter type control captures real-time data by requesting the DCOM server object. DCOM package in the form of ActiveX controls(* . ocx) can be directly imbedded into Web pages in the Visual Interdev development environment.

As a server service program, the package object accesses the corresponding database through OLE DB interface, and then sends the received data to the client by communicating with the client controls. Static objects, such as system flow chart of the plant are only obtained from the WS through the HTTP protocol for the first time and stored in the local temporary directory at the client.

Since the part of displaying the statistical report and result by processing the real-time data doesn't highly emphasize the real-time character, it is realized by the ASP technology. ASP belongs to the ActiveX technology at the server. ActiveX data object (ADO) is the basic module of ASP, which can supply a high performance connection with any ODBC compatible database or OLE DB source. Only with several line scripts, information from the background database can be easily issued on an ASP type Web page.

4 System Characteristics

4.1 High real-time characters

The new RTIS abandons the old passive broadcast way instead of the unsolicited point-to-point socket way based on the TCP/IP protocol, which limits the broadcast signals of the field system to the gateway

computer, therefore the transmission performance is improved greatly, and the MIS load is reduced obviously. Because of the different requirement of the real-time character between the RTIS on MIS and the field control system, according to the importance of the information the real-time information is classified and the refreshing rate is set, which increases the system performance further.

4.2 Complete functions

The RTIS has the following functions.

1) Real-time data integration and store

Real-time data are collected from diverse system individually and consolidated in uniform format for storage.

2) Real-time information display

The contents of the RTIS client graphic screens are the same as those of the DCS screen, including flow charts, parameters in groups, real-time trends, historical curves, analog values and digital values display.

3) Statistical report forms

Users can send out various kinds of inquiry order from the browser, and view different corresponding report forms quickly.

4) Real-time data processing

Some important operation parameters have been validated, recomputed and accumulated to display the average and total index about operation.

5) Power-generating examination system

In this examination system active power, planning power and the deviations power of the whole plant and every unit have been calculated and listed. The AGC use rate, the qualification rate of the supply power of each duty and the bad point of the main line voltage are recorded for display.

4.3 Uniform format and good opening

On the principle of "upwards unifying", at the gateway portal the data from different DCSS are imported respectively. The same open interface and data format at the gateway exit are offered to the MIS. In this way the front data acquisition system difference can be shielded beyond the MIS network.

Real-time data and historical data are stored in the database at the DS. Other systems (such as unit operation optimization system) on the MIS network may access these data through ODBC data source, which effectively raises the sharing of the data.

4.4 Convenient maintenance and upgrade

This RTIS adopts the B/S mode and all data processing is at the server. The whole application programs are running at the server (WS and DS) and the client only need to download some controls with the browser for the first time. The client will update the controls automatically after they are upgraded. By this means all maintenance and upgrade work will be done at the server, so the workload is reduced greatly.

4.5 Easy configuration

The RTIS furnishes system administrators with a set of configuration tools to enable them to modify the system functions by themselves.

With the configuration tool for data acquisition, administrators can set the data acquisition number, concrete point name, and the sampling time. Without too much professional knowledge, administrators are able to finish the configuration work of the RTIS picture with the help of the picture configuration tool.

4.6 User-friendly

Only with a browser, plant managers and personnel at client can view units real-time information. Despite of the different front platform, the RTIS will have the same friendly user's interfaces.

5 Conclusion

After being upgraded, the RTIS in Wangting Power Plant has the merits of high real-time character, low communication cost, easy configuration and upgrade, and good opening character. The RTIS can completely realize the function of collecting, analysis and remotely displaying the plant field real-time data.

The RTIS has been well received by the plant managers and personnel since June 2001 when it was put into use in Wangting Power Plant. It has achieved the desired goal, and plays an important pole in the plant management.

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基于 B/S 模式的电厂实时信息系统

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摘　要　本文介绍了望亭发电厂统升级改造后实时信息系统的系统结构和工作原理,阐明基于 B/S 模式实时系统的实现方法和功能特点.现场投用的情况表明该系统具有良好的可靠性、兼容性和扩展性.

关键词　电厂,实时信息系统,B/S 模式,DCS

中图分类号　TM621.6; TP274^{+}.2