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Design and Implementation of Real-time Database Supervision System for Coal Chemical Industry

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With the deepening of the enterprise reform of chemical companies, the requirements for enterprise informatization construction are getting higher and higher. As a means and basic tool of modern enterprise management, information technology construction is becoming more and more important while pushing enterprises to further deepen the reform. For this reason, gigabit Ethernet technology was used to successfully build the company's backbone network. The entire network is divided into 14 secondary nodes, covering all functional offices, the office area of each secondary unit and the high-speed information network foundation platform of each workshop device. The real-time database system takes the OSI PI real-time database as the core, and realizes the automatic acquisition, storage and monitoring of production real-time data in the production devices of each branch factory, so as to establish a complete production real-time information monitoring system.

1. Introduction

The core of the business information management system is the real-time database system as a surefire way that enterprises achieve automatic control from the equipment to high-level schedule management. It plays an indispensable role in modern business information construction. A real-time database is a software that collects, stores, and analyzes the huge mass of rapidly changing data, as a core foundation for modern industrial production in the information technology software (Körpeoğluabb, 2011; Zhao et al., 2013). With real-time storage and collection of a mass of data, the real-time database not only retains very important historical data for businesses, but also provides timely and effective information for businesses (Kalinowski et al., 2015). Based on the analysis of historical data and real-time data, companies can supervise and manage the operating plants, such as process optimization, quality control, equipment maintenance, and fault alarms, etc. Real-time database integrates product planning, such as maintenance and management processes, expert system, laboratory information system, simulated and optimized application management, which exerts the functions as a bridge and link between real-time production and program management (Wang and Zhang, 2013; Wu et al., 2014). Real-time database becomes an absolute data core in the business information management system and plays a key role in the whole information system. In this context, this paper takes a dive into the acquisition interface architecture, conceives the DCS as the market mainstream interface based on the real-time database of OPC technology for coal chemical production and supervision, which satisfies the vast majority of data exchange and sharing requirements, and is widely applied in the market for data collection and storage in the database, retrieve data from the DCS system as historical data. The coal chemical production monitor system requires not only a reliable relational database, but also an excellent real-time database. The latter is the core and foundation of information technology. Information construction is an important part that distinguishes a simple management information system from the like (Deng and Xiao, 2012). Currently, several mainstream databases for real-time retrieval are generally expensive in the market. Based on the PI system of OSI, this paper describes the architecture and implementation of coal chemical production and supervision system based on data acquisition, which provides an important data communication support for integrating the heterogeneous control and management systems, thus promoting the integration process of business information management and control.

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2. Demand analysis of coal chemical production monitoring system

As the automation technology grows in popularity, coal chemical companies have applied DCS or PC-based industrial control computers to form a simple distributed and automated measurement and control system in each secondary units (Liu and Wang, 2014; Fu et al., 2013). However, these automatic systems are scattered in various units. If the managers and technicians fail to turn up on the site, they cannot control the production situation in time, so that they cannot timely supervise and control the normal production operation. In this case, the plant automation system plunges into a valley of “islet”. Besides, with the simpler data, the report still requires a manual transcription when using the measure and control system since the basic networks in all stations are extremely complex, and various computer operating systems and PLCs coexist, making it difficult to implement a real-time online remote control system (Massie et al., 2004; Jin et al., 2012).

In this paper, we conceive a coal chemical production monitor system that integrates the PI real-time database platform. That is to say, the second unit will get rid of the traditional "islet" mode, change the manual transcript statement to auto data collection and report formation, intensify the effective data sharing and the real-time supervision for secondary units. With these features, it can make a comprehensive and integrated record analysis on the whole company's information.

The real-time database system applied and developed in coal chemical industry helps form the production supervision and management contents for coal chemical company, including the production equipment process schedule, key equipment, machine pump operation oversight system, trend chart, alarm record inquiry, bit number parameter analysis, mass spectrometer online analysis, production reports, etc., configuration of the flow chart involved in the project, development or reserves for interfaces integrated with or technical support for other application systems (such as LIMS, MES). It takes charge of all system configuration, application development and other works integrated with other application system and software development (Peralta-Hernández et al., 2009; Liu et al., 2013).

3. Design of monitoring system for coal chemical industry

Given the real-time database system layouts and the size of the business network environment, the real-time database model, i.e. the distributed application, is designed, as shown in Fig. 1, the application system is divided into five layers: field control system layer, data interface server layer, real-time database platform application layer, system layer based on OPC client application or web server.

In a real-time database system, the data interface server is underlying system which is directly associated with whether the business resources are accessed via a network server or other data source, and the server runs on the real-time database interface software. In the real-time database server layer, the interface server processes data interface software and appropriate management tasks while providing computation feature. The real-time data platform application layer provides a wide range of data application services for upper-layer applications, or in other areas, such as OPC servers, web servers.

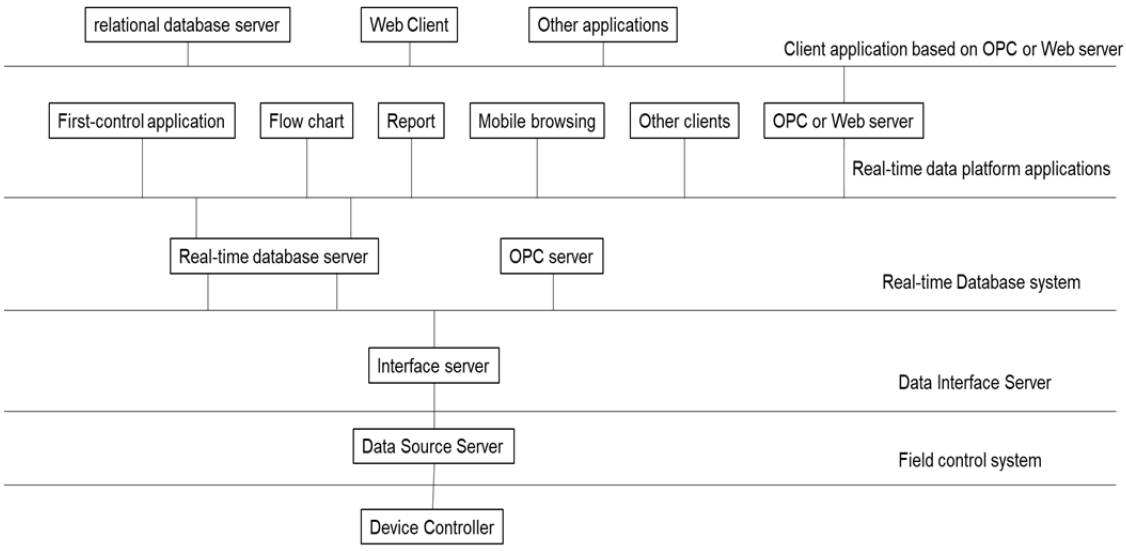

Figure 1: Application mode framework of production monitoring system

This paper designs a coal chemical production monitor system based on the real-time database framework structure. As shown in Fig, 2, which includes three levels: control system interface layer, real-time database server and client access layer. The real-time database sever layer is the key to the whole monitor system. The core of the production monitor system is the real-time database. Data acquisition is a part that connects the interface software PLC and DCS at the bottom. The middle layer of the whole system connects to the device via the DCS system, such as the information collection site, the first layer that provides the real-time database service. Data acquisition interfaces are scheduled with various parts, including OPC interface program, DDE client interface and API interface software, and in the running process of the software components, there are also data acquisition work for communication interface of real-time database management module. The three layers accesses the data acquisition modes of the interfaces OPC, DDE, and API according to the collected data types.

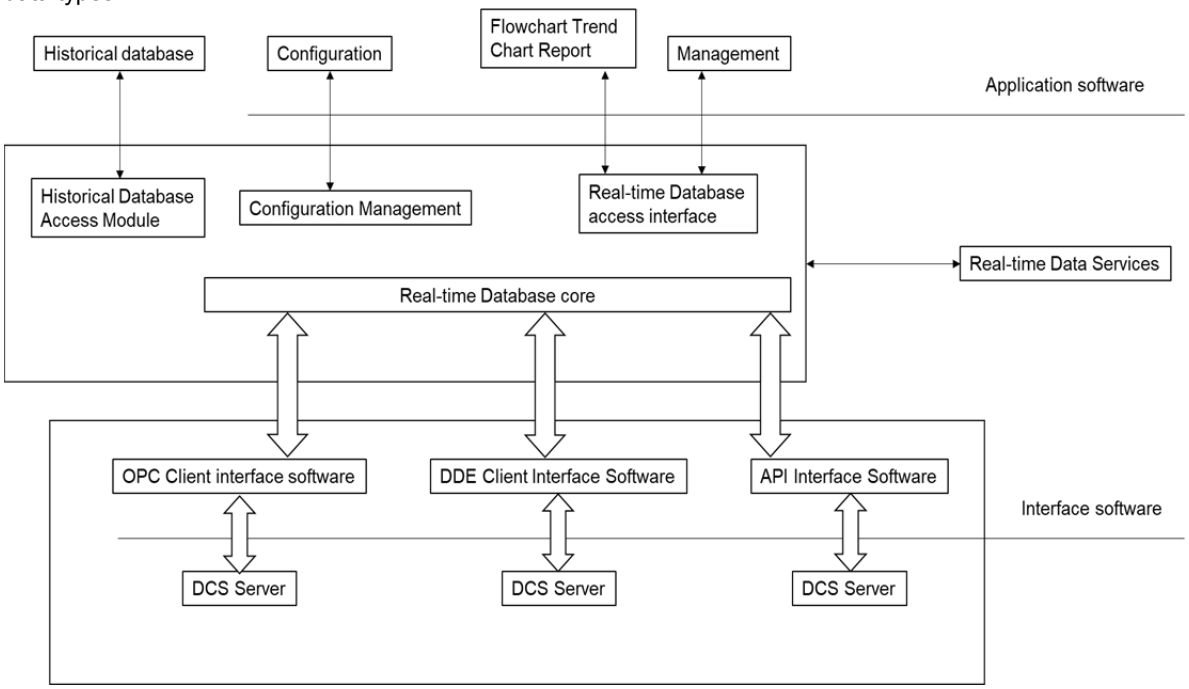

Figure 2: Real-time database detection framework

4. Implementation of coal chemical production monitoring system

4.1 System network framework

The system requires the integration and stability of the global modules, so that it is designed to integrate some parts in an economic scheme, as shown below:
The specific principles of the scheme are as follows:
(1) Unified standard hardware platform, used to reduce system implementation risk and system maintenance complexity;
(2) Two real-time database servers, used to achieve fast fault switch with hot standby;
(3) A complete storage and backup solution, in order to ensure the security of system data;
(4) A dedicated firewall set up between the control layer and the management layer, where data can only be transmitted by the control network to the management network in one way to protect the on-site DCS/PLC/ESD;
(5) Internet resources fully used to enable easy access for remote authorized users to real-time data information;
(6) Confidential business data, which non-designated divisions, users, and staff cannot be accessed.
Based on the above principles, the network topology schedule is implemented for the production monitor system as follows:

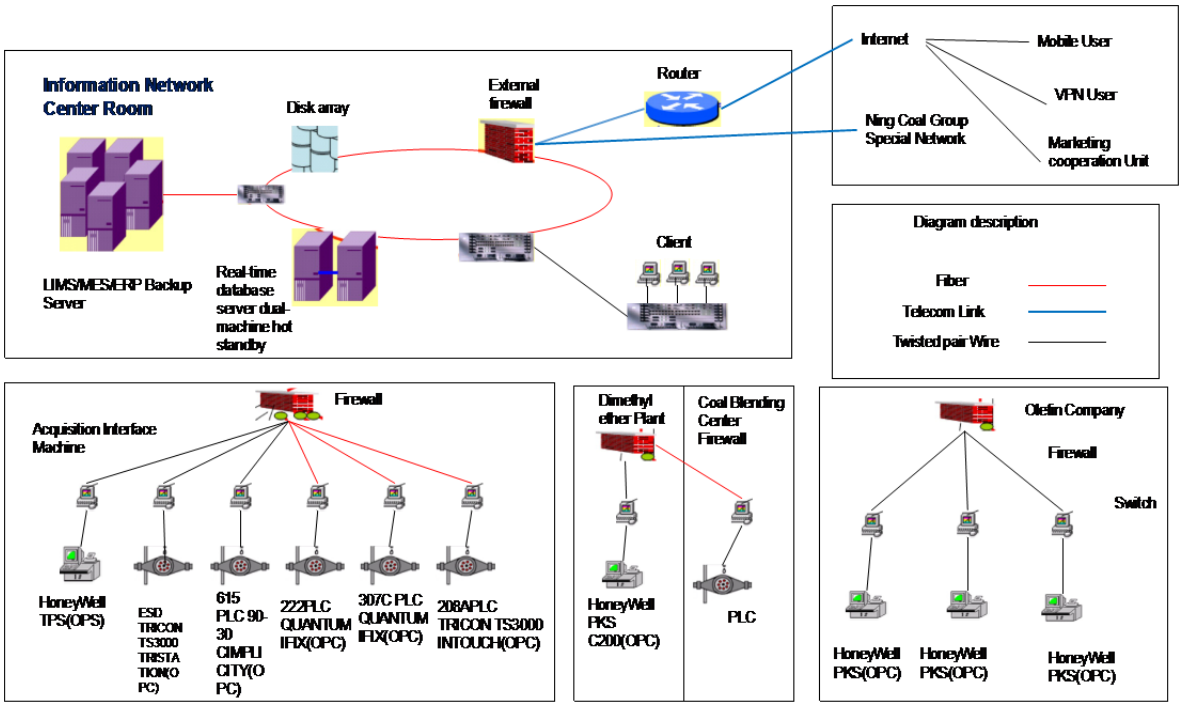

Figure 3: Network topology

4.2 Implementation of production monitor system module

The implementation of the production monitor system module is shown in Fig. 4. When the module is configured, the OPC server on the DCS side is started. The acquisition station is connected to the DCS via the Fast Ethernet, and configured with a dual NICs, one of which is accessed to the DCS production network, and the other is connected to the internal business management network. In the server side of acquisition station, the CIMIO client OPC acquisition module is installed to collect the real-time field data of the DCS, and write collected data to the server database in real time via the OPC acquisition protocol.

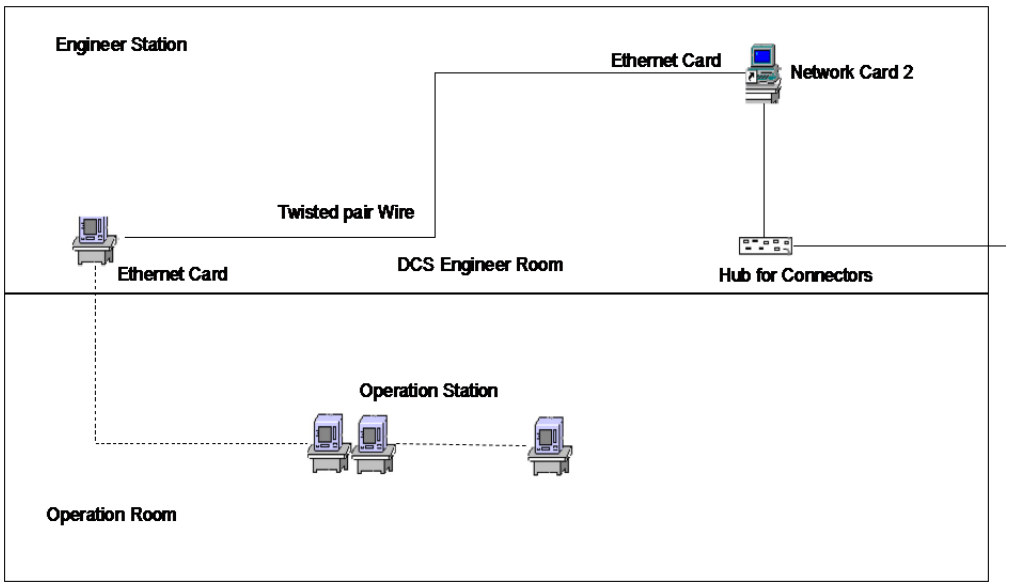

Figure 4: Physical map

Collect data of control systems such as DCS, ESD and PLC of production equipment to ensure stable and safe one-way transmission of data between DCS, ESD and PLC control systems and real-time database. The

application development based on real-time database system forms the production monitoring and management content of coal chemical branch company (production device process picture monitoring, key equipment, machine pump operation monitoring system, trend chart, alarm record query, bit number parameter analysis, mass spectrometer online analysis, production report, etc.). To configure the flow chart involved in the project, develop or reserve integration interface or technical support with other application systems (such as LIMS, MES).

4.3 System Safety Control

Most chemical products are flammable, explosive, or toxic and corrosive. In the process of production, storage, transportation and use, fire explosion, poisoning, asphyxiation, corrosion-burning and other safety accidents occur again and again in chemical enterprises across the country, which is a heavy blow to enterprises and an irreparable disaster to families.

It is found in typical accident cases of hazardous chemicals at home and abroad that the proportion of accidents in production links is the highest and the consequences are the most serious. In the investigation of the safety accident, the illegal operation caused by taking luck in the heart and the failure of routine examination caused by ideological paralysis are often the main cause of the accident. A dyke of a thousand miles may break the nest. The prevention of accidents must be the top priority. Investment for safety is the biggest benefit. No matter how high the postaccident posture is, it will not have the effect of prevention before the accident.

To avoid potential security risks, we designed a complete three-layer security monitoring, as shown in figure 5. The system is divided into equipment layer, acquisition and transmission layer and monitoring layer.

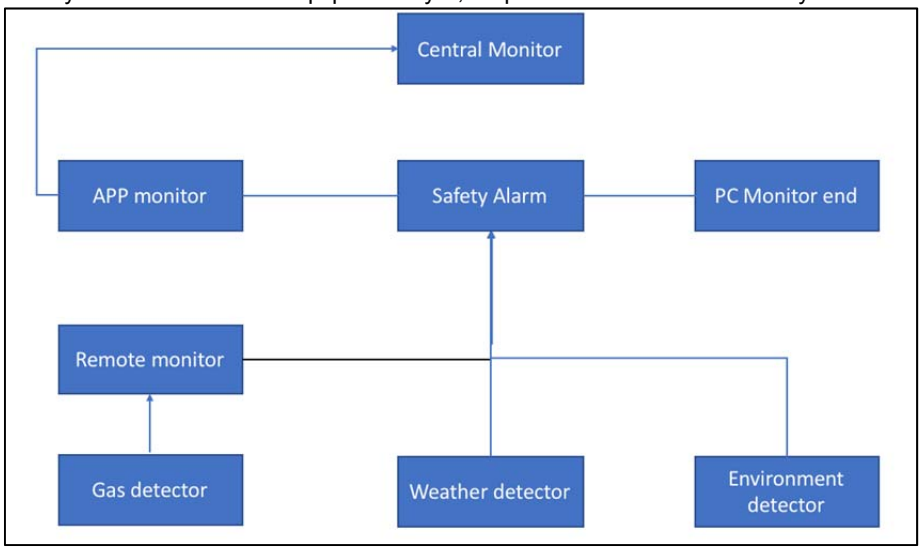

Figure 5: Safety control structure

Pressure, temperature, liquid level, flow, power, frequency, all kinds of combustible gas, toxic or harmful gases, oxygen concentration is an important safety index chemical plant, parameters, such as on how to effectively detect and manage such parameters, provided by the chemical plant security indicators monitoring system for a complete set of solutions, in order to achieve safety in production, presenting the purpose of the accident.

Chemical plant safety index monitoring system is a high-tech product integrating photoelectronic technology, field acquisition technology, microelectronic technology and computer technology. The Internet is an amazing net, software customization is also a kind of mode, to provide the most detailed quotation, if you really want to do, you can come here, the phone began to digital is a is one since the last one in the middle of the steak is see pure see, in accordance with the order together. Then you will find, want to say is, unless you want to do or understand this aspect of the content, if just coincided with, don't come.

The safety index monitoring system for chemical plants is a complete system for monitoring the real time value of industrial parameters at each production point in chemical plants.

The key parameters (pressure, temperature, liquid level, flow rate, power, frequency, various types of combustible gas, toxic and harmful gas, oxygen concentration) can be effectively monitored to achieve the purpose of safe production and guarantee product quality. Monitor electronic monitor on site to collect and display parameters, and upload data to the server. The server stores and analyses the data, displays it

centrally on the comprehensive Kanban board, and sends a control or alarm signal to the corresponding equipment or department according to the pre-configuration and setting. The server also provides query and analysis functions for data and generates reports for users to use.
The whole system is composed of field monitoring electronic Kanban, integrated Kanban, control computer (server), computer network and system software.

5. Conclusion

The coal chemical company's production monitoring system, which takes PI real-time database as the platform, concentrates all the data information scattered in various stations, such as device operation parameters, production data and instrument measurement, etc. into an intelligent real-time monitoring system, realizing the electronic and paperless office operation of real-time data collection from each station to the company.
To realize the operation of real-time on-line monitoring device and meter measurement on site provides a strong technical guarantee for the production management and command of the company.
Real-time data collection and monitoring system will be timely, accurate, efficient and convenient for manager of macroeconomic regulation and control and the data mining of coal chemical industry in the future to provide first-hand information, realize the automation of coal chemical industry company operation and management, improve the efficiency of production management, to further improve the coal chemical industry digitization construction, improve the company's production of information management mode, really achieve company data information resources sharing

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