Design and Realization of Production Monitoring System for Coal Chemical Industry Real - time Database

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In order to improve the economic efficiency of enterprises, making the process of enterprise information development, coal chemical production monitoring system is designed and implemented. On the basis of data collection, the system requirements are analysed in detail, and the DCS system is designed. On the basis of the existing OPC data collection interface specification, the OPC custom interface, the OPC automation interface and the operation procedure are introduced. In addition, the OPC client application interface is described. Therefore, the production of real-time data collection, storage and monitoring functions of the production facilities of each factory is realized. Moreover, the complete production of real-time information monitoring system is established to meet the specific functions required by coal chemical industry. Therefore, the coal chemical real-time database production monitoring system can not only provide important data communication support to the heterogeneous control system, but also can bring the management system integrated application environment, thus promoting the enterprise management integration process.

1. Introduction

Real-time database system is the core of enterprise information management system (Safaei, 2017). It is indispensable in the enterprise from the equipment automation control to the high level plan management realization process (Elbagir et al., 2016). At the same time, it plays an important role in the construction of modern enterprise information (Altmeyer et al., 2016). The real-time database stores the ever-changing data in the database, which has a timing limit for processing time limits (Saponara, 2016). It is also an important branch of database system development. More simply, the real-time database is a software product that collects, stores and analyses massive amounts of data (Vaquette et al., 2016). In information technology software, it is the core of modern industrial production. The PI real-time database of this study was applied to the production monitoring system (Ernst, 2016). It can collect the station's operating parameters, production data and instrumentation and other data, and then send the data to the intelligent real-time monitoring system (Doycheva et al., 2016). This system can monitor the operating status of the device and meter metering in real time, and provide a strong technical guarantee for the company's production management command (Lee et al., 2016). For managers, real-time data acquisition and monitoring system can be timely, accurate, efficient and convenient to provide first-hand information, thereby improving production management efficiency and improve the coal chemical industry (Njiki et al., 2016).

2. Demand analysis of coal chemical production monitoring system

2.1 System functional requirements analysis

First, the access port must have the data cache function (Massa et al., 2016). When the network fails or the database server is down, the interface unit can collect interface data from the site and store it in the database (Tripathi et al., 2016). In addition, in any computer client, the system administrator can operate and monitor the real-time database system for online monitoring (Maggiani et al., 2016). At the same time, the real-time database system between the data communication server and OPC interface machine running status can also be displayed in real time (Chermak et al., 2016). And in the system real-time operating conditions, parameters can be set and modified in the data background (Sanchez et al., 2017). Finally, the overall design of the

system must be advanced and reasonable. The interface must be secure, stable, and fast. Real-time systems have no unnecessary impact on production management systems (Pathan et al., 2016).

2.2 System performance requirements analysis

(1) Description
Real-time database system I / O points of 50,000 points, the system to meet the expansion of coal chemical project needs (Doycheva et al., 2016). The number of concurrent clients is no less than 100, and the number of client installations is unlimited (Njiki et al., 2016). According to the technical characteristics of real-time database, specific solutions and solutions can be proposed (Massa et al., 2016).
(2) Target
The production data of the DCS, ESD, and PLC can be integrated into the real-time database system via OPC SERVER (or other communication interface software) (Tripathi et al., 2016). Data transmission is one-way, safe and stable. Historical data contains all production control system process points. Online storage for at least five years (Maggiani et al., 2016).
(3) Requirements:
The project is connected with the whole plant production control system at all stages of research, design, construction and application. Therefore, the production control system must be safe, stable and reliable. In addition, the production information management system should not only have a high operation, data security, strong scalability, but also have a certain upgrade capability, system openness and integration, which is integrated in the ERP, MES, LIMS System.

3. Design of coal chemical production monitoring system

3.1 Overall frame structure design of production monitoring system

Based on the real-time database system planning and the size of the enterprise network environment, the real-time database model is designed. The model is shown in Figure 1, which is a distributed application. Application system is divided into field control system, data interface server layer, real-time database, real-time data platform application layer. The system layer is based on the OPC client application or the Web server. In the real-time database system, the data interface server is the bottom. It is directly related to the network server or other data source connection, and it affects the server run-time real-time database interface software. Real-time database server-level interface server can handle data interface software and the corresponding management tasks; it can also provide computing functions. Thus, a wide range of data application services can be provided to the application layer of the real-time data platform.
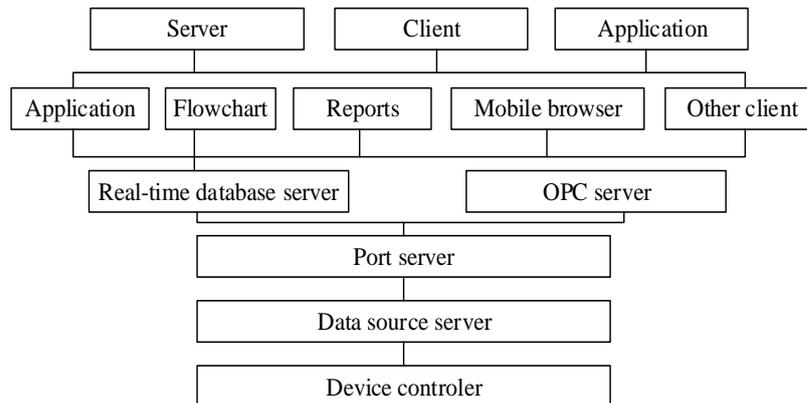

Figure 1: Production application framework for production monitoring system

3.2 Interface machine design

The interface machine (acquisition station) can be designed as a PC series computer. According to the scene, the IPC is the most suitable machine, it can guarantee the safety of the system. In the security, anti-static, long-term boot, the collection station is much more powerful than the PC. The main purpose of the collection station is to collect data, while playing a role in isolation. On the basis of ensuring the stable operation of the system, the place must be centralized control. When the control room has been connected to the LAN, a IPC can also be used as several sets of DCS collection station.
(1) Collection station design

P4 3.0GHz CPU (533FSB), 1G DDR memory, 160G hard drive, dual 100M network card, mouse, keyboard, 17 "monitor, CD-ROM.

(2) the role of the collection station

DCS / PLC / ESD system real-time connection, real-time data and historical data can be obtained.

First, the real-time and historical data exchange of the real-time database system is ensured. In the process of sending and receiving unidirectional data, physical and logical isolation is guaranteed. Second, the software running state to be real-time display. The data are dynamic and real-time for data analysis. Finally, the system must have the ability to automatically reconnect after disconnecting, thus ensuring the sustainability of the system operation.

3.3 Real - time database module design

In the real-time database design, the common object-oriented programming method is used. Real-time database is defined as a UML. Real-time database class methods are managed by specialized management programs that generate real-time applications for applications. It can perform database queries, database updates, and other requests. In addition, it can be alarmed by real-time database operations. Real-time database management program all the features encapsulated in a special class of real-time database management. Based on a class member function, it can call all database operations management. The real-time database class defines the following functional modules according to system requirements:

(1) Initialization module

When the database is stored in memory, the data list in the user class organization based on the database, real-time database can be dynamically generated. In addition, the content of the real-time database changes accordingly depending on the object assignment of the configuration database domain class. In order to complete the initialization, the SQL database and the real-time database data need to be created. It corresponds to the object of each index, thus increasing the speed of data access.

(2) the basic operation module

it provides the basic operation of data objects, such as the number of search operations. It can get the name of the data object and attributes.

(3) Data acquisition module

In the real-time database, each data object corresponds to a certain real-time industrial area and consistent state. On the specified device, the data acquisition module is responsible for reading, and the field device value is written to the memory buffer.

4. Realization and testing of coal chemical production monitoring system

4.1 Hot standby program

This scenario uses the redundancy scheme of the real-time database server system. It can not only guarantee the real-time database system reliability and security requirements, but also to ensure that all the non-stop operation of the database. Figure 2 is a schematic diagram of a typical dual machine redundancy:

A and B are server operating systems installed on the same server. They open the same service, install the same application software, and configure the same system. Disk array and dual software are the core. Real-time databases and important real-time data are stored in disk arrays. Both servers are installed with operating system, application software and dual computer hot backup software. It has two modes of "master" or "full duplex" hot backup, and is connected to the server via an RS232 interface or a dedicated network adapter.

When the system is started, the management program of the dual system hot backup software installed on the line system is run first. Then, the necessary service and monitoring system running the server agent is started. Through the RS232 interface cable or dedicated network adapter on-line monitoring, system software and hardware platform server dual hot standby service is diagnosed and managed.

When the service or hardware of the hot standby monitoring agent fails, the corresponding processing is executed. Then, the service is switched. In addition, IP drifts to the same user name on another alternate server, and the disk array returns to the primary server of the database and restores all services.
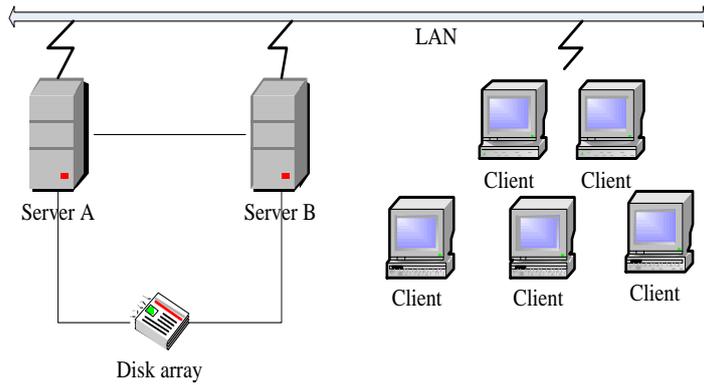
Figure 2: Hot Standby System

4.2 Realization of DCS acquisition scheme

After the OPC server side of the DCS is started, the acquisition station connects to the DCS via Fast Ethernet. The acquisition station configuration is a dual network card. One of which is connected with the production network of DCS, and the other is connected with the internal management network. The CIMIO client's OPC acquisition module is installed on the acquisition station server. The module is responsible for collecting real-time DCS data. On the basis of the OPC acquisition protocol, the collected data is written to the server's database in real time. Its physical entity shown in Figure 3, the logical diagram shown in Figure 4:
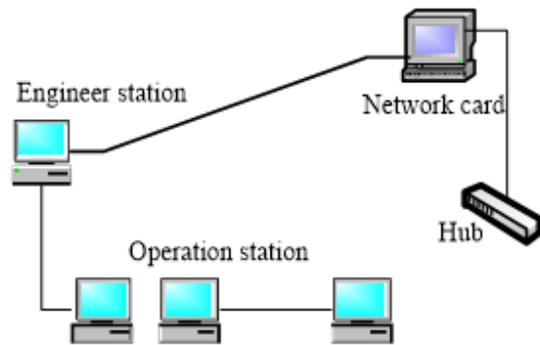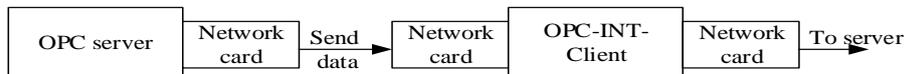

Figure 3: Physical entity

Figure 4: Logical diagram

4.3 System test

(1) System bearing capacity test
The throughput is measured by the system's response time and throughput. It can count the unit time of the system traffic, and then according to the business volume to calculate the system throughput, the specific throughput as shown in Table 1.
The throughput test results of the system implemented in this paper are shown in Figure 5.
As can be seen from Figure 5, the system can achieve seven operations per minute. The system response time increases as the number of system users' increases. The system throughput is proportional to the number of system users. But when the user continues to increase, the system's throughput will gradually decline.

Table 1: System throughput rate

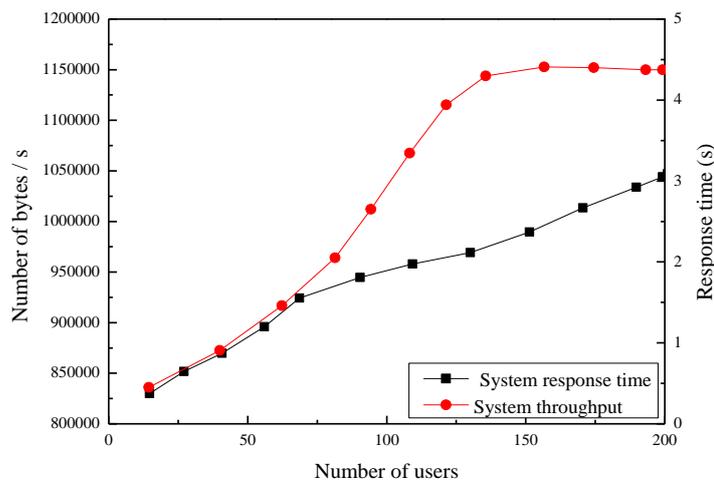| Average throughout	Concurrency user
834695	50
932939	100
1149757	150
1097286	200

Figure 5: System throughput test chart

(2) System reliability testing

The system runs continuously for 30 days, and the system responds to the user's operation function. The results show that during this period of time, the system is running normally, the error rate is almost zero, which can initially determine the reliability of the system.

5. Conclusion

This paper designs the real-time database production monitoring system of coal chemical industry, realizes the electronic and non-paperized office of the real-time data collection of the station to the company, realizes the running status of the on-site real-time online monitoring device and instrument metering, and provides the company's production management command A strong technical guarantee.

Real-time data acquisition and monitoring system can be timely, accurate, efficient and convenient for the managers of macro-control. It can also provide first-hand information for future data mining of coal chemical industry. Therefore, the realization of coal chemical company's automated operation and management is realized, the production management efficiency is improved. In addition, the coal chemical industry is optimized, the company's production information management model has been improved, in order to achieve the company's data sharing resources.

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