Managing System of Coal Mine Safety Monitoring Information Based on Real-Time Requirements

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Abstract. The traditional relations database cannot satisfy the management system of coal mine safety monitoring information which needs the real-time data fast response, but the real-time database can realize well to monitoring system's data management, exchange and sharing. According to the coal mine safety monitoring information management system's characteristic, proposed the real-time database design method. Described the system design in detail, and then introduced the real-time data engine's design as well as the real-time database's design, also described the real-time data transmission structure.

Introduction

Real-time information collection, transmission and centralized management of coal mine safety production is the data base of coal mine safety monitoring information management system. The real-time information of the coal mine safety production operation has a variety of data types, generally can be divided into analog variables and state variables, such as gas concentration, temperature, wind speed, throttle switch status, these data with strong real-time, also between the data still exist certain connection. An advanced managing system of coal mine safety monitoring information should be able to carry out a good organization, management and analysis of a large number of real-time data, through the acquisition of environmental data to feedback and even control the environment. So real-time data management is effective or not, it will affect the performance of the entire managing system of coal mine safety monitoring information [1].

Real-time database overview

Real-time database can provide timely, fast real-time data services, it established real-time data connection between the enterprise management layer and control layer , the enterprise business management and control of production process of combining. At the same time, it also provides a platform for the sharing of real-time data between different application processes [2].

The main differences between the traditional relational database and real time database are as follows:

(1)Storage medium. Usually, the traditional relational database stored in the hard medium; however, consideration of the real-time performance of the system, the real-time database is stored in memory.

(2)Defined manner. Usually, the traditional relational database can be generic, and the user can customize fields, tables, relationships, etc. However, the real time database only for special applications, usually can not be generic, and the user can not customize fields, tables, relationships, etc, but provide input program and fixed table structure.

(3)Access speed. The real-time database access speed is very fast and can achieve millisecond or even microsecond level, while the traditional relational database access speed is generally much lower, typically in seconds speed.

The system design

The system overall structure. Coal mine safety monitoring information management system using B/S and C/S hybrid system structure, makes full use of the advantages of the two to achieve data distribution processing, and any client can access the middle layer to improve the system security. The purpose of choosing C/S structure is to improve the system response speed, easy to complete the query, data analysis, parameter setting, report printing and other tasks. The advantage of using B/S structure is more convenient to operate in a unified interface, and customers can browse, query, schedule, assist decision making, publish remotely monitoring information and so on[3]. The structure model is shown in figure 1.

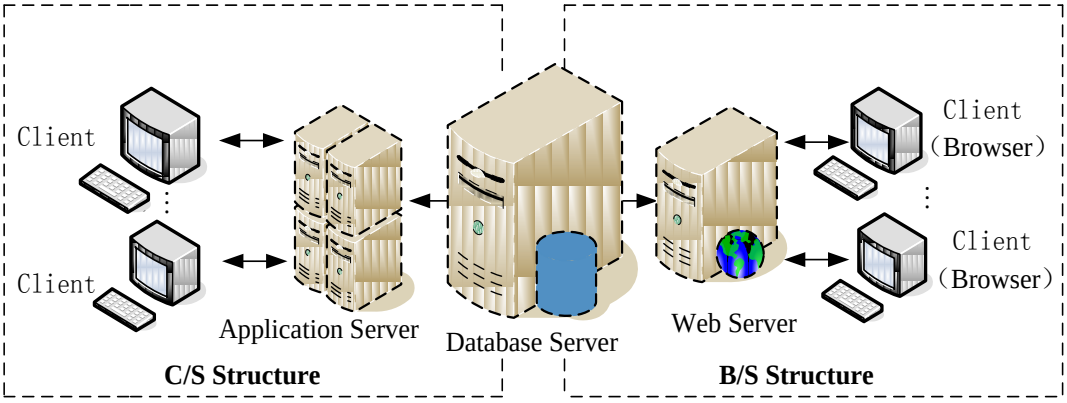

Fig. 1 system overall structure

Design of data acquisition and processing. The data acquisition and processing of the system is completed by the real-time data engine. Real-time data engine mainly consists of two parts, which are monitoring host partner and remote monitoring data engine. The real-time data and historical data of each monitoring point are stored in real-time database and historical database of the system, and the system using specific breakpoint Continuingly function of real-time data engine automatically supplement the historical data breakpoints generated due to the disruption of the network, so as to ensure the data transmission of real time, integrity and correctness. The data flow diagram is shown in figure 2.

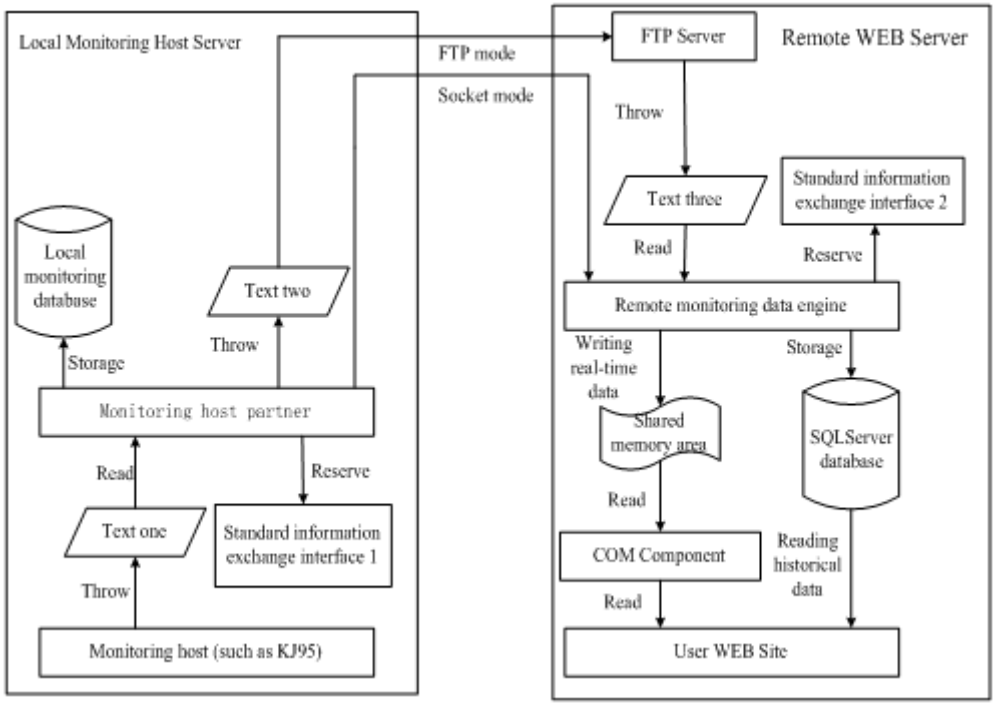

Fig. 2 data flow diagram

(1)Monitoring host partner: Read the data interface file of the monitoring host, and save the relevant information in the local historical database; At the same time, the real-time monitoring data can be uploaded to the secure information system server, which can provide two kinds of FTP and Socket uploading methods. In addition, when monitoring host partner receives applications for supplementing historical data sent by the remote monitoring data engine of security information system server, it will automatically extract relevant data from the historical database to replenish the historical data which lost in the server[4].

(2)Remote monitoring data engine: After collecting and processing the real-time monitoring data uploaded to system serve by monitoring host partner through FTP or Socket, the system will store the data into the server monitoring database and real-time database so as to display with Web. Meantime, the engine can automatically inspect the integrity of the server0side database. An application for supplementing historical data will be sent by the safety information monitoring host partner, when the data is incomplete, to replenish the missing data[5].

Socket communication. Through the socket communication mechanism to achieve the data connection between the system monitoring host and the data engine, monitoring the host and remote WEB server act as the socket server and client[6]. Because the real time data will be uninterruptedly sent to the client over socket, non-blocking TCP protocol is employed by socket to check and resend data. This is suitable for transmitting data in a large amount (e.g. FTP, Telnet). A specific port is monitored by a server program and a specific link is established between the two when there is a connection request. In the processing operation of link building, a local port is provided to them. Meanwhile, sockets are bound to their ports respectively for mutual communication. This operation is as follows:

(1) If the Socket object has been successfully created through the server process, created socket handle is returned, otherwise re-created;

(2) Bind local address to distinguish the Socket;

(3) The client is ready to request connection. At the same time the server side is ready to connect the client's request;

(4) The client generates the Socket;

(5) The client sends a request to the server to connect to the server;

(6) The server side responds to the request to generate a new socket, and then connect the client socket;

(7) Send and receive data;

(8) Close the socket.

Design and implementation of real-time database

The design goal of real time database. Real-time database is applied to a system that there is strong timeliness to update and handle the data. A contrast is a great difference between the issues and data of real-time database and the issues and data of general database which is temporal constraint. The correctness of the system depends not only on the logical result of the transaction, but also on the time generated by the result of the logic[7]. Real-time database is not a simple combination of database and real-time system. It needs to be studied and developed in many aspects, such as data model, architecture, transaction processing mode, data storage mode and so on. The high performance requirements of the real time database are based on the memory, so the management of the memory buffer becomes more important. The real-time database is divided into two parts: the memory database and relation database. The storage mode of the memory database is sequence structure with indexes by maintaining certain capacity to store the data. The expired data will be updated or deleted and be stored in the relation database, so the historical data could be stored and managed by using the relation database[8].

Using memory-mapped files to realize the design of real time database. The memory-mapped file is the lowest level mechanism to realize multiple process data sharing on a

single computer in Windows system, achieving high performance through small overhead. Additionally, the direct memory read data mode could be employed to operate files and data[9]. With the help of memory mapping file, the processing of the application development could be more convenient and the operating efficiency will be enhanced significantly.

(1)The basic principles of memory-mapped file

Memory-mapped files generally have 3 cases. The first case is the executable file; the second case is the data file; the third case is the exchange file based on the page of. The memory-mapped file used by the general system application is usually the data file and the exchange file, but the memory-mapped file used by the system itself is usually the executable file. The principle of the three kinds of memory-mapped files is roughly the same, the difference is that the address is different.

The memory-mapped file used by the system is the data file, so that several or more process is mapped to the view of the same memory-mapped file. That is to say, they share the area or memory given by physical memory. When a process writes data to the mapping object of the shared file, almost at the same time other processes can synchronously observe and read the changing data in the view. The memory-mapped schematic diagram of the system is shown in Figure 3.

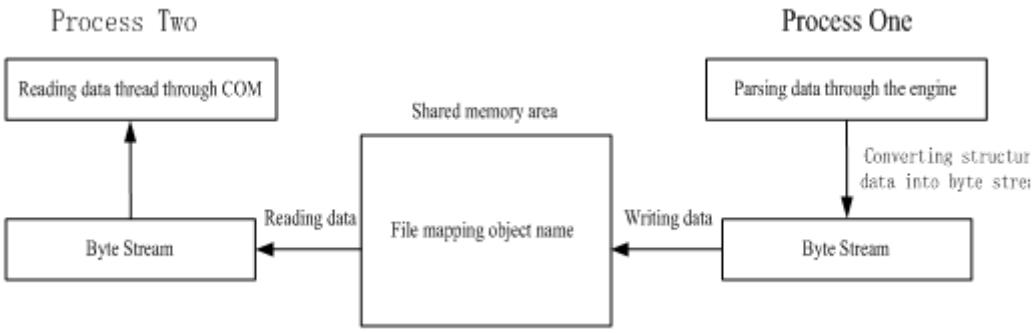

Fig. 3 memory-mapped schematic diagram

(2)Implementation

The function of the memory-mapped file provided in Windows is used to perform the following operation steps:

1)Through the CreateFile() function, a special method is used to create a file object;

2)The CreateFile() function returns a file handle as a parameter in the CreateFile Mapping() function, it is to create the core object of memory-mapped file and its appropriate properties.

3)The MapViewOfFile() function is called to map the corresponding file information in the address space of the system process.

When the file is mapped to the address space of the process, you can use the data pointer returned by MapViewOfFile() function to call the data.

(3) Maintenance of memory-mapped file

Maintenance of memory-mapped files usually can be used in two ways.

Method 1: After the data processing, the memory mapping file, created last step, is to be cleared and deleted. So the memory mapping file will be recreated before the next process of data, and then the byte stream is written into the memory mapping file so that another process could read data from it. The capacity of the memory area could be indeterminate, as long as the memory mapping area is larger than the data. This is greatly suitable for the case that the data size is uncertain.

Method 2: A fixed-size memory-mapped file is created. And the old data is covered over with the new as the byte stream which is dealed in advance is wrote in this file.

At intervals between deleting the previous memory mapping file and building the present one, if a process need to read data, unobtainable then, mistakes will happen, which is the defect of method one. Therefore, this system uses the method 2 to carry on the maintenance of the memory-mapped files.

Conclusion

With the continuous development of coal mine enterprises, the management system of coal mine safety monitoring information is becoming more and more complex, and the higher requirements have been put forward for the consistency and security of the data, especially for the fast response of the real-time data. Real-time database is the basic to realize various functions for coal mine safety monitoring information management system. In accordance with the characteristics of coal mine safety monitoring information management system, this article proposes to combine real-time database (i.e. the memory database) and relation database to accomplish the management of real-time data. Quick access, independent data, extensible database, flexible support for extensive application and so on will be the features of coal mine safety monitoring information management system. The system has the advantages of simple operation, excellent performance, safety, reliability and so on. And the system has been successfully applied in a coal mine in Shanxi province, and the field test and application results show that the popularization and application of the system to the coal mine safety production and management has important theoretical significance and engineering value.

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