The IOT of Coal Mine Production of Remote Data Acquisition System Design

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***Abstract*—The system described in this paper want to solve several problems such as data safety, clock synchronous and mistake redundancy etc. while the system running on wide area IP network. The system involves the Internet of Things (Hereinafter referred to as "IOT") technology and data to achieve robustness and data synchronization and other key issues. Using the IOT technique to establish a data transmission pipeline, and in order to adapt to run on a wide area network, the system will refer to B/S mode combining SOA framework system software architecture design pattern, make the system more flexible, safe and efficient.**

Keywords-IOT; Safety; BS; SOA

I. INTRODUCTION

Since the National Twelfth Five-year Plan, the research projects related to coal mine IOT become very hot. Compared with the coal industry abroad, the domestic coal industry has a certain gap in technique, equipment, management mode and concept of innovation and so on. Coal mine IOT, in which high-speed enterprise network acted as the core, the various application software of the mine as the tool, the high efficient and automated data acquisition system as the method, realize the informatization, automation and industrialization in mining industry. Obviously, the coal mine IOT is a huge and complicated engineering. Under the framework of the coal mine IOT，all kinds of application system produce vast amounts of data, among which the production monitoring system is an important component. At present, most of the production data acquisition system (including hardware and software) apply the C/S framework to conduct the development, deployment, and maintenance within a local area network (LAN). Generally it may have the following questions:

(1)Tradition production data acquisition system is developed by using visual language. Although adopting the language to improve the development of technology has been more mature, but with the development of the programming technology, the visual language programming has been gradually replaced by the object oriented language.

(2)Usually，it does not involve issue of development framework in visual programming phase . Just to develop the program according to the demand from the front to rear in accordance with the order. But if the demands become more complex，the difficulty of the software development would be doubled and redoubled，it also could cause extra expense of software upgrading and secondary development.

(3)The current production monitoring system client's ability to process the data is not strong, and it depends greatly on the server side, and real-time monitoring need to transfer massive data between the client and server, and at the same time the server also need to display the page back to the client, this will increase the load on the server.

II. REQUIREMENTS ANALYSIS

There is a large number of coal producing mines in the existing domestic large-scale coal enterprise group, and the geographical position is dispersed, these characteristics determine that the coal enterprise group need efficient ways of working in production management mode .The coal production data acquisition system based on the IOT technology can improve work efficiency and the security of data, and strengthen the management.

In the aspect of secure transport, in order to better ensure the safety of the software system, under the framework of IOT technology, it conducts the development by combining B/S mode and SOA framework system software architecture design pattern.

A. Technical analysis

As the production data acquisition system is based on wide area network, all monitoring information of the monitoring subsystem must be transport via IP network. Therefore, the choices should consider the network bandwidth and network redundancy. The bandwidth has direct relationship with the system of information access. Correct and reasonable estimate of the network information flow-rate is one of the key impacts to ensure the network architecture. Production data acquisition system adopts the hierarchical and distributed control mode. This mode, besides the advantages of good real-time performance, from the perspective of information flow, makes each layer of information flow of the whole control network into equilibrium. There is no flow channel of highly concentrated. By analyzing the information of all kinds weighing equipment can obtained: Set each mine unit information for U（i）, each weighing equipment information M including voltage, current, active and reactive power, switch displacement, over voltage protection and other information accounts for about 26 bytes, so M=26×8=208bit；Mineral sheers have 20 sets of heavy equipment; Access to 2 times per second, so the amount of information per second U (I) = 20 * 2 * M = 8320 bit/s. If an enterprise group has 15 mines, then the effective information per second as E is

$$E = \sum_{i=1}^{20} U(i) = 20 \times 8320 bit/s = 166400 bit/s$$

According to the network transmission of information redundancy value as (1:4), the amount of information per second is 665600 bit/s. So the measurement control information for the actual bandwidth of 2 m or so on the network. The access networks must satisfy the bandwidth.

B. *Terminal access and data analysis*

Current remote coal mine production system is through a variety of installed electronic weighing equipment in coal mine pit, continuous measurement monitoring of coal production, and transform into digital signal, through the network communication upload monitoring data and video signals to the monitoring center of the data server, implement the coal mine production real-time monitoring and source control, functional departments at all levels can also browse, query the coal mine production and equipment running status at any time through the terminal, to implement the real-time parameter collection in coal mines.

(1) Hardware interface. Terminal equipment composed by the controller, field bus, sensors and actuators and some other equipment. The scene of the controller can be embedded PC controller, PLC and special monitoring stations, etc. Each terminal can choose different ways of controller and the field bus or other flexible methods, for the best solution to the scene. Finally, through the field controller to access the control layer network.

(2)Software interface. Analysis of the present situation of the terminal, it is necessary to develop the following interface to get the best application effect: OPC（OLE for Process Control; DDE/NetDDE (Dynamic data exchange);ODBC(Open Database Connectivity);FTP(File Transfer Protocol).

III. SYSTEM ARCHITECTURE

Currently, at the coal mine pit, the way of output coal mainly rubber-tyred vehicle transportation, tape transportation, car transportation and skip transportation. Choose corresponding bearing device according to these four kinds of transport modes, and design corresponding weighing metering device and control equipment according the coal process. The pit production weighing system main components are: the measurement sensor on coal mine , data acquisition unit, video monitoring system, automatic identification of vehicle information system, coal mine working computer and the weighing monitoring software ,weighing video information upload system, speed sensor and so on, as shown in figure 1.

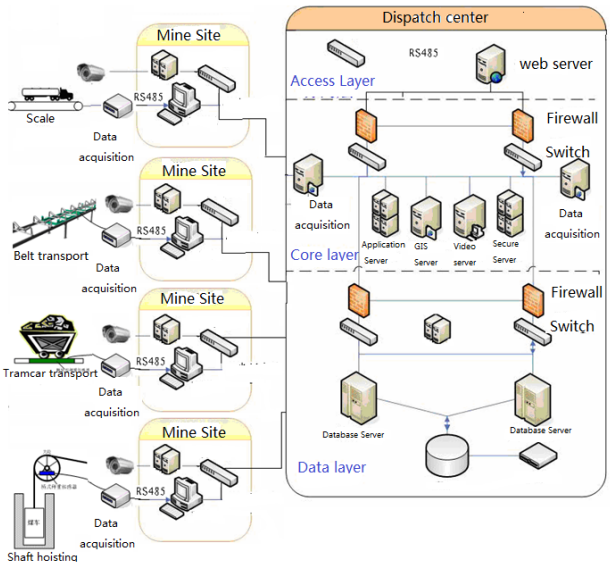

Figure 1. System architecture

IV. THE KEY TECHNOLOGY AND SOLUTIONS

In the process of development, in the aspect of secure transport, in order to better ensure the safety of the software system, under the framework of IOT technology, combining B/S mode and SOA framework system software architecture design pattern to develop. Through shielding the data effectively of communication between the user and the server, to make all the data effective encryption packages which the foreground users produce, and the data pipeline can be formed between the user and the server. Thus, it can effectively guarantee the data security and reliability. B/S mode just need to install a server-side, the client is based on the browser, so the deployment, and later maintenance costs will be greatly reduced. The software designed and developed according to the SOA framework thoughts, is based on the service mode, for the later system upgrade and modular splicing provides strong support. Make the coal tax-controlled system meets the needs of users to upgrade and expand in the future.

Programming language use the object oriented programming language ActionScript3, different from the browser programming language JavaScript, ActionScript3 is more powerful, in fact, it is more like c # and Java from the syntax structure. Therefore the development of RIA applications based on the IOT can create flexible and powerful business logic. Most of the traditional web-based application business logic is dependent on the strongly typed language of the server side, such as Java, c #, but the Web applications based on IOT can make the related business logic transferred to the client for processing, greatly reduce the burden of the server. Adopt MXML to deal with the IOT interface design and layout, MXML is an xml-based declarative markup language, can quickly build their own interface layout and interface behavior, also be able to bind data to the relevant MXML controls, if the data content changes, it can dynamic update in the interface without page

refresh. The IOT provides three data access components interact with the server, is the HTTP (REST - style) service, web service and Remote Object, it can use different access components according to the different technology of server applications, flexible and powerful.

A. Logical construction

Framework based on the IOT as the presentation layer and data interactive engine, make full use of the client operation ability and the ability of the client cache, thus to ease the burden on the server, reduces the response time and amount of data. On this basis to build a production data acquisition system of B/S structure. Figure 2 describes the architecture of the system. The system adopt a presentation layer, business logic layer, data layer and the architecture of serial communication layer, realize the loose coupling between layer and layer.

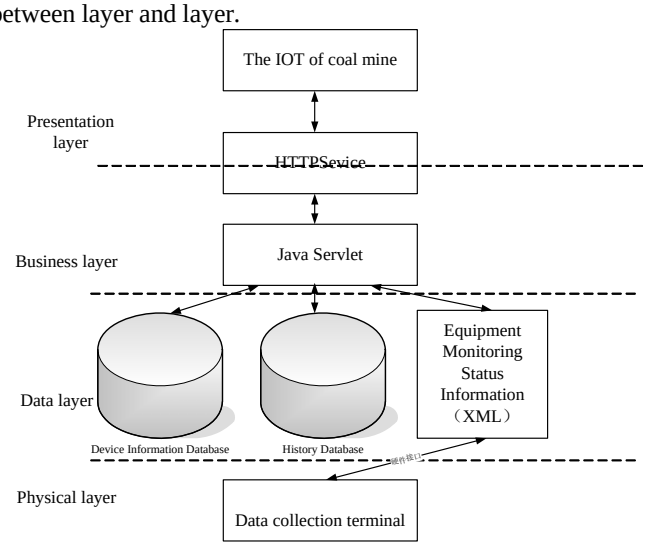

Figure 2. System structure

(1)Communication Layer. Use hardware interface communication between the system and the terminal (USES RS - 232, RS485 serial port technique or Ethernet) to realize data interaction. The serial port communication layer is to parse the data, and specific XML file formats to store the data on the server, for reading, analysis and processing, at the same time, implementing the corresponding action according to the results of the data.

(2)Presentation layer. Actionscript3 reads the serial port communication layer and generated XML, its powerful XML analyze and processing capacity makes the client needless to send any processing requests to the server. After processing the data through the data binding on the corresponding control updates on the interface.

It can also cache some frequently used fixed information (such as equipment basic information, historical monitoring equipment status information), after the return to the data on the server for the first time, the terminal will cache the data; avoid frequent requests for this information. Compared with traditional data which cache in server mode, it can visit the server cache data without network bandwidth again, has a greater degree to reduce the burden of the server.

(3)Business logic layer. Business logic layer is responsible for the communicate with the IOT interactive layer, and it disposes the request of the IOT by Servlet, reading the weighing information of XML file, and return back to the client; acquire the detailed weighing data information; application server defines the business rules of the system, responsible for responding to requests, logging, read or save the data. Because of adopting the more powerful client, the business logic function of the server has been simplified; furthermore reduce the burden of the server.

(4)Data layer. The data layer consists of multiple data servers, mainly include: log files, historical information database, equipment state information database, real time status information storage, management and maintenance of files.

B. The key problems and solutions

(1)The XML data structure generated via a serial port communication. Terminal information data is the core of transmitting data and monitoring system, using the data description language XML defines its structure. State information data mainly include the equipment number, sensor number used to send data and other information.

(2)Java server and client interaction. The system provides three data interaction patterns, respectively are HTTP Service，Web Service and Remote Object. Since the server adopt the Servlet to handle the client request, hereby take the HTTP Service pattern to interact with the server. HTTP Service uses event mechanism to handle returned result by the server, implements a good asynchronous functionality. At the same time, making the results dynamic update in the interface through binding the data with the component, the process is simple and fluent. Compared with the traditional web-based applications, the seamless interaction with the server, a good event mechanism realizes the asynchronous data access, at the same time, object-oriented programming and powerful XML processing ability of the ActionScript3 makes client-side programming simple and efficient.

V. CONCLUSION

This article describes the coal production following data acquisition system based on the technology of IOT, this solution has the following features: 1) the system provides users a very personalized page display. 2) on the same system, the user can visit the system at any time according to their own network conditions without considering where they are; 3) take the SOA framework for software design and development ensure the extensibility of the software; 4) the IOT technology hierarchical processing most of the business logic and data transmission to give the data security the biggest guarantee. The key techniques adopted in the construction of the system has the vital practical significance ,

not only improves the production efficiency and security of the data acquisition system, also make effective combinations among different technology applications, provides a good direction of system development.

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