

A Coal Mine Security Production Dispatching System with Web Configuration Technology

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Abstract

Coal mine security production dispatching system with web configuration technology is an advanced information system that integrates Internet, Database, XML and Web configuration technology. The system combines organically information of real-time data of coal mine safety monitoring and production scheduling, and digitizes it and finally discloses solution Visual Graph via ActiveX-based components of Web configuration to achieve standardization, normalization, and high efficiency of coal mine safety production scheduling. This system has been successfully utilized in coal mine for two years and achieved expected success of providing fresh, quantitative, and truthful production scheduling information for safety production scheduling and management department.

Keywords: web configuration, database, XML, safety production scheduling, coal mine

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1. Introduction

Coal is one of the world's most important energy sources. As the world's growing shortage of oil energy, the coal industry is facing important strategic opportunities. On the other hand, the coal industry is a high-risk industry which is threatened by water, fire, gas, coal dust, roof et al. The slightest mistake will lead to accidents and make huge loss of property and political influence to the state and society [1].

Before IT is introduced into coal mine scheduling information management, coal mine production scheduling information was mainly taken manually recording, rendering and storing by text, tables, graphics, which results in the protection of data and use of information exits inefficiency, poor sharing, slow retrieval speed, not timely information processing and many other shortcomings [2].

The development of information technology makes it possible to informationize the coal mine safety production scheduling system. Over the years, the research subjects in related fields of China coal science and technology workers are focused on mine safety monitoring. There are many kinds of progressive development of monitoring system, such as motor vehicle scheduling "sets" system, safety attendance system, industrial television system, mine hoist monitoring system, safety monitoring system and so on. But most of these systems are independent, and installed in different departments. So that information sharing and exchange is inconvenient, and the coal mine leaders and related persons cannot be timely and comprehensive understanding of mine safety, production and working operation information. These systems make production scheduling inconvenient. So it is necessary to make full use of the mine equipment and system, on the basis of development to form a mine safety and production scheduling information fusion system as a control room of production command system center and the relevant departments.

Nowadays, the coal mine security production dispatching information is available mainly from KJ4 and its upgraded KJ2000N security monitoring system and human inspection, reporting [3]. In this way, the information is displayed on a large screen in forms. It can be displayed in only one way and it is not easy to update and maintain and also to monitor production dispatching. As the displayed information cannot be released, decision-making layer and related functional departments of the mine cannot receive information about underground mining safety production and mining dispatching easily, timely as well as completely, which is out of requirements of

modern production. Therefore, it has to be done to build a modern safety production dispatching system.

Coal mine security production dispatching system with web configuration technology is an advanced information system that integrates Internet, Database, XML and Web configuration technology, which is designed and developed for such application.

2. General Structure and System Hardware

The coal mine security production dispatching system contains three-layered architectures which are logically divided into the presentation layer, business logic layer, data service layer and functionally into presentation, business, and data, each of them are set on the same or different hardware platforms [4-6].

Data service layer is composed of database server and video server system to save and exchange data of the system; business logic layer is composed of Web servers to process logic of the system; presentation layer is composed of user controls, multi-channel video controllers and display devices to display logic of the system. Topological architecture and hardware components of coal mine security production dispatching system with web configuration technology are shown in Figure 1.

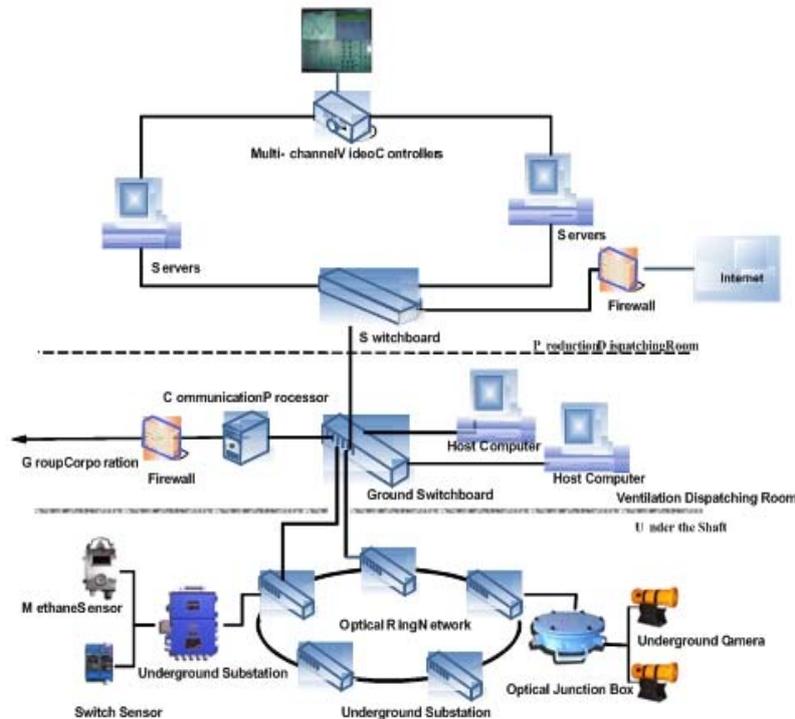


Figure 1. Topological Architecture and Hardware Components

Underground optical ring network transfers data about security and mining which is collected from sensors to underground ventilation dispatching center. All security production data collected from underground will be processed and stored into SQL database by KJ2000N safety monitoring system of ventilation dispatching center. Finally, Web server of production dispatching center selects real-time data and the center selects those required to be displayed information about safety production and operation of mining equipments, and finally releases Web configuration.

3. Design of System Software

The concept of configuration comes from “configuration”, the meaning is configuration resources of computer and software by using software tools, making the computer or software according to the preset to automatically perform specific tasks and meet users requirements.

Configuration software is a special software for data acquisition and process control, they are software platform and development environment on the automatic control system monitoring layer level. They provide rapid construction of industrial control system monitoring function, the general level of software tools for the users by using flexible configuration. Corresponding to the original concept of HMI (human machine interface), configuration software is a software tool or development environment which can make users quickly set up their own HMI. In the configuration software, industrial users write HMI applications by hand or entrusting the third party. But the development time is long, the efficiency is low, the reliability is poor or it needs to buy special industrial control system which is usually a closed system, often cannot meet the demand and is difficult to external data interface, upgrading and increasing function is restricted. The emergence of configuration software makes the users free from these difficulties, they can set the most suitable application for themselves by using the function of configuration software.

Coal mine security production dispatching system with web configuration technology is developed and operated on .NET with Windows Server 2003 operating system and IIS 6.0 Web server for the system. Database is utilized in SQL Server 2005 database with ADO.NET access connection. Mining equipment operation and safety production information is displayed on the development platform of interactive graphics Visual Graph [7-8].

3.1. Web Configuration Solution

The main problem solved by the configuration software is providing the flexible configuration tool to users, that can be adapted to the needs of different application areas, collect and control the data exchange between the device, associate the data from device and the elements of computer graphics screen, processing the data alarm and system alarm, storing the historical data and inquiring historical data, generating of various reports and printouts, ultimately generating the application system is stable and reliable, has an interface of third-party programs to facilitate data sharing.

The development of web technology provides the foundation of technology for network-based manufacturing. The HTTP model in the application layer of WWW service is non dynamic, it only provides little or no interaction interaction. The common gateway interface (CGI) can realize the interactive form, make the web with interactive ability. The appearance of ActiveX and Java technology also enables the web server actively inform data change to client[39]. These technologies provide solutions to monitoring the running screen of the industrial site configuration by remote users via standard browser.

ActiveX technology is based on Component Object Model, is a fusion of technology and OCX OLE technology, the content of ActiveX included:

(1) ActiveX Automation Server. ActiveX automation server is a component that can be used by other applications after being programmed. An ActiveX automation server includes at least one dispatch-based interface, other applications created it and connect the server through it.

(2) ActiveX automation control. ActiveX Automation control is the application that use and operate the ActiveX server.

(3) ActiveX control. An ActiveX control can be a DLL, it can also be EXE files, it can operate the automation server by local or remote mode and activated in place.

(4) ActiveX Documents. ActiveX document was previously called the document object, In one such document can include a lot of other objects, such as a picture, an audio object and a table, etc. ActiveX documents have UI, this is the UI consists of a container application to operate, such as the operation and use of the UI of Word through the IE browser.

(5) COM object. From the analysis of the structures, The COM object is similar with the automation servers and automation control, they have one or more COM interfaces, but only a few UI interfaces, or even none. The difference between them is the automation server can be operated by automation control, but COM objects not. Windows operating systems have hundreds of COM objects and user interfaces, they are used as the operating system

extensions. Using COM object is a good way to organize and manage relevant data and functions, this approach is also used to create a high-performance dynamic link library.

The system adopts ActiveX-based development platform of interactive graphics Visual Graph as a Web releasing solution and its releasing system architecture is shown in Figure 3 [9].

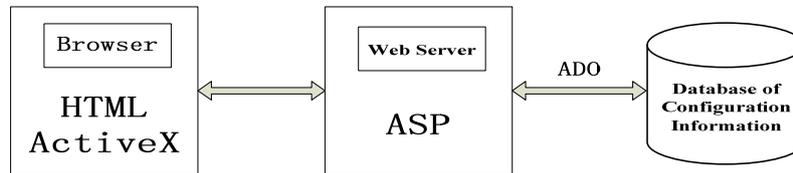


Figure 2. ActiveX-based Web Configuration Releasing Architecture

With ActiveX-based configuration releasing, the decision-making layer and all departments can watch how the configuration operates through the browser and the real-time situation in producing site. However, there is a defect of ActiveX which is that the procedures are complicate and huge quantity of codes are involved because both systematic data processing logic and screen display logic are combined in one ASP [10]. Therefore, the system separates systematic data processing logic and screen display logic with ASP.NET and effectively solve the problem.

The development platform of interactive graphics Visual Graph provides functional ActiveX core component and supports the embedded IE. Because of compressed size 300K only of whole Visual Graph system, it is particularly suitable for B/S architecture network applications with web of the system.

3.2. Data Acquisition and Processing

Update information acquisition program of the system is developed in Visual Basic programming language and is run in Web server of system business logic layer, then sends out application of data processing to database server in SQL and thus, gets access to the database. The switching and analog data that analyzed by update information acquisition program will be stored in different forms of local Access databases to create XML text for access to Visual Graph [11].

Furthermore, this information acquisition program meets the actual needs of coal production and records the total on-off time of the belt, daily maximum and average of the gas at the monitoring station and outputting of current production. All timely and quantitative information will be at last displayed on Web page via Visual Graph components, which provides effective support for decision makers and dispatchers.

3.3. Web Configuration

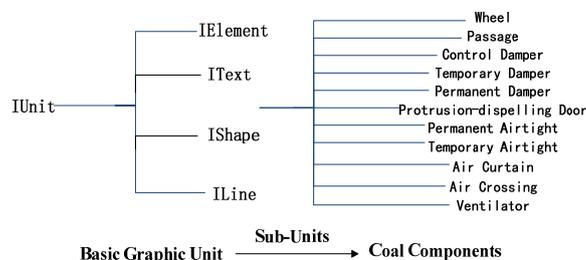


Figure 3. Coal Components Graphic Modeling

Visual Graph provides a basic graphic unit - IUnit and four sub-units: IElement, IText, IShape and ILine. With these basic graphics which offers new Value and Setvalue to these

components, the system can edit VG scripting language program and program new coal components. The designer can easily draw configuration graphics which is required for production dispatching about the actual situation of coal production with coal components. The process diagram of coal components graphic modeling is shown in Figure 3.

Components of coal component of the system include:

1) On-off equipments which are used to start and stop mining equipments in simulation mine production, such as belt components, main fan components, pump components, and pressure fan components.

2) Analog display components which is used to display data information of coal mine safety producing and output such as gas display, wind speed display, the total on-off time of the belt open belt display.

In order to get real-time data, a data update component is put on the Visual Graph page. When data update component OnTimer() is generated, data is send to the server in GetURL(). After data delivery successes, attributes of all components on graphic page are changed in Visual Graph language and each component is updated. Finally, Web configuration can be released by loading appropriate configuration files in ActiveX. Take the belt as an example. Page of running the belt after release is shown in Figure 4.

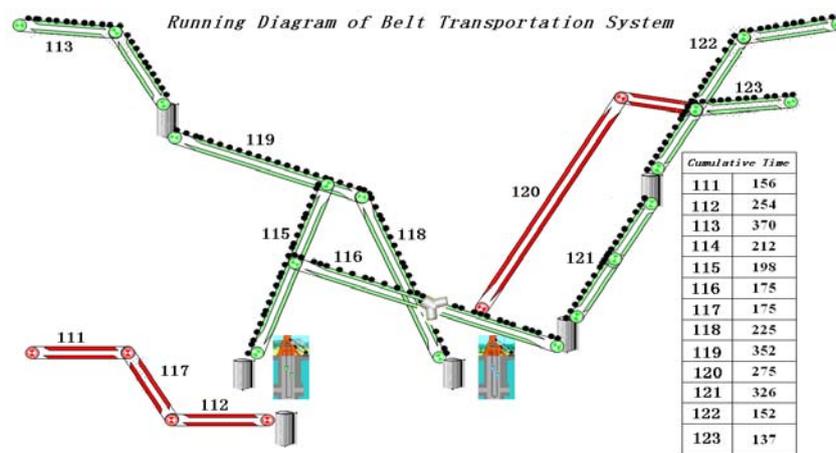


Figure 4. Running Diagram of Belt Transportation System

4. Conclusion

Coal mine security production dispatching system with web configuration technology effectively enhance production dispatching management level of the coal mine after being put into operation in 2008. Decision-makers and departments can visually check real-time running situation of the major underground production equipments and gas, wind and other safety production information. Page dispatchers can direct more effectively. In all, there is a great improvement to achieve. When new mining is explored in the mine, the maintenance personnel only need to drag the packaged coal components and drop to current configuration page, unnecessary to modify the source program. It is flexible, simple and easy to maintain.

Acknowledgements

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References

- [1] Liang YT, HZ Luo. Current situation and development trend for coal mine fire prevention & extinguishing techniques in China. *Journal of China Coal Society*. 2008; 33.2: 126-130.
- [2] Jiping, Sun. Effect and configuration of "six systems" for safe act of rescue of coal mine underground. *Industry and Mine Automation*. 2010; 11: 1-4.

- [3] Wan-qing SHL, Wen-qing M. Coal Mine Safe Control Model Based on RS-ANN. *Systems Engineering-Theory & Practice*. 2009; 29(1): 174-180.
- [4] Zhenjun Fan. Implementation method of ASP.net-based the three layers. *Computer Science*. 2007; 34(4): 289-291
- [5] Liang Y. Theoretical analysis and practical application of coal mine cooling in Huainan mining area[J]. *Journal of Mining Safety and Engineering*. 2007; 24(3): 298-301.
- [6] ZHANG, Huawei, Yisha LUO. On the primary and secondary degrees of gas collection of top corner: Based on gray integrated assessment method. *Mineral Engineering Research*. 2009;1: 015.
- [7] The company of Visual Graph in Beijing. Visual Graph [EB/OL]. <http://www.Visual-Graph.com>.
- [8] Noack, Andreas. An energy model for visual graph clustering. Graph Drawing. Springer Berlin Heidelberg, 2004. Yang, Dong, et al. Product configuration knowledge modeling using ontology web language. *Expert Systems with Applications*. 2009; 36.3: 4399-4411.
- [9] Li Zhang, Futing Ma, Liyong Zhang, etc. Research of configuration software and its browser with web. *Chinese Journal of Scientific Instrument*. 2007; 28(10): 1746-1750.
- [10] Zanker M, Aschinger M, Jessenitschnig M. Development of a collaborative and constraint-based web configuration system for personalized bundling of products and services. *Web Information Systems Engineering–WISE 2007*. Springer Berlin Heidelberg. 2007: 273-284.
- [11] Park H. *Advanced Security Configuration Options for SAS® 9.4 Web Applications and Mobile Devices*. Proceedings of the SAS Global Forum 2014 Conference. 2014.
- [12] Towers K, De Buen P, Dietrich F. High power radio device communication parameter configuration and methods using limited configuration power: U.S. Patent 8,634,482[P]. 2014-1-21.
- [13] Pohl C, Hof HJ. *The All-Seeing Eye: A Massive-Multi-Sensor Zero-Configuration Intrusion Detection System for Web Applications*. SECURWARE 2013, The Seventh International Conference on Emerging Security Information, Systems and Technologies. 2013: 66-71.
- [14] Nguyen H V, Nguyen H A, Nguyen T T, et al. *Dangling references in multi-configuration and dynamic PHP-based Web applications*. *Automated Software Engineering (ASE)*, IEEE/ACM 28th International Conference on. IEEE. 2013: 399-409.
- [15] Kor YY, Mesko A. Dynamic managerial capabilities: Configuration and orchestration of top executives' capabilities and the firm's dominant logic. *Strategic Management Journal*. 2013; 34(2): 233-244.
- [16] Thangarathinam T. Professional ASP. NET 2.0 XML. Indianapolis: Wiley Publishing, Inc., 2006.
- [17] Block, Glenn, et al. Designing Evolvable Web APIs with ASP. NET. O'Reilly Media, Inc. 2014.
- [18] Gonzales Jr, Merced, Francisco Loya III, Michael Gonzales. System and method for gauging performance based on analysis of hospitalist and patient information. U.S. Patent No. 8,666,774. 4 Mar. 2014.
- [19] Hours, Credit. Curriculum for the Bachelor Degree in Software Engineering (SE). Diss. Al-Balqa' Applied University.
- [20] Janjua, Naeem Khalid. *Validation and Evaluation of GF@ SWA. A Defeasible Logic Programming-Based Framework to Support Argumentation in Semantic Web Applications*. Springer International Publishing. 2014; 235-273.
- [21] Metkar, Suraj, Pankaj Khapare, and Amit Palve. Web Enabled Remote Toxic Gas Monitoring and Controlling System. *International Journal of Computer Applications*. 2014; 90.
- [22] Bray T, Paoli J, Sperberg-McQueen C M, et al. Extensible Markup Language (XML) 1.0 (fifth edition). W3C Recommendation, 2008. <http://www.w3.org/TR/REC-xml/>
- [23] Wang, Cheng, et al. ASP. NET Websites Longitudinal Security Theoretical System. *Applied Mechanics and Materials*. 2014; 513: 597-601.
- [24] Mirzoev Dr, Lawton Sack. Webpage Load Speed: ASP. NET vs. PHP. *arXiv preprint arXiv*. 2014; 1404: 2163.
- [25] Yi, Shi, Quan Liu, Jing Song Li. Design and Realization of Large File Asynchronous Upload and Broken-Point Continuingly-Transferring Based on ASP. NET MVC. *Applied Mechanics and Materials*. 2014; 543: 3165-3168.