Construction of Mine Roadway Safety Monitoring System based on Integrated Integration Technology

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Abstract: Mine roadway safety monitoring system is a complex system, the problem of non-sharing of data information existing in mine roadway safety monitoring, the design framework of mine roadway safety monitoring system based on integrated integration technology is proposed, using HTML5 and WebGIS technology to achieve the real-time monitoring of mine roadway。 The integrated mine roadway safety monitoring system has data input and output, planning analysis, auxiliary decision making, monitoring and feedback functions, and it is a combination of man and machine, all kinds of information data, various types of servers, smart devices and mining organic integration. The application of integrated integration technology in mine roadway safety monitoring has played a positive role in promoting the improvement of mine safety management level in China.

Keywords: Mine; Mine roadway safety monitoring; Integrated integration technology; Man-Machine combination; HTML5; WebGIS

1. Introduction

Production safety is an inevitable problem in the development and industrialization of human society. At present, China's mines are in a critical period of transformation and development, in theory and practice, a large number of new theories, new technologies and new methods also lead to the innovation and breakthrough on mine roadway safety monitoring. In the mid-1980s, Qian Xuesen, a famous scientist, personally initiated and guided the academic activities of "system study seminar", aiming at establishing the basic theory of system science [1]. The open complex giant system proposed by Qian Xuesen and its methodology have opened up a new scientific field [2]. However, the application of integrated integration in mine safety monitoring is still in its infancy. With the development of mining industry, its requirements for safety management are getting higher and higher, which requires the realization of safety monitoring anytime and anywhere on the intelligent terminal, and the understanding of mine production safety monitoring situation at any time. Existing 3DGIS technology and virtual simulation technology can realize the acquisition of production automation data such as down hole personnel positioning, operation environment and mine equipment, and provide technical support and decision support for mine safety production [3, 4]. Realizing digitization, visualization and intelligentization of intelligent mines can ensure the effective management of safe production and actual rescue of mines [5, 6]. There are many researches on mine safety monitoring system in China, but the data information is not shared, the existing integrated integration technology has not been applied, and the integrated integration management of mine is relatively complex. Therefore, this paper proposes a new scheme, the use of HTML 5 and WebGIS technology to realize real-time monitoring mine which focus on integrated application of integration technology in mine safety monitoring system, using integrated integration technology to maximize production, ensure the safety of the mine construction to avoid accidents occurred in the machinery, equipment and personnel work, so as to improve the economic benefits of mine.

2. Integrated Integration Technology

Integrated integration technology is mainly about recentralizing and reorganizing the business data of decentralized information systems in an enterprise. As soon as new and different data is produced, new steps are required to achieve data integration. After years of development, the informatization of an enterprise will produce a large number of messy, repetitive and ambiguous data, which is very detrimental to the statistical analysis of the enterprise, so the need for integrated integration is increasingly urgent. Integrated integration technology research began in the early 1980s, and now has been applied in the practical field, and achieved good results. Integrated integration technology is the combination of scientific theory and empirical knowledge. The system integration thinking is used to combine multiple discip-

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lines for integrated research. A large computer system with the characteristics of management information system, decision support system and integrated integration function is used [7].

3. Main Technologies

3.1. HTML 5

HTML5, the 5th version of HTML as a hypertext markup language developed by W3C, is a collection of HTML, CSS3, JavaScript and a series of API [8]. HTML5 is designed to support multimedia on smart devices, and new syntactic features introduced to support this, such as video, audio, and canvas tags, which can really change the way users interact with documents.

3.2. WebGIS

WebGIS is a combination of GIS technology and Internet, and is an extension of network GIS. WebGIS develops GIS from a geographic information system to a network shared resource, thus greatly improving the use efficiency of GIS [9]. The realization of WebGIS is based on the multilevel B/S architecture of Web technology, including Web browser, GIS server, database, etc. In the B/S structure, the user working interface is realized by the large desktop screen, mobile phone, PDA and browser, and the main transaction logic is realized on the Server side (Server). Thus, simplify the procedure, reduce the workload, reduce the mine cost. The B/S structure not only enables different people to interface from different locations and operate on a common database, but also manages access rights and protects the server's database.

4. The Integrated Integration Technology is Applicable to the Safety Monitoring System of Mine Roadway

For a long time, most of the mine equipment and technology level in China is relatively backward, extensive management, decision-making, design, production and many other aspects rely on experience, scientific level is not high, the degree of safety monitoring information is not enough, the safety monitoring information between departments is independent of each other. The format of safety monitoring information between various departments or mines is not unified, the exchange of safety monitoring information is not smooth, and it is difficult for departments and enterprises to communicate and share safety monitoring information. Mine roadway safety monitoring is very necessary, and mine roadway safety monitoring system is used to monitor a lot of content, such as video monitoring, personnel positioning, communications, roof monitoring, water supply rescue, harmful gases, emergency and ground pressure monitoring. The factors to be considered are also very complex, and systematic theoretical techniques are needed to guide

mine safety monitoring. Therefore, by HTML 5 and WebGIS technology to realize real-time monitoring mine based on B/S structure of the integrated integration technology platform as building form for the practice of mine safety monitoring system, realize the common use of mine safety monitoring information resources, mining managers and decision makers can get the latest information between different departments and the mining, which can dynamically adjust the mine safety production at any time.

5. Design and Implementation of Safety Monitoring System for Mine Roadway

5.1. Design of mine roadway safety monitoring system based on integrated integration technology

Mine safety monitoring system is to build a distributed integrated platform based on B/S structure, integrated the existing system, collecting mine personnel positioning and harmful gas, video monitoring, downhole monitoring and ventilation equipment, all kinds of data, having centralized management and analysis for the data, providing all kinds of hazards of real-time status for the enterprise leaders and mining safety management personnel, enabling managers to respond quickly when encountered in the process of mine production safety accidents, and make decisions quickly and minimize the risk of mine production. The system structure diagram is shown in figure 1, which mainly includes the client side, application layer, integrated integration platform, special mine network and data collection.

First is the client side. The client is directly connected to the mine personnel. The mine roadway safety monitoring system with integrated technology can be installed on different intelligent terminals to provide resources to the mine personnel and save relevant data. It mainly includes: human-computer interaction, monitoring information analysis, opinion summary and decision voting. The client side sends various requests related to monitoring information analysis to the integrated service platform through the application layer. The conclusions and suggestions after the system analysis should be sent back to the client side and presented to the mine personnel.

Second is the application layer. Responsible for the transformation between the client side and the integrated integration platform. Can not only send back monitor information analysis conclusions and recommendations to the client side, but also can store the input information from the client side into a variety of databases. As key stratum in the information integration platform, the technological process of mine production in our country, design the personnel management, video monitoring, emergency rescue and production management system, specific functions include personnel positioning and monitoring of mine, mining planning and production scheduling

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management, measurement acceptance, ventilation and drainage process monitoring, control and some manage- ment etc.
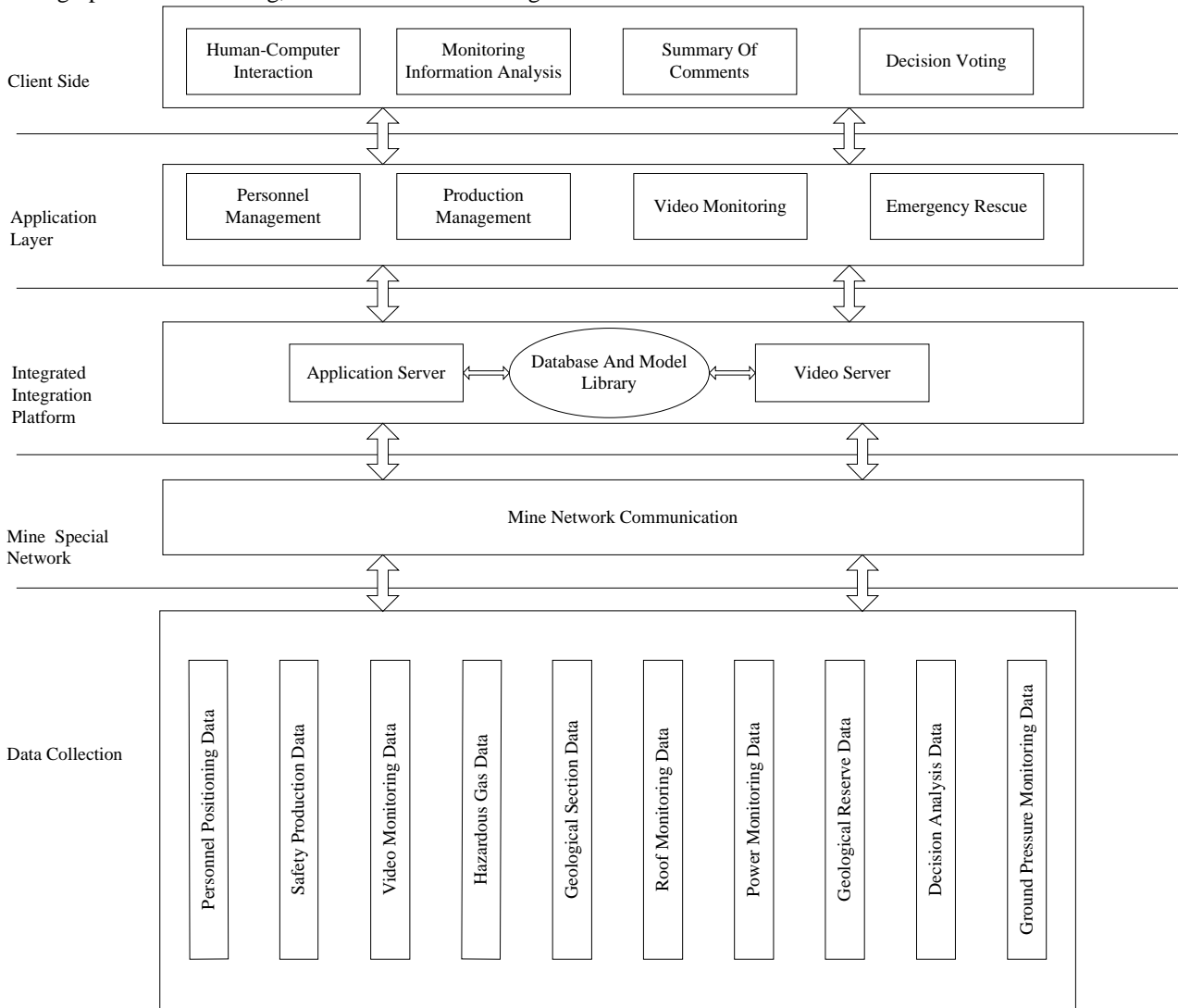

Figure 1. Structure diagram of mine roadway safety monitoring system based on integrated integration technology

Third, integrated integration service platform. It is composed of two types of servers, one is an application server, which mainly processes data of related aspects; The other is video servers, which deal with multimedia data. The application server analyzes and encapsulates the raw data acquired by the data acquisition layer, searches the database and model library according to the request, classifies, distributes and summarizes the received service request, and generates various instructions. According to the service request, the monitoring information analysis platform is invoked to conduct analysis simulation and generate analysis database. According to the request of monitoring information analysis platform, invoke corresponding various services; Also, can carry on the transformation to the integrated information according to the need, which is convenient for mine-related personnel carries on the analysis and decision.

Fourth, the mine special network. Mainly responsible for the management and analysis of computing resources and network communications. Through the mine special network, the interconnection and information transmission between the integrated integration service platform and the various servers in the data acquisition layer are realized.

Fifth, data collection. In the past, the collection of safety monitoring information of mine roadway has some drawbacks due to its technical defects. The collection of information is single, and the collection method is relatively backward. In the past, the mine data collection is manually input, and the collection time and periodic collection cycle are long. Data acquisition relies on the in-

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stallation of all kinds of sensors and video monitoring in the mine, such as hazardous gas sensors, sensor network through a number of sensors to obtain a variety of real-time data to provide safe production and personnel positioning system; The data monitored by the camera is provided to the video surveillance system. In general, data acquisition is the use of distributed storage on the Internet, through the mine network to achieve the call of data and integrated integration service platform.

5.2. Realization of mine roadway safety monitoring system based on integrated integration technology

The system is based on a B/S structure, as shown in figure 2. As can be seen from the figure, the system is divided into two parts: the server side and the client side. Server side is mainly for all kinds of sensors, processing and storing the data information from the camera under the mine, the client side receives the data information pushed from the server side, then client side and server side establish the data information connection though the application layer, then use HTML 5 and WebGIS technology, and is responsible for presenting the data information that processed by the server side to related staff of mine.
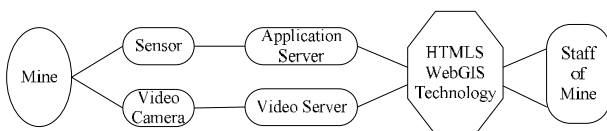

Figure 2. B/S structure of mine roadway safety monitoring system

On the implementation of foundation, through the underground mines, especially to improve the communication infrastructure, construction including mining network, network line, dedicated servers and other data communication equipment, regulate the interface of the standards, and the open API, development tools and resources to access the portal, provide basic support for mine safety monitoring system.

On the implementation of B /S three-tier mode:

First is the implementation of the client side. The distributed integrated integration well safety monitoring client based on B/S structure mainly presents real-time data to related personnel of mine, and at the same time raises real-time data query function, such as harmful gas, temperature and video monitoring. Through the human-computer interaction, monitoring and analysis, decision-making and voting summary and other functional interfaces, the access, service requests, having data interaction through the server and integrated integration service platform.

Second, the realization of integrated service platform. The server of the integrated integration services platform that provides access to the basic resource system for var-

ious service requests on the integrated integration services platform. Through distributed computing, data exchange technology, various models, human interaction, etc., an integrated integration service platform with data service, model service and video service is constructed based on B /S structure.

Third is the implementation of the server. Servers mainly include application servers and video services. Video monitoring function uses audio and video player to view monitoring images, add server address and path to achieve the network form of video, audio player, network form of video, audio player needs to consider its server address and application and to achieve the local loading of the player. The application server realizes the system layer by layer based on HTML5 and WebGIS technology, the server monitors real-time data, and the acquired underlying data is directly sent to the client through the processing layer.

5.3. Function analysis of mine roadway safety monitoring system based on integrated integration technology

5.3.1. Data input and output functions

Data is the basis of safety monitoring system of mine roadway, containing a large amount of information, such as spatial data (geological section data, underground roof data and spatial model data, etc.) and monitoring data (video monitoring, personnel positioning, main ventilation and drainage, etc.). The more integrated the data information collected by the system is, the more scientific the information management is, and the more scientific the mine safety monitoring system will be.

5.3.2. Basis and planning analysis of mine roadway safety monitoring system

Build distributed integrated platform based on B/S structure, using the integrated technology for mine safety monitoring system based on the analysis and planning, such as using the human-computer combination system, combing science and experience to evaluate the mine safety monitoring and forecast of mine safety monitoring, positioning the mine personnel, etc.

5.3.3. Decision support function

Mine safety monitoring system is also a safety management behavior; mine safety monitoring system has a good decision-making function. Through the mine roadway safety monitoring system, the mine production site analysis, the use of integrated integration technology, making optimized decision through the system decomposition, system analysis and resource integration.

5.3.4. Monitoring and feedback functions

The mine roadway safety monitoring system has monitoring implementation and feedback monitoring effect, so

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that the monitoring results can better serve the mine development.

5.4. Important work flow of mine roadway safety monitoring system based on integrated integration technology

Mine personnel first enter the interface login, on this page, the user input account and password, login button. If the authentication information is valid, enter the main interface of the system, otherwise an error will pop up. During the transmission control command, if the device does not respond for a period of time, the system automatically sends the command again. If there is no answer to the command sent again, the system will prompt the relevant staff to overhaul the equipment. As the server, the video server and the application server use the sensor and video to collect the data of the production personnel and related equipment. After the completion of data collection, mine personnel can view the real-time data, conduct real-time monitoring and analysis of the data, and view the relevant results. The workflow flowchart is shown in figure 3.
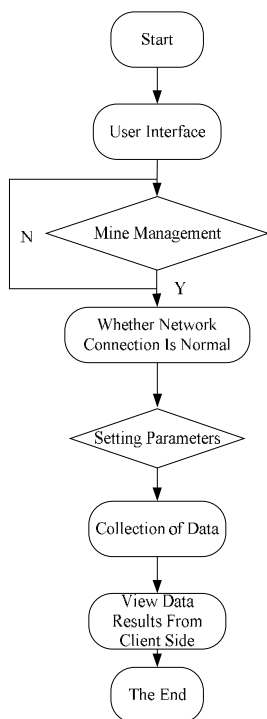

Figure 3. Important work flow of mine roadway safety monitoring system based on integrated integration technology

6. The Significance of Integrated Integration Technology to Safety Monitoring System of Mine Roadway

Integrated integration is to integrate the mine's existing information system, data system, model system and computer system to form a highly intelligent human-computer interaction system.

6.1. It is helpful to promote the innovation of mine roadway safety monitoring thinking

To develop safety monitoring in innovation, it is necessary to apply integrated integration technology, apply integrated integration technology to safety monitoring in mine roadway, and review the existing mine roadway safety monitoring, which is helpful to promote the innovation of mine roadway safety monitoring.

6.2. It is conducive to remote real-time on-site monitoring of production command center

The system can realize the interconnection of all personnel and equipment in the mine and carry out remote monitoring at the same time. Each mine can upload monitoring data to various servers in real time to provide online remote monitoring. All monitoring information can be displayed visually on the phone or on the web, and the production command center can be monitored remotely.

6.3. It is conducive to improving the efficiency of mining enterprises

The distributed integrated integration mine roadway safety monitoring based on B/S structure can realize the sharing of mine data information, so that the mine personnel can obtain the latest mine data information, if the mine safety production meets difficulties, it can provide the best solution for the mine personnel's production decision.

6.4. It is helpful to standardize the safety monitoring and management of mine roadway

At present, there are some problems in mine safety monitoring management, such as loose management, isolated safety monitoring information and impractical operation. The safety monitoring system of mine roadway is a complex system. The change of any one monitoring factor will cause the change of other factors and even the whole system. The emergence of integrated integration technology solves the "information asymmetry" in the safety monitoring of mine roadway to a great extent, establishes the whole process and dynamic management, maintains the scientific management of mine roadway safety monitoring, and ensures the scientific implementation of mine roadway safety monitoring.

6.5. It is helpful to innovate the safety monitoring system of mine roadway

Some mine personnel gradually integrated the research methods of management, sociology, intelligent machine and other disciplines into the mine safety monitoring process. Some recent technology that has been used: such

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as 3S technology, virtual reality technology, etc., this is not only beneficial to improve the technology of mine safety monitoring, but also is helpful for greatly improve the efficiency of mining, reduce man-made subjective elements, the integrated integration technology that combined human and computer has innovated the mine roadway safety monitoring system.

7. Conclusion

Integrated integration technology is one of the three technologies in the 20th century. Integrated integration technology in mine roadway safety monitoring system building, which fully learns from Qian Xuesen proposed the "integrated method" and distributed integrated platform based on B/S structure, using HTML 5 and WebGIS technology to realize real-time monitoring of mine, putting forward the design framework and realization method for integrated technology of mine safety monitoring system, combing all kinds of information data, all kinds of server and mining relevant personnel, so as to greatly promote the innovation of safety monitoring thought and method for mine roadway, greatly improving the level of mine roadway safety monitoring, It promotes the human-computer combination of safety monitoring in mine roadway and improves the efficiency of mine enterprises in China. Through the research on the construction of safety monitoring system of mine roadway by integrated integration technology, an intelligent safety monitoring system of mine roadway is constructed, which will promote the application of integrated integration technology in safety monitoring of mine roadway.

8. Acknowledgment

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