

# Design of Online Mine Safety Detection System Based on Internet of Things

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**Abstract**—Safety production is a major problem faced by mining enterprises. In view of the requirements of mine safety production and the development of information technology, the application of Internet of Things technology to the mining process can not only improve the safety management technology of mine enterprises, The steady growth of the national economy and the sustainable and healthy development of mining have a profound impact. The on-line monitoring system of mining safety based on Internet of Things technology can help mine personnel, equipment and environment comprehensive management, enrich the mine safety production management means, and improve the ability of mine to resist various risks and disasters. In this paper, combined with the actual situation of the mine, focusing on the Internet of Things technology-based mine safety inspection and protection system construction of the necessity, and based on the three-tier architecture of the open architecture of the network, based on mine safety on-line detection support system Of the application model structure. For the construction of mine networking provides the experience and technology.

**Index Terms**—mine safety; on-line monitoring; Internet of Things technology

## I. INTRODUCTION

Mine production safety issues affect the development of mining enterprises, each mining enterprises in their development process must face and solve the problem of production safety. Relying on the power of science and technology to help solve the mine production and security issues have been recognized in the industry, nowadays, based on digital, information technology, integration and automation control technology to realize the downhole part of the operating process and environmental conditions in real-time monitoring [1]. So that mining enterprises in the safety management level can be greatly improved. The concept of the Internet of Things, breaking the traditional thinking before, for mine personnel, equipment, environment, intelligent perception provides a new road, for the establishment of mine safety production system provides new methods, new ideas.

As an important application field of Internet of Things technology, the mine safety monitoring system of the Internet of Things refers to the interconnection between the real mine production security system and the security-related items that need to be networked through the information technology and equipment according to the agreed agreement. , And carries on the information exchange and the correspondence, realizes to the real mine human, the equipment, the environment visualization, the

digitization and the intellectualization recognition, the localization, the monitoring, the monitoring and the management[2]. Based on the Internet of things mine safety monitoring system, that is, the overall mine production security system and security system information digital, close integration of Internet of things technology and mine security system in the physical mine to build a need for all the interconnection Of people or things closely linked to the network, real-time display and monitor the operation of the mine security system, and effectively protect the safety of mining production. The system architecture consists of three levels of network structure: integrated application network, service platform network, sensor network. As shown in Figure 1.

### A. Sensor Identification Layer

The main task of the sensor identification layer is through the various sensors on mine production support system, safety and security system related personnel, equipment and environmental data collection, is the Internet of things mine safety and security online detection and protection system construction foundation and key, for the top Of the application services to provide a strong foundation of data sources.

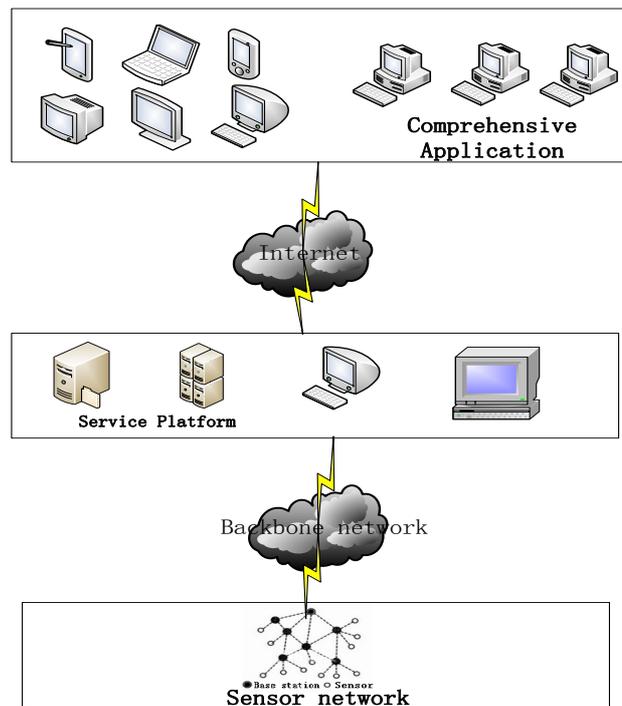


Figure 1. Internet of things mine safety online detection system architecture

### B. Network Transport Layer

The task of the network transport layer is to transfer the data information acquired by the sensor identification layer to the application service layer. At the same time, the control commands issued by the application service layer are transmitted to the sensor identification layer network to realize the corresponding control and management functions.

### C. Application Service Layer

The tasks of the application service layer include the unified storage, intelligent processing, depth analysis, and directional mining of the sensor identification data from the bottom layer, mainly accomplishing the production management and security monitoring, and a higher level integrated application.

## II. THE DESIGN OF THE SAFETY MONITORING SYSTEM

Based on the system structure of mine safety on-line detection system based on Internet of Things and the function of comprehensive perception, reliable transmission and intelligent processing, the mine-aware system is composed of unified network transmission platform, unified application service platform and perfect application subsystem[3].

### A. A Unified Network Transmission Platform

The unified network transmission platform is the basic guarantee for the reliable transmission of the whole information of the mine safety on-line detection system, and it is an effective way to solve the single transmission of the subsystem information of the mine in the past and to isolate the data. The unified network transmission platform includes the underlying sensor network and backbone transmission network.

### B. The Application of Functional Subsystems

Mine-based on-line mine safety detection system is a unified complex giant system, which consists of a number of functions of the subsystems are relatively independent. It can be summarized as follows: Mine Lifting Monitoring and Control System, Underground Transport Automatic Monitoring and Dispatching System, Mine Ventilation Monitoring and Monitoring System, Mine Pressure Monitoring and Monitoring System, underground water supply monitoring and control system, underground drainage monitoring system, underground power supply monitoring and control system, mine filling Monitoring and monitoring system, downhole personnel positioning management system, mine environmental monitoring and control system, dispatching command communication and communication system.

### C. A Unified Application Service Platform

In order to realize the graphical display of each system and intelligent processing of information data, a unified application service platform should be established. Application service platform construction should meet two main functions: First, the use of graphical interface to the true rendering of all aspects of the mining process and its environmental characteristics; Second, it can effectively mine the production and safety monitoring subsystem And finally realize the unified storage, data mining, compre-

hensive analysis and intelligent processing of mine system's perceptual data.

Mine online safety detection system of things through the three-tier network structure to achieve a comprehensive mine security system perception, reliable transmission and intelligent processing. The first level network is the bottom of the wireless sensor network, the main integrated wireless base stations, controllers, wireless sensors and other components; the second level network is the backbone network, mainly by the ground core switches and underground industrial explosion-proof switches and fiber optic cable composition; The three-level network is the ethernet network of the sensing center, which mainly consists of computer host, data server, Web server and so on. As shown in Figure 2.

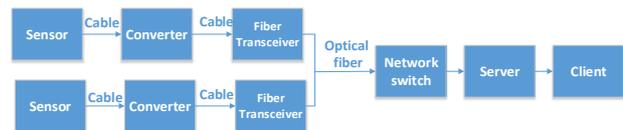


Figure 2. the overall structure of the framework

## III. THE SYSTEM DEVELOPMENT ENVIRONMENT

The system uses the hierarchical B / S structure design, the so-called B / S mode, namely the browser / server mode, is a new network structure pattern developed from the traditional C / S mode. B / S mode, the biggest feature is: the service application deployed on the server and store data, users do not need to install any user application, the browser software installed on the client, simply use the browser from the Web server to download the program[4]. To the local implementation, the Web server will be issued by the user database related to the instructions submitted to the database server to complete the implementation and return the results to the Web server, and then return it to the user. The server has a file server and a processing server. Users can access the server through the login browser, get the file transfer, browse information and send and receive e-mail and other appropriate services.

Database design is the core of the whole system, to meet the user's application requirements, and convert it to the available data structure, in order to achieve data storage and analysis and management. This is the data core component of the online monitoring software system, and the effective database structure design can efficiently complete various management functions such as system data storage, analysis and query. The main content of the design of the logical structure of the database is to transform the conceptual model of the design into a database model supported by DBMS. The core logical structures in the online monitoring system are: Equipment's table, seepageconfig table, GPS device configuration table, GPS device data table, Alarm data table, GPS data table, (Alarm information table). The design diagram is shown in Figure 3.

The whole system is designed with 2 databases, the original database and the observation database. The original database mainly stores the data collected directly by the automation system. It only records the reading of the instrument. The original stock is on the IPC without any modification, but allows the user When viewing or restoring the original data; observation database original monitoring values all from the original library, and save the calculation of intermediate results and final results for the

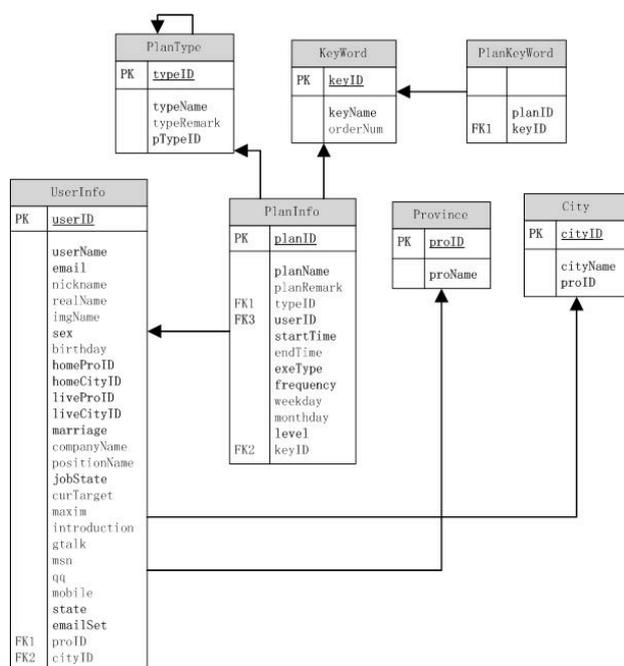


Figure 3. database structure design

query, online analysis and other operations, the library allows to delete add and modify, the library can be Stored in the industrial computer, data analysis machine or database server, data integration and data analysis using the library. The library includes automated data and all other data required for system operation and maintenance.

Data acquisition module, only for the original database operation, and the preparation of a data transmission program automatically performs the exchange, the original database data read into the corresponding observation database table, including remote transmission and automatic reading of the original observation data. Therefore, in the architecture design, monitor the object as the main line, according to different monitoring items to organize monitoring equipment. The architecture of the whole database is as follows: project-monitoring object-monitoring project-monitoring database.

#### IV. CONCLUSIONS

Mine safety has always been a top priority in mine safety production. Its operation is directly related to the economic benefits of mines and the lives and property of local people. Mine in the event of dam break, the sur-

rounding ecological environment will cause unpredictable catastrophic consequences. In recent years, China has occurred more than mine production safety incidents, the operation is not optimistic, the security situation is worrying. The main reason is because the mining of mining and operating conditions can not be grasped in time. Through the Internet of Things mine safety online detection system can effectively solve such problems. In this paper, through the design of the entire detection system for the application of Internet technology to improve mine information technology and improve the safety of mine production management has become the industry consensus.

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