Comprehensive colliery safety monitoring system design based on wireless sensor network

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ABSTRACT

This paper briefly summarized the logical structure of the model's attribute characteristics in the wireless sensor network management system of coal enterprise. Due to all kinds of mapping relations between different datum, while extracting some device status information, we can detect it by the method of hierarchical search, and according to the determined geographical location, then obtain the attribute and graphic information, finally get all the relative information of the device, so that the information management system is fast and convenient to be used.

Keywords: Colliery, Sensor network, Comprehensive safety monitoring system

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INTRODUCTION

In the process of coal production, we must pay enough attention to the security problem. In order to effectively prevent coal accidents, the safety monitoring system must be used for the coal safety production. In the system has a large number of sensor network, which can be to detect the colliery information, and then analyze the detected data to obtain the abnormal situation in time so that we can formulate the corresponding countermeasures fleetly and maximize to prevent coal accidents. Coal integrated security monitoring system includes a network of gas sensors , wind speed sensor network , a pressure sensor and a temperature sensor networks and other networks , in the wireless sensor network information management system not only to the inherent properties of the production management with data, and the individual data hierarchical distribution relationship clear[1]. This paper introduces the design of coal monitoring system and coal fuzzy information fusion algorithm, and then the coal fall detection and coal integrated safety monitoring system are combined to be analyzed.

COAL TRANSDUCER NETWORK MONITORING SYSTEM DESIGN
In the coal management system, not only do digital management to the production properties inherent of coal, and also sort out the level distribution relationships between the various data clearly. So, the management system model includes both coal production attribute and spacial graphic information. Chinese scholars in different stand- sit - stand models of seats study found that although there are differences between these models, this can be judged based on the experimental results, compared with ways to fall, this difference is not very big. In the experiment of fall, undoubtedly, experimental subjects selected in a reasonable way is a very critical issue, and in the choice of subjects fully considering the impact deviation to its results is necessary.

Fall pattern can be a variety of categories, in actual life, we are all likely to encounter down slow and down fast phenomena. Through research and analysis related to that, forward fall occurred in the actual probability of falls is up to 60%, while the forward fall mode must be simulated by experiments. Compared with it, backward fall is

relatively common. In the lateral fall, it includes left and right direction of fall mode, and the difference between these two directions is not very large, due to the impact of laboratory equipment and geographic factors, so we only choose the right direction to carry out simulation experiments fall.
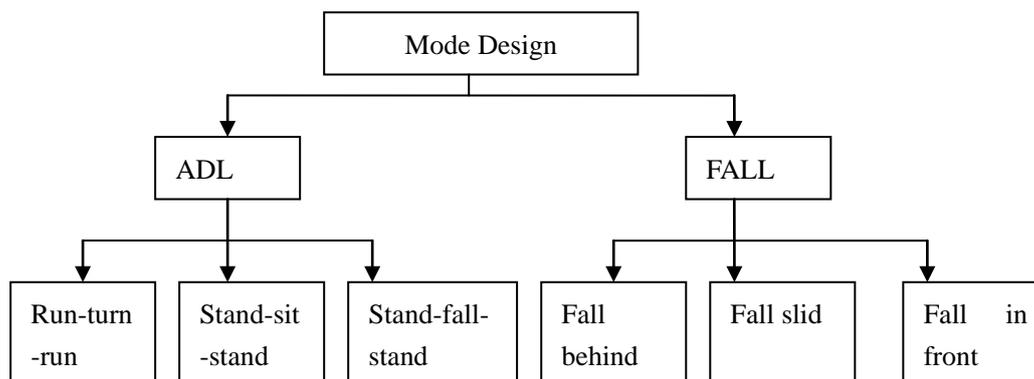
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                              ┌──────────────┐
                              │ Mode Design  │
                              └──────┬───────┘
                      ┌──────────────┴──────────────┐
                 ┌────┴────┐                    ┌────┴────┐
                 │  ADL    │                    │  FALL   │
                 └────┬────┘                    └────┬────┘
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    │Run-turn│  │Stand-sit│ │Stand-fall│ │Fall  │ │Fall   │ │Fall  in│
    │-run    │  │-stand  │  │-stand    │ │behind│ │slid   │ │front   │
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Fig 1 Experimental activity patterns fall

In the experiment, we first use the straps to fix transducers networks on the object in simulation experiments, and then conduct the ADL experiments on the spare parts of the sponge pad. The Order to carry out the experiment: calibration, three times simulation of "stand - sit - stand ", re-calibration, three times simulation of "go - turn - go", the third calibration, three times simulation of " stand - lying - Stand ". After completion of ADL actions, we will lash experimental subjects on the sponge pad and at the same time prepare a high-speed video camera , a calibrated beforehand , followed by a fixed order to the right , forward and backward experimental simulation falls for three times respectively, and then using high-speed cameras for each fall collection action execution [1] .

FUZZY INFORMATION FUSION ALGORITHM APPLICATION IN SENSOR NETWORK MONITORING SYSTEM DESIGN

All coal comprehensive safety monitoring information fusion in sensor networks local decision results, belongs to the category of the decision level fusion, and so, in order to make judgment for each sensor network attributes, carrying on the transformation processing firstly is essential, and then conduct order convergence for properties of each sensor network verdict. In the coal fall of the sensor network structure, the specific test results are the main basis of feature extraction operation for sensor networks, and then sending them to the fusion center; Fusion center based on the judgment of all sensor network to make the final global judgment[2].

Wireless sensor network information fusion system, sensor network established collection is the factor set, ranking fusion system decision results is needed, get the decision set, fusion rules requirements, popularize binary hypothesis testing problem fusion rules, so that local sensor network can carry out multi-level or soft judgment. Hierarchical data can have properties, and put all the collected classification layered graph according to their characteristics, demand, final results, and is also the key point of attribute and graphics. Geometry data is a basic data to describe feature shape size, space location and its topological relation. Complicate enterprise internal environment, the attributive character information is describes the relationship between various factors of enterprise characteristics. However, graphical information and attribute information have extremely close relationship. Entity objects and layer information has a one-way attribute data.

At the present stage, with the development of information technology and mature, more and more information management systems are able to aim at complex geographic information resources to implement comprehensive consideration. Generally speaking, process of monitoring and management of sensor networks is the process of implementing the design. The application of monitoring information system in enterprises generally consists of five stages, namely the system investigation stage, concept extraction stage, establishing model stage, numerical calculation stage and results of inspection stage. Of course, the gas concentration, the pressure and temperature use more detection parameters, the system is implemented through collection of synthetic operation of fusion center operator. And then put the collection data into fuzzy set, getting the fusion results finally.

THE COAL SAFETY SYSTEM DESIGN BASED ON WIRELESS SENSOR NETWORK

In order to achieve a predetermined requirements of the network bandwidth, in the design of security information system uses the design solution of stratified data exchanging and forwarding, and the local LAN multicast, which is that in each network layer sets forward data exchanged service port, and in the field of coal, urban counties

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establishes monitoring and management centers, improving data exchange decoders of all departments, television wall and other facilities. Specific data exchange network monitoring system design shown in Figure 2. As coal is usually long construction period and more remote, the bandwidth is not sufficient, the network design can be well applied to a wide area network data exchange, with taking the provincial network platform data exchange model into account, is undoubtedly the best choice for current 2 Mb bandwidth, otherwise it is easy to cause instability and even cannot be used to monitor network[3]. With some nodes of the network design known coal network, after authorization by superiors to exchange streams of data connection and log in management service port, you can easily view the work of production data exchange server monitoring mine, which does not increase the bandwidth of the front-end load and can image information to a plurality of users to share.

Through four monitoring stations or polling D1 single screen, the screen is divided and uploaded to the management services port of exchange data flow, and then the management services port of exchange data flow exchanges interface signals for storage and release. However it is likely to cause customers wanton operation, eventually resulting in the collapse of the threat of back-end database at any time. So, we should take some techniques applied to the system as a comprehensive security, such as encryption systems, firewalls, real authentication, authorization control technology, etc. After receiving the data exchange information, the monitoring center in the first time issues to a remote server data exchanger PTZ control signals, and ultimately transfers to the camera pan and tilt control line and directly uploads to the system client[4].

DESIGN OF SOFTWARE FOR THE DATA MONITORING NODE
The development environment for the system software is IAR Embedded Workbench for MSP430, and the programming language is C [10]. The system software can be divided into two modules: the main processor program, which is responsible for processing the water environment parameters collected by the sensors, and the ZigBee wireless communication program, which is designed for receiving and sending the water environment parameters. The integration of the two modules enables the nodes to sense, collect, process and transfer the water parameters. The power module is illustrated in Figure 2.
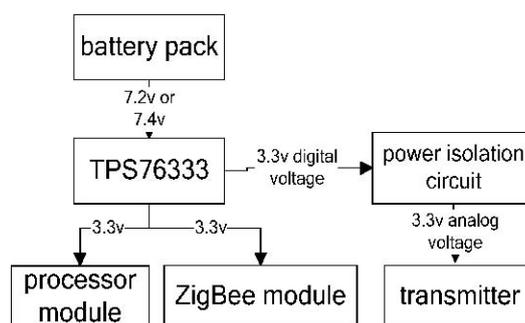

Fig 2.Power module.

OTHER CIRCUIT FUNCTIONS
The other circuit design, the system is in order to better complete risk control monitoring, also need other plus circuit hardware design, the main implementation life events reported; PLCU real-time statistics and analysis; Operation risk dynamic warning; Life events file management, etc

LIFE EVENTS REPORTED
Risk control is the project and the normal development of the various events for real-time monitoring, to prevent any risk of the mechanism. If it can detect the normal event in our life and remind, It can reduce the occurrence of risk probability accordingly. In order to achieve the life events reported in the design of peripheral circuit function, is adopted in the system, LED display circuit and the numerical and characters music remind modules, LED digital display can display the time of life event, Chinese character display shows the specific content of life events, and the music is real-time remind reminding function. In order to reduce the occurrence of risk, it needs to be updated every day of life events, their content input into the single chip center control unit, achieve the function of life events regularly reported. Circuit diagram as shown in fig.3
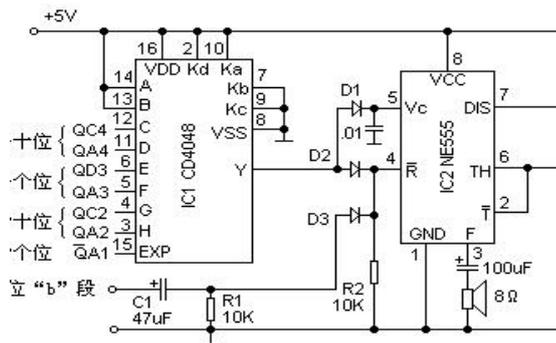
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Fig 3 .life remind circuit diagram

PLCU REAL-TIME STATISTICS AND ANALYSIS

Real-time PLCU statistics and analysis, through PLCU unit connected to the center control unit, makes it the rest of the world gathered the information and input information of normal corresponding comparison and analysis, realize the real-time detection of the risk, when the risk surpass than the default one of the biggest standard dynamic warning module which is about to start, until the risk is to reduce or get rid of, just close the dynamic display warning, but need to keep the real-time information in the process of statistics and analysis.

DYNAMIC WARNING OPERATION RISK

In the operation process, some risk factors will enter the normal work all the time, these factors have strong uncertainty and randomness, and the dynamic operation risk warning is when these uncertainties are added to the normal system operation when reminding function, better use the interrupt program, reduce the application steps, and save the storage space. In circuit design application buzzer alarm, when the risk information value reaches preset began to appear LED lights flashing and buzzer buzzer, until the user buzzer will risk rule out and need to manually preset. The circuit principle diagram as shown in the fig.4
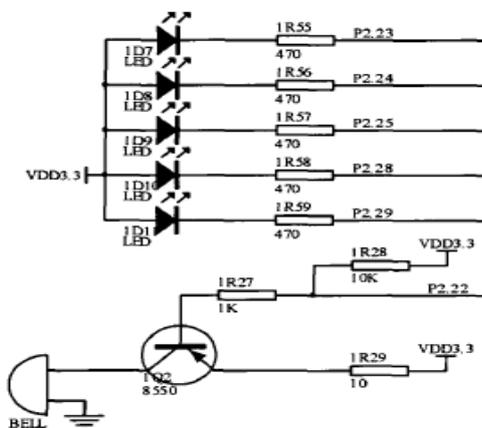

Fig 4 Buzzer alarm circuit diagram

LIFE EVENTS FILE MANAGEMENT

Everyone to complete the practice every day is different, this will require a file management separation of life events, and in the system control center in the allocation of reasonable storage unit and space, and realize its classification processing, more logical consecution and time. Handled separately, at the same time, make the music remind function of more targeted. The process of life events presets, and then controls the display on the LCD screen, the LCD display is chosen on STC, achieved 320 * 240 pixels. Its circuit connection diagram as shown in 4 to 3
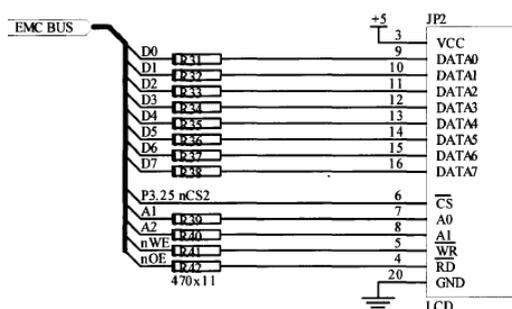
Fig 5. LCD display port circuit connection diagram

CONCLUSION

To sum up, the principle of computer network information technology based on the sensor network to the information management of coal enterprises not only can greatly reduce the difficulty of enterprise management, but also control the enterprise cost, and obtain the optimization of enterprise management solutions. This system can realize the control of risk management, and reduce to minimum the most reasonable, can obtain the minimum cost into the biggest benefit, realize real-time understanding of the changes of risk status and change, and adjust risk control scheme in processing. This system has the transmission distance which is adjustable, no transmission medium, strong sensitivity, reliable performance, flexible structure, easy to layout etc, makes the risk control system of the real time and applied, is more advantageous to reduce risk value to make it more towards zero.

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