

## Design of Mine Environmental Monitoring System

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**Abstract.** A mine environmental monitoring system which is composed of hardware and user software is designed. Monitor the complex coal mine environmental factors, upload monitoring data and control the designed environmental equipments are the functions of hardware. The user software is developed by Java language, it stores the uploaded data in a database, draws curves and it also can make a prediction. Through analyzing and processing uploaded data, user software makes decision and sent control commands to hardware. For the purpose of make the environmental parameter adjustment possible, harmful gas filter and oxygen regeneration device are designed. An improved multi-sensor information fusion algorithm is used to improve the stability and accuracy of this system. At last, an experiment is carried and the results indicate this system achieve desired objective.

**Keywords:** Monitoring system, Multi-sensor information fusion, Gas filter, User software

### 1 Introduction

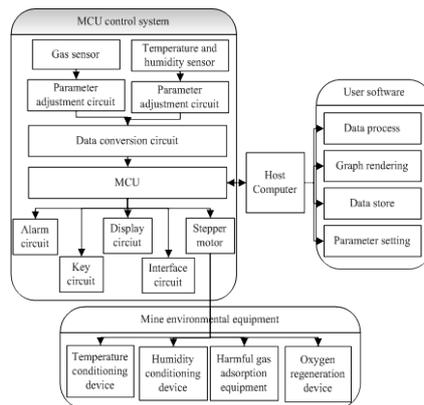
Mine environmental monitoring system is not only important in the development of coal industry research, but also has an important significance to improve the safety of coal mining. The so-called coal mine environmental monitoring system generally consists of 5 parts: sensors, data acquisition, controller, transmission line and ground control center.

However, the traditional monitoring system has the following problems: complex route, difficult to add subsequent modules, unable to change network structure, high manufacturing costs, and high maintenance costs. Some of the shortcomings impede the continued development of the product, limit the scope of application and make the system difficult to operate. Another major problem is the operation of user software cannot be divorced from specific machine, which lead to a limited transplant.

Aiming at the above problems, this paper insisted on opening principles to design a cost-effective, sustainable development and high degree of automation system which can accurately monitor the environment.

## 2 Design of MCU Control System

Mine environmental monitoring system based on MCU can monitor the environmental factors in certain confined environment. Electronic equipment and related software are the components of this system. The overall design of this system is shown in Fig. 1.



**Fig. 1.** The overall design of this system.

The main peripheral of the control system is the measurement module of temperature and humidity, gas concentration sensor module, display module, alarm module, clock module, key module, motor module, serial communication module.

## 3 Design of Harmful Gas Adsorption Equipment

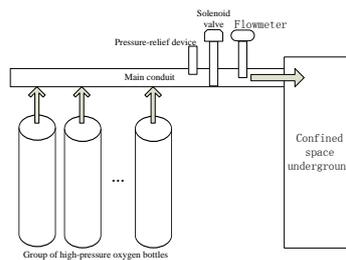
This device is made up of pharmacy bed, fans and heating device. Pharmacy bed is installed in the middle of the device, driven by a special motor, so it can rotate at a fixed rate. On one side of the wheel is installed a suction blower and a drawout blower. On the other side is a heater which can heat the regeneration section of pharmacy.

The core of the harmful gas filter device is a constantly rotating wheel. Pharmacy bed on the wheel is divided into two parts: regeneration zone and non-regeneration zone. By calculating, some parameters like min wind speed of this system, bearing radius and the radius of rotor core can be calculated.

## 4 Design of Oxygen Regeneration Device

Usual supply of oxygen and their advantages or disadvantages are as follows: Outside oxygen supply is simple but not reliable; The product of chemical reaction process

oxygen and electrolytic process oxygen is not easy to storage, in addition, the process of the reaction is not easy to control; High pressure oxygen bottle supply oxygen is relatively safe and reliable, this method is easy to monitor the oxygen concentration and the remaining amount of oxygen. Therefore, this design uses high pressure oxygen bottles supply oxygen. The structure of oxygen regeneration device is shown in Fig. 2. The capacity of high pressure oxygen bottle and the number of bottles can be calculated by formulas.



**Fig. 2.** Structure of oxygen regeneration device.

## 5 Host Computer User Software Design and Implementation

This user software developed by Java language and it is supported by SQL Server 2000 database. The uploaded data like temperature, humidity and gas concentration values are stored in the database. To observe the relevant data and draw curve, user can click the select button to choose a different observation point. Add or delete items button is used to add or remove the item in existing observation items. Add or delete observation point button is used when increase or decrease observation point. For observe the abnormal value and time in recent time, set display abnormal button. In order to achieve the goal of automatic alarm, user can set the abnormal range of parameter values by set limit button. For the purpose of improve the stability and accuracy, an improved multi-sensor information fusion algorithm is used to process the uploaded data.

## 6 Testing of the System

An experiment in lab environment is carried out to test the above designed system. After assemble and connect above system, we place the hardware in a confined space. We use 5 DS18B20 sensors as temperature sensor kit, 5 DHT11 sensors as humidity sensor kit and 5 TGS816 sensors as gas sensor kit. The space between each sensor is not less than 10 cm. We also use 3 stepper motors to execute commands. Some of the results are shown in Figure 8.

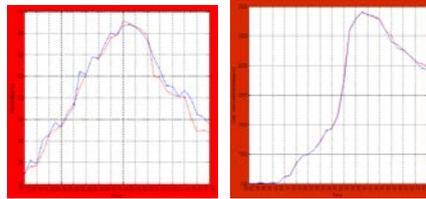


Fig. 4. Humidity curve and the speed of stepper motor.

## 7 Conclusions

The hardware and software of a mine environmental monitoring system is designed. The hardware system is composed of MCU control system, host computer software and mine environmental equipment. AT89S52 microprocessor is selected to build the MCU control system. The user software is developed by JAVA language, this makes the system has better portability. Besides realizes data storage, display, graphics rendering and monitors abnormal data, this software can forecast the dangerous information according to the abnormal data. Harmful gas adsorption equipment and oxygen regeneration device is designed. For the purpose of improve the reliability of this system, an improved algorithm is proposed. At last, a joint system testing is carried out, it shows this system can stable operation and achieve desired objectives.

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