GIS-based mine flood preventing and controlling assistance decision system

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Abstract. The author has proposed the overall structure of mine flood preventing and controlling assistance decision system by analyzing the present situation of mine flood research survey, established the mine flood assistance decision platform. We have realized the mine flood preventing and controlling informatization and intelligent by using re-development on software.

1. Introduction
In China, coal mine flood disaster has always been a serious problem affecting coal mine safety production and scientific research, but the processing of coal mine flood disaster information is in a scattered and imperfect state, which makes it impossible to scientifically analyze and utilize all kinds of hydrogeological information for reasonable prevention and control work. Geographic Information System (GIS) is a specific and very important spatial Information System. It is a technical System supported by computer hardware and software System to collect, store, manage, calculate, analyze, display and describe the relevant data in the whole or part of the earth surface space. With the help of gis technology, the scientific management and full utilization of coal mine data can be realized, and the service can be provided for the forecast and prediction of coal mine flood disaster, so as to guarantee the safe production of coal mine.

2. System framework design
By visiting coal mine units and conducting field research, we obtained the functional requirements of coal mine users for the flood disaster prevention and control system, and then determined the overall framework of the auxiliary decision-making system for coal mine flood disaster prevention and control. The overall framework design is shown in Figure 1.
3. Realization of system functions

The software of SuperMap GIS is developed by using the component development technology and the object-oriented high level programming language C#, and the program of coal mine water control system is compiled to realize the system function.

3.1. Hydrogeological data management subsystem

The management of drawings mainly includes drawing, modifying, printing and output of borehole column drawing, coal seam reserve drawing, seam floor contour drawing of mining area, exploration and release water drawing and other drawings. Data management mainly realizes the query, modification, addition and deletion of the data in the database. The import and export function is mainly to realize the conversion between different formats of data to achieve data sharing.

3.2. Water inrush prediction subsystem

3.2.1. Baseplate water prediction module.

Bottom water to predict the water inrush coefficient method, the water inrush coefficient method (Tr) is the basic principle of predictive model by the water pressure (P), water-resisting layer thickness (M), the thickness of the floor damage zone (Cp), according to the calculation of formula one or two, the hydrological observation hole space interpolation coefficient of water inrush for obtaining the water inrush coefficient value in the study area, and carried out in accordance with the level of regional space, so as to achieve water inrush prediction [1-2].

\[
\text{formula one: } Tr = \frac{P}{M - Cp} \quad \text{formula two: } \quad Tr = \frac{P}{\sum b_i * m_i - Cp}
\]

Where, bi is the lithology conversion coefficient of the i water-proof layer; mi is the thickness of the i waterproof layer.
3.2.2. Roof water prediction module.
The probability index method is adopted to predict roof water bursting, which quantifies the factors affecting roof water inrush, gives corresponding weights according to the importance of each factor, and finally obtains the index of water inrush probability index through the weighted sum [3].

![Water bursting probability index E](image)

The mathematical model established by weight summation:

$$E = W \times P_w + S \times P_s + R \times P_r + P \times P_p + G \times P_g$$

$P_w, P_s, P_r, P_p$ and $P_g$ are the weights of probability exponent W, S, R, P and G respectively. For example, the four levels of strong, strong, weak, and weak can be set as 1.0, 0.7, 0.5 and 0.3 respectively. Among them, weight, level division and level value are determined through discussion with experts and engineers.

3.3. Assistant decision subsystem.
The auxiliary decision-making subsystem is to use GIS technology and computer technology to realize the prevention and control of coal mine flood disasters, to provide a computer artificial intelligence environment for working technicians to solve the problem of coal mine flood disasters, and also to provide plans for leaders to make decisions and improve the level of scientific decision-making.

3.3.1. Exploration and discharge module. The calculation of the volume of water, the hole diameter of the drainage hole, the advance distance of the water exploration and the band distance are all completed by the computer. The user only needs to input the relevant data according to the prompts on the interface of this module. In addition, this module also stores the water exploration operation and water exploration method in the form of text and schematic diagram in the software for users to refer to when they are in use.

3.3.2. Grouting module. This paper mainly realizes the grouting water stoppage, curtain grouting and grouting reconstruction, and gives detailed operation methods for its application conditions, construction methods, construction technology and effect inspection.

3.3.3. Retaining module for waterproof coal and rock columns. According to various conditions of retaining and fortification water-proof coal (rock) columns stipulated in the Mine Hydrogeological Regulations, relevant calculations of retaining and installation of water-proof coal and rock columns [4-6] are completed.
3.3.4. *Water inflow prediction module.* Hydrogeological analogy method, Q-S curve method and regression method were used to calculate the amount of water flowing into the mine in a unit time.

3.3.5. *Drainage module.* Drainage refers to drainage and pressure reduction. The calculation of drainage and pressure reduction in coal mines mainly consists of roadway drainage and borehole drainage, and its structural design is shown in figure 3 [7-9].

4. **Conclusion**

After the system was developed, it was applied on site in Ping Coal Industry Group. The results showed that the software interface was friendly, the operation was simple and easy to grasp, the prediction accuracy of mine flood disaster was high, and the drainage scheme was feasible, which played a positive role in the prevention and control of mine flood disaster.

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