Development and Application of Coal Mine Geological Drawing System Based on GIS Technology

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Abstract. Resource exploitation and competition have always been one of the most important topics in the world. Because the possession and exploitation of resources is directly related to the supply of social environment, we need to use various technologies to detect the resources owned by various environments in the country to make a reasonable allocation. In our country, the most commonly used technology should be GIS technology. Similarly, with the development of the past and times, the reserves of coal have begun to decrease, and the utilization of new energy has not been fully popularized, so the purpose of this paper is based on GIS technology to study the manufacture of geological drawing systems in coal mines, and to develop and apply them. After exploring the discovered coal, mine topographic map and the structure of the coal mine and its possible location, we can carry out systematic development and application through GIS by consulting the relevant literature of the geological map of the former coal mine and the development of GIS technology. Finally, its effect is verified by conducting another field survey of the discovered places. The experimental results show that the coal mine geological drawing system based on GIS technology can be more beneficial to our discovery and survey, which is 20% higher than the previous detection efficiency and 40% higher than the drawing accuracy.

Keywords: GIS Technology, Coal Mine Resources, Geological Survey, Spatial Drawing

1. Introduction

Due to years of mining, the total amount of coal in China has been declining, and due to the nonrenewable nature and pollution of coal mines, China has been looking for new energy to replace coal in the national system [1]. However, due to the limitations of the times, the research and development of new energy is not so fast, and our demand for energy is far greater than the supply of new energy, so we can only use coal as our main heating energy [2]. And in winter, because the heating system in the North needs continuous heating for about six months, it needs to consume a lot of coal. This is a great consumption for coal mines, so in order to better exploit coal resources, we use GIS system to map coal mines, and then carry out reasonable mining and utilization [3].
Due to China's abundant coal resources, and in response to the strategic policy of "green water and green mountains are golden mountains and silver mountains", China is vigorously promoting the output of environmental protection resources [4]. So now it's time to transform coal from a traditional polluting industry into a digital modern cleaner energy. In the past, coal was mainly burned directly, such as honeycomb briquette and briquette. Now, coal is mainly made into gas and water gas by various physical methods such as degradation and compression, so as to reduce pollution and improve combustion efficiency [5]. But the situation of each coal mine is different. Coal combustion is part of the cause of environmental pollution, and the environmental pollution caused by coal mining may be more harmful [6]. Therefore, we should start from the source, look for less impurities, less radioactive coal mining, and try not to damage the original mountain landform and pollute the environment in the mining, mainly mining non densely populated and water sources. So, we use GIS technology to survey the coal mine terrain and find the most suitable place for mining [7].

Nowadays, as the main fossil fuel, coal is widely used in power generation, heating and other aspects; in most areas of China, coal is the most important civil fuel, especially in cold winter[8]. In the north, the water is boiled by burning coal, and the steam is transported to each household through heating pipes to ensure the heating demand in winter; in the south, each household mainly burns coal in the furnace, and people gather around the furnace to get a little heat; and coal is an important chemical raw material, known as the mother of chemical industry, which can be obtained through some physical processes. There are thousands of main chemical products such as asphalt; the used cinder can be made into cinder brick for fire resistance; some coal seams contain radioactive elements, which can be collected. Therefore, the rational development and utilization of coal resources is very important [9]. However, there are also some risk factors in coal, so we are constantly studying more effective and more rational use of coal resources. Among them, the production of coal mine geological mapping system for survey is also a good method [10].

2. Electronic label image matching algorithm

2.1. SIFT feature point generation

The Gaussic scale core can define the scale space of the image using the refringing operation of the original image and a variable-scale 2D Gauss function:

\[ L(x, y, \sigma) = G(x, y, k\sigma) \ast I(x, y) \]  \hspace{1cm} (1)

\[ G(x, y, k, \sigma) \] is the scale variable Gauss function, and \( I(x, y) \) is the original image; \( k \) is the amount of scale variation. In order to ensure the stability of detected feature points, different Gaussian differential cores and image recesses are generally used to generate Gauss differential space:

\[ D(x, y, \sigma) = G(x, y, k\sigma) - G(x, y, \sigma) \ast I(x, y) = L(x, y, k\sigma) - L(x, y, \sigma) \]  \hspace{1cm} (2)

For detected feature points, calculate the neighborhood gradient histogram and determine its primary direction. It is important to note that some feature points not only have the main direction, but also have a secondary direction, which is not always important for the stability of subsequent matches.

2.2. PCA fundamentals

PCA is a statistical analysis method that transforms multiple variables into a few new comprehensive variables through linear transformation. The goal of the PCA is to maintain as much of the original intrinsic information as possible after the de-dimensionality and to determine the importance of that direction by measuring the size of the data variance in the projection direction. The mathematical principle of PCA is as follows: set \( n \)-dimensional vector \( w \), which represents \( l \) mapping vector in low-dimensional mapping space, and the adverse formula is available after maximizing the data mapping

\[ \max_w \frac{1}{m-1} \sum_{i=1}^{m} (w^T(x_i - \bar{x})^2) \]  \hspace{1cm} (3)
M is the number of data involved in the dimensional reduction; xi is the specific vector expression of random data i; \( \overline{x} \) is the average vector of all the data involved in the de-dimensionality.

Definition W is a matrix consisting of column vectors of all feature mapping vectors, which can better preserve the information in the data, and the matrix can obtain an optimized target function through linear transformation

\[
\min_{w,\lambda} \text{tr}(W^TAW),
\]

\[
s, t, W^T W = 1
\]  

In the method: \( \text{tr} \) is the trace of the matrix; A is the co-variance matrix. The A expression is as follows:

\[
A = \frac{1}{m-1} \sum_{i=1}^{m} (x_i - \overline{x})(x_i - \overline{x})^T
\]  

The PCA is the output, which can be represented by \( Y^T W^T X \), and the optimal W is the characteristic vector corresponding to the maximum feature value of k in front of the data covariance matrix, which reduces the original dimension of X to k dimension.

3. Experiment

3.1. Selection of experimental sites

Because this experiment is more complex, it can not be well satisfied in the laboratory. So, we're going to the coal mine for field trips and surveys. We measured the terrain by surveying the field, then comparing it with previous coal mine field maps, analyzing and observing whether the terrain had changed over the years, and then selecting a smaller area where the terrain had changed, or a small portion of the coal mine that had not yet been mined, to measure the data. Then, when the experiment is complete, we present all the resulting data in the display, and then compare it for analysis.

3.2. Extraction of experimental data

Although the terrain of the places we selected changed less, natural factors such as crustal motion, or man-made factors, can lead to changes in coal mines. So, we culled several sets of data with obvious anomalies, and then linearly coupled the entire data to extract the best part of the entire data for image analysis.

4. Evaluation results

4.1. Results of the technical assessment

Table 1. Comparison of image processing rates of systems produced by various algorithms

| Algorithm                  | Image processing rate m/s | Image rendering rate m/s | Image label rate m/s | Fine-grained processing rate m/s |
|----------------------------|----------------------------|--------------------------|----------------------|----------------------------------|
| Satellite distribution algorithm | 2.1                        | 1.4                      | 1.0                  | 0.8                              |
| Branch label algorithm      | 2.6                        | 1.7                      | 1.3                  | 1.1                              |
| Electronic label image matching algorithm | 3.5                        | 2.7                      | 2.4                  | 2.1                              |

After analyzing the data of Table 1, we find that the first step of image analysis is image processing, followed by image rendering, image labeling, fine processing. Because only by roughly processing the image, then rendering it, then labeling it with data, and finally fine-tuning it, can we get a better image,
this part of the image is the image that finally appears in front of us. Therefore, only the image processing rate is fast, followed by the deep processing rate is fast. Because the image processing speed of the satellite distribution algorithm is only 2.1m/s, his fine processing speed is also low. Then the electronic label image matching algorithm, its processing speed of 3.5m/s, relative to the distraction distribution algorithm nearly doubled by 1.5 times, so he later all aspects of processing are relatively faster, and to be more accurate. Because the processing rate is fast, it can be checked to the point where the accuracy is higher. So, we think we'll eventually experiment with electronic tag image matching algorithms.

![Figure 1. The distribution trend of coal mines](image1)

![Figure 2. The distribution trend of the original coal mine](image2)

Because the image processing speed and aspects of the electronic label image matching algorithm are better than the other two algorithms, we use the electronic tag image matching algorithm and GIS technology to build a drawing system to compare and analyze with the original. In the image, green represents the surface of the coal mine, with reduced content, red represents the mining coal mine, and blue represents the area with higher radiation. By describing the images in Figure 1, Figure 2, we can get the following results: The current coal mine analysis map compared to the original coal mine analysis map will also be marked out of the danger zone. And a larger area to explore the location of coal mines, more reasonable coal mine can be mined part of the focus on the selection, compared with the original, more detailed.

4.2. GIS system

The GIS system is GIS. It is a kind of space information system, which is mainly developed under the development of computer technology. It mainly collects location and geographic information, such as latitude and longitude coordinates, the altitude of mountains, and so on, and analyzes and processes spatial information, then makes it into an image and analyzes it. Subjectively, IS technology being a more intuitive experience on a map-integrated display on the surface.

GIS, macro, should have been from ancient times. Because GIS is the study of geographic information. Long ago, people drew maps, carved stone statues, and so on to record the topography,
which can be considered part of GIS. But now, thanks to the development of computers, GIS is completely different, because there are many new technologies. GIS is now generally divided into five parts, namely, people, data, hardware, software, processes.

Personnel, mainly developers, maintenance personnel, operators. Because only developers develop good software, and maintenance personnel to maintain it in real time and timely processing, coupled with the operator's precise operation, can make the GIS system better operation. Data is one of the cores. Because only good data can be drawn into good charts and can be used for analysis. And if the data doesn't work, then the tables that are made don't work.

Hardware, mainly refers to the composition of computer systems and the hardware composition of each operating system. Only good hardware can be satisfied with fine processing, otherwise the image can not be fine. For example, a graphics workstation and a regular computer treat the same picture the same way. Graphics workstation through good hardware can produce high frame rate pictures, resolution can be on 4k, and ordinary can not, can only make a general picture resolution of only 1080p.

Software, GIS system is naturally the core. But GIS is useless, but also have the corresponding supporting database, drawing, statistics, watch making, imaging and other processing software to make a good image.

Process, the variety of processes is more. We need to find a relatively simple and convenient process from a variety of processes with low consumption of resources, high accuracy to map to ensure the rational use of resources and the results of relative excellence.

So, we finally helped each other build the GIS system through the various parts, and then analyzed the data we needed and charted it. And that's what we need.

5. Conclusion

In summary, after using a variety of algorithms to make reasonable use of geography and graphing, using GIS system to construct the topographic drawing of coal mines, we finally found that even if we can reasonably use the drawing system to carry out reasonable mining and excavation of coal mines, but there is always a time when coal resources are exhausted. So, we hope that the development of new energy sources, such as the use of water potential energy, wind energy, and of course, if we can use nuclear fusion to generate energy, then our energy problems can basically be solved. Because nuclear fusion is a completely clean source of energy, its source is thorium in water, the production in seawater is very rich, and nuclear fusion produces very large amounts of energy, a nuclear fusion nuclear power plant energy is comparable to ten nuclear fission nuclear power plants. So, we only hope that our current coal mine drawing system can help us to increase the rational use of coal resources, so that we have enough time to find new energy to replace coal resources. We hope that in the future, we will no longer need to use fossil fuels such as coal mines to supply energy, but clean and clean new energy sources.

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