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SUSTAINABLE HORIZONS: THE GAME-CHANGING ERA OF MINE REHABILITATION THROUGH REMOTE SENSING

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Abstract: As science and technology advance, the global community faces escalating challenges: burgeoning populations, resource overconsumption, environmental degradation, and ecological peril. Preserving the ecological balance has emerged as a paramount concern uniting nations worldwide [1]. Remote Sensing (RS) technology, a non-contact detection methodology for capturing data on targets or natural phenomena, assumes a pivotal role. Precise information garnered through ecological monitoring constitutes the linchpin in executing seamless ecological restoration initiatives. Guided by the ethos of ecological reparation, concerted efforts have been invested in rejuvenating the ecological landscape of abandoned mines, yielding commendable outcomes [2]. RS technology is characterized by its expansive data acquisition capabilities, swiftness, minimal constraints, diverse information acquisition methods, and copious data volumes [3]. In the realm of mining, persistent geological challenges, notably the management of solid waste, persist in China, exerting discernible impacts on the industry's sustained progress. Consequently, a thorough examination of RS technology and an enhanced integration thereof become imperatives [4]. In scrutinizing the ecological milieu of mines, RS technology exhibits remarkable prowess. It empowers technicians to swiftly amass diverse ecological data, enabling the construction of three-dimensional spatial models of abandoned mines. This, in turn, lays a robust foundation for tailoring precise strategies in mine ecological restoration endeavors [5].

Keywords: Remote Sensing Technology, Ecological Monitoring, Abandoned Mines, Ecological Restoration, Geological Environment Issues

1. Introduction

With the progress of science and technology and the great improvement of social productive forces, problems such as population explosion, excessive consumption of resources, environmental pollution and ecological destruction have become increasingly prominent, and the ecological environment has become a major issue of universal concern to all countries in the world [1]. RS technology is a detection technology for remote sensing of targets or natural phenomena without direct contact. Accurate information obtained through ecological monitoring is the basis and key to ensure the smooth progress of ecological restoration projects. In order to protect the natural ecological environment, under the guidance of the concept of ecological restoration, people began to renovate the ecological environment of abandoned mines, and have achieved good results [2]. RS technology has the characteristics of wide

range of information and data acquisition, fast speed and short period of information acquisition, few restricted conditions when obtaining information, many means of obtaining information and large amount of information [3]. As far as mine production is concerned, there are still geological environment problems such as solid waste in China, which have affected the stable development of mine production. Therefore, it is very necessary to analyze RS technology and further deepen its application [4]. In the process of investigating the mine ecological environment, RS technology has shown strong advantages, which can help technicians collect different ecological data in a very short time and build a three-dimensional spatial model of abandoned mines, laying a good foundation for the specific development of mine ecological restoration work [5].

Mine geological disasters are multiple and complex, so it is necessary to monitor the mine geological environment effectively. Investigation of mine ecological restoration is an effective means to measure the effectiveness of mine ecological restoration, and it is also an indispensable key link in mine ecological restoration [6]. The traditional ecological restoration investigation adopts the way of manual field investigation, and the staff investigates the local ecological restoration evaluation results on the spot. Traditional monitoring methods can't monitor the geological environment in real time. Applying surveying and mapping technology to mine geological environment monitoring can combine surveying and mapping technology with monitoring technology, thus improving the real-time and effectiveness of mine geological monitoring [7]. According to the characteristics of high spatial and temporal resolution and hyperspectral resolution of RS technology, it is advocated to use RS technology to monitor the quality of land ecological restoration, extract various ecological indicators and environmental indicators of land and environment in mining areas from RS images, and give a comprehensive evaluation of land restoration level [8]. This aricle studies the application of surveying and mapping technology in RS dynamic monitoring of mine geological environment, in order to improve the real-time monitoring of mine, so as to make accurate prediction and minimize the economic losses and casualties in mining areas.

2. Problems existing in mine production and application value of RS technology

Solid waste refers to the solid substances produced in the process of mine production. Usually, these substances have a complicated composition. For example, some solid substances have a very high proportion of metal elements, while others have more harmful radioactive substances. Although RS technology can have a great positive impact on land use dynamic monitoring to a certain extent, how to use it and which parts of it can achieve the best results have become the focus of attention. In mine production, these solids are generally piled up in a centralized way, which takes up a lot of space and has great influence on geological environment monitoring, mine production and surrounding environment. Common mine geological disasters include landslide, debris flow, mine pollution and collapse [9]. Landslide refers to the downward movement of soil or rock on the slope under the action of gravity of the earth. In the process of mining mines, people will pile up a lot of mud or rocks around them. These rocks and mud will form mudslides when they encounter heavy rain. The use of RS technology has really improved the dynamic monitoring of land use, both in speed and efficiency.

If the solid waste violates the relevant standards in the process of stacking and is not properly managed, it will easily slide under the influence of rain and vibration, which will have a serious impact on the surrounding environment. In the process of land use, every characteristic and future development mode must be considered [10]. There are many detailed information about land, and it will change greatly with the passage of time, the change of natural environment and human intervention. In some mines, underground storage is used in the process of excavation, which changes the distribution of groundwater, greatly affects the stability of surface structure, and then causes disasters such as collapse. Figure 1 shows the RS monitoring screen of the mine.

Figure 1: Mine RS monitoring screen

Using RS technology, the detailed information of land can be dynamically monitored and collected synchronously, which avoids the recurrence of bad problems in the past work. Debris flow in mines has strong impact and destructive power, which will cause heavy casualties and economic losses in mines. Collapse means that there will be many mined-out areas underground in the process of mining mines, and the roof strata of these mined-out areas will move down or bend under their own gravity and the pressure of the upper strata, which will lead to the collapse of the mined-out areas. The causes of cracks and surface disasters are similar, but the impact of such disasters is more serious. Some cracks will stretch for several kilometers, and once they appear, they will be irreversible. Usually, cracks will directly damage the infrastructure of the mine, and in serious cases, there will be large-scale collapse, which will make the mine production unable to continue.

3. Application of RS in mine ecological restoration

Every object on the earth is absorbing and reflecting energy all the time. This energy is composed of many forms, among which electromagnetic wave is the earliest energy recognized and utilized by human beings. The monitoring methods of RS technology for forest ecosystem restoration can be summarized into two types [11]: one is to compare the changes of land use area/type at different times after classifying RS data at different times; The other is to judge by calculating the correlation index that reflects the change of forest vegetation. RS dynamic monitoring of mine geological environment refers to the monitoring of mine geological environment through natural electromagnetic energy such

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as light, heat and wireless waves during the monitoring process. RS technology is based on the electromagnetic waves with different characteristics reflected by different objects. By detecting the electromagnetic waves reflected and emitted by objects, the real information of objects can be obtained, and the purpose of identifying objects at a distance can be achieved.

The application of RS technology to monitoring the geological environment of mines should not only be aimed at geological disasters, but also at pollution factors such as wastewater, waste gas and solid waste produced in the production process of mines. If all kinds of pollution factors are not effectively controlled and properly handled, it will seriously affect the mine environment and the surrounding environment, and even cause bad social impact [12]. It should be carried out in synchronization with mining activities. According to the technical characteristics and natural environment of mines in different mining periods, corresponding reclamation or ecological restoration schemes should be made in time to avoid or reduce the damage to the environment as much as possible and realize the integration of mining and ecological restoration. Solid waste is bound to appear in the process of mine production, and the most reasonable way must be used to treat these solid wastes, otherwise it will have a serious impact on the mine environment and the surrounding natural environment. People can establish a reliable remote command system through the information system, scientifically plan the remote control system, provide more accurate reference information and scheduling specifications for the commanders of the mine information system, and reduce the loss of structural functions of various equipment in the mine geological environment under the remote state. Figure 2 shows the structure of the mine monitoring system.

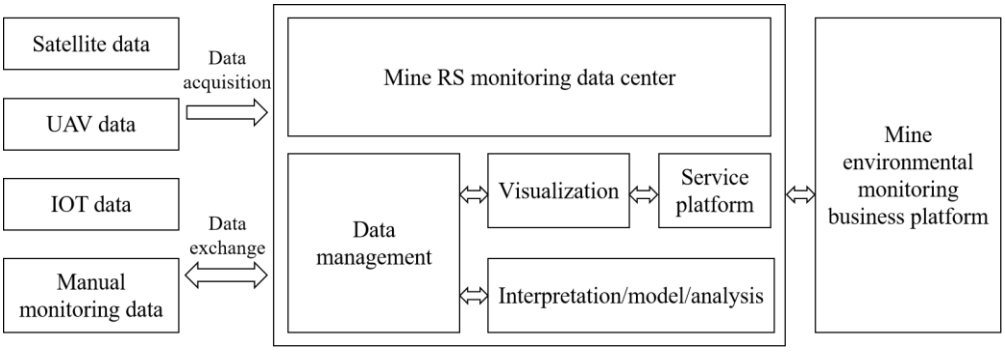

Figure 2: Composition of mine monitoring system

RS information, with its advantages of objectivity, real-time, accuracy and wide coverage, is being used more and more in grassland ecological restoration monitoring and evaluation. In general, there is a strong positive correlation between vegetation coverage and vegetation index: the higher the value of vegetation index, the greater the vegetation coverage. Monitoring personnel can use various monitoring platforms, spectral resolution and various series RS dynamic monitoring technologies to effectively monitor the mine geological environment, thus reducing the monitoring time and cost of the mine geological environment. The role of RS technology in different fields is different, for example, in meteorological prediction, we can observe the weather and the land, rivers, forests and other information on land. Reclamation and ecological restoration are the most effective ways to solve the

environmental protection and comprehensive management of mines, mainly aiming at the problems of land function degradation, ecological structure defect and dysfunction caused by mining.

Using RS technology to monitor the environment can clearly show the exposed bedrock and destroyed vegetation, and predict the possible impact on the landform environment next, and then we can change the production mode and carry out solid waste treatment in time to reduce the impact on the environment. By establishing an integrated platform of mine information through information system and setting up an executable data scheme, mine operators can know the changes of various data in the process of mine mining in time, thus effectively analyzing mine geology through remote technology and improving the effectiveness of mine dynamic monitoring and command system.

4. Conclusions

Ecological restoration of mining land is a long-term undertaking, and the importance of process monitoring is self-evident. How to quickly obtain the dynamic changes of land, vegetation and other environmental indicators is the focus of monitoring. The application of RS technology in land survey and dynamic monitoring is of great significance, which is crucial to the rational utilization and scientific development of land resources. With the continuous improvement and progress of RS technology, there are more and more dynamic monitoring projects of land use, which not only fundamentally solve the problems of data and basic information, but also establish corresponding monitoring schemes in different regions. Massive data storage is also a key part of the system establishment, which needs special research. Although there are many GIS softwares, the GIS platform suitable for land reclamation and ecological rehabilitation needs to be developed. In the process of monitoring, faced with all kinds of RS data, people need to process and analyze the RS data, find out the appropriate RS dynamic monitoring method of mine geological environment, effectively protect the environment around the mine and realize the sustainable development of mine mining.

References

Zhang C. Application of remote sensing technology in mine ecological restoration investigation [J]. Science and Technology Innovation Herald, 2022, 19(25):4.

Wang D, Wang X, Lei Z. Ecological quality assessment of Fuxin based on remote sensing ecological index [J]. Ecological Science, 2020, 39(3):7.

Fenta A A, Yasuda H, Haregeweyn N, et al. The dynamics of urban expansion and land use/land cover changes using remote sensing and spatial metrics: the case of Mekelle City of northern Ethiopia [J]. International Journal of Remote Sensing, 2017, 38(14):4107-4129.

Wellmann T, Haase D, Knapp S, et al. Urban land use intensity assessment: The potential of spatio-temporal spectral traits with remote sensing[J]. Ecological Indicators, 2018, 85(2):190-203.

Moisen G G, Mcconville K S, Schroeder T A, et al. Estimating Land Use and Land Cover Change in North Central Georgia: Can Remote Sensing Observations Augment Traditional Forest Inventory Data?[J]. Forests, 2020, 11(8):856.

Fu C, Song X P, Stewart K. Integrating Activity-Based Geographic Information and Long-Term Remote Sensing to Characterize Urban Land Use Change[J]. Remote Sensing, 2019, 11(24):2965.

Ali S, Rehman Z U, Khan S, et al. Assessment of land use pattern in District Abbottabad through Geographic Information System and Remote Sensing[J]. Biologia (Lahore, Pakistan), 2017, 63(1):87-90.

Ejiagha I R, Ahmed M R, Hassan Q K, et al. Use of Remote Sensing in Comprehending the Influence of Urban Landscape's Composition and Configuration on Land Surface Temperature at Neighbourhood Scale[J]. Remote Sensing, 2020, 12(15):2508.

Wang L, Huang N, Niu Z, et al. Remote sensing monitoring and auxiliary performance evaluation of ecological protection and restoration project of lake grass in landscape forest field [J]. Journal of Remote Sensing, 2022, 26(8):15.

Li J, Pei Y, Zhao S, et al. A Review of Remote Sensing for Environmental Monitoring in China[J]. Remote Sensing, 2020, 12(7):1130.

Shivakrishna A, Ramteke K K, Kesavan S, et al. Monitoring of current land use pattern of Ramsar designated Kolleru Wetland, India using geospatial technologies[J]. Journal of Environmental Biology, 2021, 42(1):106-111.

Li L, Yang J, Dong C, et al. Remote sensing investigation on the distribution and ecological restoration of abandoned open-pit mines in Jiangsu section of Yangtze River Economic Belt [J]. Hydrogeology Engineering Geology, 2022, 49(1):8.