Suggestions on Using Three-dimensional Models to Transform Mining Villages into Smart Villages in the Context of Big Data- Taking Songshumao Molybdenum Mining Area in Xingcheng, Liaoning as an Example

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Abstract. The construction of smart villages is the trend of future rural development. This article uses Songbei Village as an example, using unmanned aerial vehicle (UAV) to achieve efficient and fast aerial photography to establish a three-dimensional (3D) model of the area. After the mining, the current situation of Songbei Village was analyzed, and some suggestions were provided for the economic development and rural layout of Songbei Village to promote the construction of smart villages in Songbei Village.

1. Introduction
The maturity of drone technology has lowered the threshold for aerial image acquisition, making the acquisition of large-scale images more and more convenient, and the maturity of image processing technology has gradually made drones a convenient digital elevation model (DEM) and three-dimensional (3D) model. Obtain platforms, and their applications in the fields of surveying and mapping, electric power, engineering, mining, land and other areas have gradually increased [2].

With the continuous improvement of the structure from motion (SFM) algorithm, photogrammetry, ranging and modeling based on photomodeling have been applied more and more. Photographic modeling can quickly restore the shape of a modeled object, benefiting from its true texture mapping. It greatly reduces the workload after modeling, enables the complete restoration of complex objects (such as geological outcrops and geomorphological phenomena) in the model, and gives real textures. It provided a great help for us to understand the situation in the area by modeling the images obtained by aerial photography of drones.

The so-called smart village refers to the use of various information technologies or innovative concepts to integrate the processing of rural systems and services, thereby improving resource utilization efficiency, optimizing rural management and services, improving the quality of life of villagers, and achieving the long-term development goals of the village. If we can strengthen the construction of smart villages and improve their infrastructure in practice, it will be conducive to improving the service functions of modern villages, improving the level of informatization in their construction process, and increasing the technical advantages and content of smart villages in practice [1,3].

This article uses drones to aerially mine the mining area, and establish a three-dimensional model of the mining area and surrounding villages. Based on this model, to protect the ecology and the environment, the urban planning and rural transportation and living environment will be arranged as a whole, the spatial layout will be optimized, the disasters will be prevented, and natural resources will be used reasonably.
2. Model Construction and Analysis of Songbei Village

2.1. Generation of the three dimensional models
The structure from motion (SFM) algorithm has greater flexibility. As long as the images obtained by aerial photography using the drone have a sufficient overlap ratio, they can match images taken at different scales and perspectives. Under the shooting conditions of orthophoto synthesis in this article, the drone images with a repetition rate of 50-60% between adjacent images can meet the needs.

In this paper, the Context Capture software is used to process the image data obtained by aerial photography of the drone, and the absolute directional control points in the image are extracted by aerial triangulation. That is to say, by using continuously captured aerial cameras with a certain overlap, according to a small number of field control points, the corresponding route model or area network model (optical or digital) corresponding to the field is established by photogrammetry to obtain the plane coordinates and Elevation. Then, the orthophoto map of the area is obtained through software-related processing (Fig. 1). Based on this image, the study of the Songshumao molybdenum mining area is conducted.

![Figure 1. Orthophoto of the Yangjiazhangzi Songshumao molybdenum deposit in Liaoning Province.](image)

2.2. Model analysis
An orthographic model of 4 km × 2 km in the Songshumao area was established using drone aerial photography, and the conditions of the pits, villages, mountains and vegetation can be clearly seen on the model.

(1) Analysis of mining area
After consulting the relevant data of the Songshumao mining area, combined with field investigations, the interpretation signs of the drone orthoimage were initially established. Combined with the established model and the software's own measurement function, it can be concluded that the total surface area of the surface of the mining area is 1.71 square kilometers (Figure 2), and the height difference between the highest point of the slag accumulation in the mining area and the surface house is about 80 meters (Figure 3).

(2) Analysis of village situation
The area is named Songbei Village according to the main village. The village as a whole is arranged along both sides of a highway leading to the town (red area in Figure 4). The east and west sides are two mountains up to 300 meters. The village's drinking water is mainly Groundwater. At this stage, the economic source of the village is mainly cultivated land and small-scale farming. The cultivated land is presented in earthy yellow tones in the orthophoto, and the farming is only sufficient for self-sufficiency. There are basically no entertainment facilities in the village, the main way to get out of the
village is by a shuttle bus that runs every three hours from 6:00 to 17:00, and the departure time of the shuttle bus is not on time.

![Figure 3](image1.png) ![Figure 4](image2.png)

**Figure 3.** Height difference of slag heap, the red and yellow dotted lines in the picture represent the distance from the top of the mine to the houses on the surface, the white label represents a height of 80 meters.

**Figure 4.** Distribution of villages.

3. **Suggestions for smart villages in the era of big data**

The arrival of the era of big data has gradually increased the amount of data in the production activities, and put forward higher requirements for data information processing. Therefore, based on the urban-rural planning in the era of big data, the relevant points need to be clarified. Specifically includes the following aspects: (1) set up a comprehensive system framework. (2) focus on the integration and use of data information.

Explained from the following aspects.

3.1. **Rural layout planning, building a relatively complete system framework**

Due to the large slag accumulation volume and the height difference of up to 80 meters, some houses need to be relocated for safety reasons. The house next to the slag heap shown by the red arrow in Figure 4 is recommended to be moved to the No. 1 position. The investigation found that the area had a large amount of water during the precipitation period, and the flow of small rivers flowing through the village skyrocketed, often flooding the roads crossing the river. In order to prevent flooding, it is recommended to flow out of certain areas for buffering.

From the perspective of data information, the river flow during the precipitation period can be analyzed by analyzing the water flow in the past years, taking the average value as a reference, and taking a larger value for precautions. Taking the stability of the mine pile in the past years, and considering the vibration caused by passing vehicles whether it has any impact on the mine pile, etc. And discuss with the villagers, and give certain subsidies to the villagers if conditions permit, formulate solutions that meet the interests of the villagers, build a reasonable and safe rural layout, and improve the overall appearance of the village.

3.2. **Economic Development Suggestions**

In order to solve the economic downturn in the area, the following suggestions are made after integrating and utilizing data and information:

(1) Most of the mountains are shrubs and are not used reasonably. The field survey found that Songbei Village has a relatively gentle mountain range. Only a small part of the mountain is planted with vegetables and other crops, making it difficult to achieve self-sufficiency. It is suggested to manage the mountain uniformly and select a relatively flat part to plant fruit trees in a large area as one of the income-increasing items.
(2) The Songshumao molybdenum mining area can be built into a civilized mining village, and the process of science mining can be implemented to achieve a series of popular science processes. People can visit the pit left after mining (up to 180 meters deep, with blue residual wastewater at the bottom of the pit) and other mining equipment. It can be combined with the fruit tree planting in the previous article to allow tourists to pick independently and develop into a characteristic tourism project.

3.3. Development Proposals for Smart Villages
(1) In the era of big data, smart data management can be realized through analysis and processing of massive data, with the support of different types of sensors and cameras, to meet the smart travel requirements of transportation. Therefore, for the convenience of the people's itinerary in Songbei Village, a sensor or camera can be installed at the center of the village. In addition to the scheduled departure from the departure station to Songbei Village, through the sensor or camera, we can also make arrangements based on the number of passengers in Songbei Village. When a certain amount is reached, a bus can be sent automatically.

(2) Install a water level monitor at the river location. Automatic warning when the water level reaches a certain level to reduce or avoid the impact of flood disasters. Install a stability monitor at the mine pile to monitor the stability of the slag pile at all times to avoid disasters Impact.

(3) An indispensable part of a smart village is security monitoring equipment. Monitoring equipment is set up at key locations in the village to monitor the security issues in the village in real time. Through big data analysis and comparison, real-time monitoring and early warning of suspicious people are conducted to ensure the villagers in Songbei safety.

4. Conclusions
1. Utilizing drones can quickly obtain high-definition images of the research area and establish high-resolution three-dimensional (3D) models. Through the models, we can carry out the next work. This method can greatly save our time.

2. Based on the analysis of the model, areas where landslides are prone to occur and areas where river surges may be affected by heavy rain are derived. On this basis, suggestions were made on the distribution of some cottages in Songbei Village. In addition, we propose to install monitoring equipment at the slag heap in Songbei Village and water level monitoring equipment at the river to ensure disaster warning and ensure the safety of villagers.

3. In order to facilitate people's itinerary in Songbei Village, based on the analysis of the bus interval in Songbei Village, a suggestion to set up a monitor in the center of Songbei Village is proposed. In addition to the normal departure time, when the number of people reaches a certain number, buses are automatically added.

4. According to the three-dimensional (3D) model obtained from aerial photography, suggestions were made on the economic development of the area. We can build the mining area into a mining tourism scenic area, and combine it with fruit tree planting to develop a characteristic tourism project.

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