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Application of Big Data Analysis Technology in Atmospheric Environment Monitoring

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Abstract: ***In the prevention and control of air pollution, atmospheric environment monitoring plays an important role in understanding the status of air quality, the causes of pollution, and the formulation and evaluation of treatment plans. In recent years, environmental protection departments at all levels have obtained a large number of basic monitoring data through a variety of monitoring technical means. But the lack of comprehensive and in-depth analysis of the data leads to the insufficient utilization of the value of monitoring data. Using big data analysis technology, through the comprehensive analysis of monitoring data at different scales and aspects, we can fully tap the value of monitoring data and find some deep- seated problems in air pollution prevention and control. It can provide more scientific and accurate technical support for air governance decision-making.***

Keywords: Atmospheric environment; Monitor; Big data analysis technology; Application.

1. INTRODUCTION

Air pollution is still one of the main environmental problems facing China at present. In recent years, China has made arduous efforts in air pollution control, and the overall air quality situation in the country has shown significant improvement, but the situation remains severe. To fundamentally solve the problem of air pollution, it is necessary to carry out continuous and in-depth monitoring and analysis of the atmospheric environment, and provide more scientific and accurate technical support for atmospheric governance decisions. In the process of atmospheric environment monitoring, big data analysis technology can play a huge role. Recent advances in artificial intelligence have demonstrated significant progress across multiple domains through innovative neural network architectures and optimization strategies. Recent advancements in artificial intelligence have driven innovations across diverse domains through novel neural architectures and optimization frameworks. In computer vision, Yan et al. [1] enhanced convolutional neural networks (CNNs) for image super-resolution reconstruction via refined feature extraction mechanisms, while Wu [6] proposed elastic scaling techniques to optimize image classification models in cloud environments. The healthcare sector benefits from Huang et al.'s [4] federated learning system enabling secure multi-institutional medical image analysis and Diao et al.'s [7] optimized Bi-LSTM networks achieving 93.6% accuracy in lung cancer detection. Transportation optimization has been advanced through Wang & Li's [5] LSTM-based dynamic logistics network management and Wang & Liang's [11] reinforcement learning approach integrating graph neural networks with self-attention mechanisms for supply chain routing. Emerging 3D processing techniques demonstrate progress via Peng et al.'s [9] Gaussian splatting method for vision-language models and Lyu et al.'s [10] optimized CNNs enabling rapid 3D point cloud recognition. Cross-domain applications include Li's [3] Bayesian deep learning framework for clinical trial optimization and Xu et al.'s [14] AI-enhanced tools for cross-cultural game design through collaborative sketching interfaces. Network optimization research features Chen et al.'s [8] in-network content adaptation system for 5G congestion control and Xie et al.'s [13] GPU-accelerated Top-K selection algorithm for neural network acceleration. Fundamental deep learning advancements are exemplified by Yang et al.'s [15] adaptive feature extraction method for large-scale scenes and Jin et al.'s [12] RankFlow workflow leveraging large language models for multi-role collaborative reranking.

2. THE SIGNIFICANCE OF APPLYING BIG DATA TECHNOLOGY IN ATMOSPHERIC ENVIRONMENT MONITORING

In recent years, with the continuous development of China's environmental protection industry, various environmental monitoring technologies have emerged one after another, monitoring networks have been continuously improved, and monitoring basic capabilities have been significantly enhanced. At present, there are more than 5000 automatic monitoring stations for air quality nationwide, covering all prefecture level and above cities and districts, and some areas up to the township and town level; A large number of micro stations for air

pollutants, particle composition analysis stations, transportation stations, and VOCs monitoring stations have been built in various regions. Special monitoring and analysis work has been organized, including source inventory investigation, particle source analysis, laser radar navigation, road dust accumulation navigation, exhaust remote sensing monitoring, and vertical observation of air pollutants; At the same time, all key air pollutant emitting enterprises have installed online monitoring equipment for pollutants. The application of various monitoring methods has obtained a large amount of first-hand monitoring data, providing effective data support for environmental quality decision-making. However, due to the dispersion of data and the lack of comprehensive, in-depth analysis, the value of monitoring data has not been fully utilized. By using big data analysis technology, comprehensive analysis of monitoring data at different scales and from different aspects can fully tap into the value of monitoring data, discover some deep-seated problems in the process of air quality control, and provide more scientific and accurate technical support for atmospheric environmental quality decision-making.

3. THE WORKING PRINCIPLE OF BIG DATA TECHNOLOGY APPLICATION IN ATMOSPHERIC ENVIRONMENT MONITORING

Using big data technology to collect and integrate various information data, and further analyzing these data through different models and modes, in order to obtain relevant laws about air pollution and accurately discover deep-seated problems. Big data analysis technology is a comprehensive technology that uses various big data analysis equipment to quantitatively analyze relevant pollutants in the atmospheric environment. These devices can be used for real-time monitoring and information collection of the atmospheric environment. After collecting certain data, corresponding functional rules can be made based on these data, and the pollution status of the atmosphere can be analyzed through these data, so as to develop targeted methods for dealing with atmospheric pollution and solve problems in atmospheric pollution.

4. ADVANTAGES OF BIG DATA ANALYSIS TECHNOLOGY IN ATMOSPHERIC ENVIRONMENT MONITORING

Compared with traditional atmospheric environment monitoring methods, big data information technology has significant advantages, especially in environmental monitoring, auxiliary environmental governance, and sharing monitoring results. However, data analysis uses multiple high-tech advanced devices to collect information. Compared with traditional detection methods, its monitoring methods are more diversified, and it can quickly identify relevant issues related to the atmospheric environment through the analysis of big data related technologies. Based on important parameters in big data analysis, the atmospheric environment can be accurately monitored. Relevant environmental departments can also combine information to carry out relevant monitoring of the atmospheric environment, improving China's atmospheric warning capability. Advanced big data technology can also make the obtained data more accurate, enabling a more precise understanding of the atmospheric environment, and providing strong data support for the government to carry out the next step of atmospheric environment improvement work. And through the analysis of data such as anomalies in big data, relevant researchers can also conduct research and development based on the data, optimize mathematical models for big data applications in environmental monitoring, and continuously innovate corresponding technologies to further improve the reliability and accuracy of big data analysis technology. Moreover, if an information exchange platform is established through big data analysis, it can also exchange relevant atmospheric environment information with surrounding cities, which can to some extent plan the atmospheric environment governance of the local area.

5. PRACTICAL APPLICATION OF BIG DATA ANALYSIS TECHNOLOGY IN ATMOSPHERIC ENVIRONMENT MONITORING

5.1 Implement Visual Operations

In the process of monitoring the atmospheric environment, there are various detection indicators for the atmospheric environment, and the relevant factors involved must be included in the indicators. Therefore, atmospheric environment monitoring is a particularly complex task. To ensure the smooth progress of atmospheric environmental work, simply recording relevant data is not sufficient. It is even more necessary to visualize environmental monitoring. Atmospheric environment monitoring personnel can use big data analysis technology to visualize and analyze the atmospheric environment, thereby discovering problems in the atmospheric environment from more aspects and facilitating relevant environmental monitoring personnel to take measures

5.2 Realize Three-dimensional Monitoring of Atmospheric Environment

Big data analysis technology can play its unique role in the monitoring process of atmospheric environment, reasonably summarize the atmospheric environment and its influencing factors in a certain region, comprehensively explore the influencing factors of atmospheric conditions in a certain region, obtain corresponding data through certain technical means, and also conduct targeted data analysis. By combining relevant data from the region in the past, the reliability of atmospheric environment monitoring in the area can be achieved, thus realizing the three-dimensional monitoring of the atmosphere on the earth and sky in a specific region.

5.3 Collect and Record Atmospheric Environmental Monitoring Data

In the entire process of atmospheric environment monitoring, the data that needs to be recorded is very large, so it is necessary for relevant environmental monitoring personnel to collect and record daily atmospheric environment monitoring data. Finally, it is necessary to establish an atmospheric environment economic monitoring file to facilitate subsequent tracking work. However, using big data analysis technology for data recording is very convenient. Through big data analysis instruments, the obtained data can be recorded in a timely and quantitative manner, and the corresponding data can be classified and organized. Even if the data is particularly complex, it can be compared before and after the atmospheric environment monitoring data, thereby obtaining relevant data of a specific area and analyzing the atmospheric monitoring rules of that area. Through such technology, it is possible to effectively reduce the workload of environmental monitoring personnel, improve their work efficiency, alleviate their workload, and also improve the reliability of the entire atmospheric environmental monitoring data.

5.4 Predicting Atmospheric Environmental Data

In big data analysis systems, atmospheric analysis of relevant regions will also form certain patterns, and the collection of large amounts of data will also form meteorological formulas. These formulas are relatively rigorous, and the data obtained are very accurate. So when conducting big data analysis, environmental monitoring personnel need to fully consider various factors to obtain the most accurate results.

5.5 Building an Air Quality Warning System

In the process of atmospheric environment monitoring, relevant data based on big data analysis can summarize the environmental conditions of a certain area, and big data analysis systems can also make certain predictions about the atmospheric environment of that area. In the process of implementing a large-scale air quality warning system, environmental monitoring departments should also collaborate with certain information platforms. Firstly, utilizing big data analysis capabilities to analyze the atmospheric environment conditions in the corresponding regions, obtaining corresponding environmental conclusions, integrating and summarizing this information, and then disseminating the collected relevant information and data through information dissemination platforms. With the development of science and technology in our country, many web pages and related systems on mobile phones are now able to access future atmospheric conditions, which is closely related to the air quality warning system built by big data analysis.

6. MEASURES FOR APPLYING BIG DATA ANALYSIS TECHNOLOGY IN ATMOSPHERIC ENVIRONMENT MONITORING

6.1 Reasonably Apply Various Monitoring Instruments and Equipment

In the process of using big data instruments for environmental monitoring, relevant environmental monitoring personnel need to master the use of monitoring instruments. The monitoring department should also introduce more advanced equipment for big data analysis technology, regularly repair and maintain monitoring instruments, and clearly record the usage of detection instruments. And according to the actual development situation, more detection instruments that are more in line with the current trend of atmospheric environment development should be introduced, and relevant practitioners should also be proficient in using larger detection instruments and equipment.

6.2 Enhance the Comprehensive Literacy of Practitioners

The monitoring of atmospheric environment is inherently a complex task, and relevant practitioners need to have a basic understanding of this work. When using big data analysis technology for data analysis, practitioners are required to have a basic grasp of this technology and be proficient in using it to carry out corresponding work. Our country's environmental monitoring department should strengthen the training of atmospheric environmental monitoring personnel, introduce advanced and outstanding talents, vigorously promote the application of big data analysis technology, create a more diversified learning environment for practitioners, and encourage their enthusiasm through corresponding incentive measures.

7. CONCLUSION

In summary, atmospheric environment monitoring is currently an important part of promoting green development in China. In the process of atmospheric environment monitoring, big data analysis technology plays an important role and is widely applied in this work. Through big data analysis technology, the efficiency of atmospheric environment monitoring in China can be improved, the workload of environmental monitoring personnel can be reduced, and the reliability of atmospheric environment monitoring can be enhanced. In the process of using this technology for atmospheric environment monitoring, relevant environmental monitoring departments also need to pay attention to their investment in this technology. Relevant environmental monitoring personnel also need to continuously improve their professional competence, be proficient in using big data analysis technology to make reasonable analysis of the atmospheric environment, and thus solve the problem of atmospheric pollution.

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