Smell machine -- Innovative city odor grid monitoring system based on MEMS sensing technology

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Abstract: As one of the important indicators of urban environmental quality, city odor has an important impact on residents' quality of life and city image. Traditional odor monitoring methods have problems such as sampling difficulty, time delay and low spatial resolution, which can not meet the needs of accurate and real-time monitoring of urban odor. Based on microelectromechanical system (MEMS) sensing technology, this paper proposes an innovative city odor grid monitoring system, the sniffing machine. The system uses the array of micro gas sensors, and arranges the sensors in different areas of the city to form a grid layout, so as to realize the comprehensive monitoring of city odor. It provides a new idea and method for urban environmental management and improvement, and helps to promote the improvement of urban environmental quality and the improvement of residents' quality of life.

Key words: MEMS sensor; Grid monitoring; Urban smell

1. Introduction

Air pollution has a serious impact on the environment and human health. It is an important problem that needs to be solved urgently. In order to strengthen the protection and control of air environment, China has issued ten policies on air pollution, which clearly emphasize the control objectives. During the 14th Five-Year Plan period, China promoted the energy revolution, built a clean, low-carbon, safe and efficient energy system, adhered to source prevention and control and integrated policies, and strengthened coordinated control and regional treatment of air pollutants. Atmospheric grid monitoring technology has become the core of governance, providing strong support for air pollution control.

The atmospheric gridding monitoring method based on MEMS sensing technology divides the atmospheric environment into gridded areas, and installs MEMS sensor equipment at each grid point to monitor the concentration and change of atmospheric pollutants in real time. Compared with traditional monitoring methods, the technology has higher spatial resolution and real-time performance, providing more accurate and comprehensive air pollution data. The traditional method relies on sampling analysis of a few fixed monitoring stations, which can not accurately reflect the spatial and temporal distribution characteristics of air pollution. The grid-based monitoring method based on MEMS sensing technology deploys small and highly sensitive sensors at each grid point to capture changes in atmospheric pollutants in real time, and has data interconnection, real-time alarm and online analysis functions to provide effective information support for decision makers, optimize governance measures and improve governance effects.

The rapid development of the Internet, cloud computing and sensor technology further promotes the application of atmospheric grid monitoring technology. The Internet and big data analysis systems support centralized management, real-time transmission and analysis of atmospheric monitoring data. Advances in sensor technology have made monitoring equipment smaller, portable and intelligent to adapt to complex atmospheric environments. These technologies provide a broad space for the innovation and application of atmospheric grid monitoring technology.

This paper aims to deeply study the principle, application and development trend of atmospheric gridding monitoring technology based on MEMS sensing technology, and discuss its role and effect in air pollution control. As a micro and nano technology, MEMS sensing technology is widely used in the field of atmospheric monitoring because of its small size, low power consumption and high sensitivity. The application and advantages of MEMS sensing technology in atmospheric grid monitoring are discussed. At the same time, pay attention to the application of Internet and big data analysis system in atmospheric grid monitoring, and make full use of these technologies to promote environmental protection work. The Internet is widely used to realize remote monitoring and data transmission, obtain air pollution data in real time, and realize data sharing and integration. The big data analysis system processes massive monitoring data and extracts valuable information and trends using data mining and analysis methods to provide a scientific basis for decision makers.

2. Relevant theories and techniques

2.1 Basic principles and status quo of air pollution monitoring and control

The traditional point monitoring method of air pollution monitoring has the problems of low spatial resolution and low sampling frequency. In order to overcome these limitations, grid monitoring technology based on MEMS sensing technology came into being. The technology divides the atmospheric environment into gridded areas, and sets sensor devices on each grid point to realize continuous monitoring of atmospheric pollution. Through the Internet and data transmission technology, monitoring data can be transmitted in real time to data centers for processing and analysis.

Grid-based monitoring technology based on MEMS sensing technology has obvious advantages, including high-precision sensors, higher spatial resolution and real-time monitoring capabilities. This enables us to have a more comprehensive understanding of the spatial and temporal distribution characteristics of air pollution, and take appropriate measures to control it in a timely manner. The support of

the Internet and data transmission technology allows monitoring data to be transmitted and shared in real time, promoting cooperation and information sharing among environmental protection management departments and scientific research institutions at all levels.

2.2 Grid monitoring technology

Grid monitoring technology is a monitoring method based on network and sensor technology, its core idea is to divide the monitoring area into uniform grids, and deploy sensor equipment on each grid point to measure the concentration and change of air pollutants in real time. The sensor equipment can include gas sensors, particulate matter sensors, weather sensors, etc., which can sense the environmental parameters in real time.

The realization of grid monitoring technology cannot be separated from the support of Internet and data transmission technology. Through the Internet, monitoring equipment and data center to achieve real-time data transmission and interaction, monitoring data can be centralized management and analysis in the data center. In addition, cloud computing technology can realize the storage and processing of massive data, providing powerful computing power for large-scale grid monitoring.

2.3 MEMS sensor technology and Internet applications

Sensor technology is the key support of grid monitoring, and its development is crucial to improve the accuracy and reliability of monitoring data. With the continuous innovation and progress of sensor technology, sensor equipment has become more miniaturized, portable and intelligent.

The MEMS gas sensor module is a small, low-cost, easy-to-use gas sensor PCB module for measuring and monitoring the concentration of various gases. The module consists of a gas sensor, a control circuit and a communication interface, which can convert the electrical performance changes of the sensitive materials of the MEMS gas sensor into a digital signal for output. Compared with other gas sensors, the module has the advantages of higher selectivity, stability, fast response time and low power consumption. In addition, the module has a variety of communication interfaces to facilitate data interaction, data storage and analysis with other devices.

The rapid development of the Internet also provides a broad application space for grid-based monitoring technology. The Internet technology enables the monitoring equipment to realize remote control and data transmission, and realize real-time data collection and transmission. The application of cloud computing technology can realize the storage and processing of large-scale data, and provide support for data analysis and decision-making.

3. Sniff system design ideas

The sniffer system architecture includes the terminal device layer, the network communication layer and the platform application layer in order from low to high.

The terminal equipment layer is the underlying hardware equipment of the sniffing system, including multi-function sensors and power supply and distribution cables. This layer is responsible for realizing the functions of odor detection intelligent control, data collection, information release and wireless network coverage of the sniff system. Among them, the odor grid monitoring system based on MEMS sensing technology is a part of the system, and the MEMS sensor is used to collect environment-related data. These sensors, including illumination sensors, temperature and humidity sensors, gas sensors and smoke sensors, are distributed in different locations indoors and outdoors to collect various environmental variable information and send it to a wireless intelligent gateway.

The network communication layer is the information transmission hardware device of the sniffing system, and the Internet of Things communication module is used to provide reliable and efficient information transmission channels for the terminal equipment layer and the platform application layer to meet the needs of different communication methods.

The platform application layer is the core of the sniffing system, responsible for data storage, data processing and analysis, control management, information display and push and other functions. This layer is the key part to determine whether the sniffing system is intelligent.

The information processing center is composed of terminal equipment and mechanical learning algorithm, which is mainly responsible for receiving, processing, forwarding and local real-time display of environmental information, as well as sending abnormal alarm and remote alarm information. The remote monitoring terminal is the smart home remote monitoring host, after receiving the environmental information forwarded by the terminal device, it can display the sensor data indicators on the remote monitoring page in real time, and carry out remote alarm tips, and store the alarm information to the corresponding database.

Information processing center includes the initial gas detection module, environmental information capture module, environmental information processing module, environmental information real-time display processing module, abnormal information sound alarm module and abnormal environmental information image display module and other functional modules.

Through this architecture, the grid-based monitoring system based on MEMS sensing technology can realize real-time and accurate monitoring and analysis of odor changes in the city, providing strong support for urban management and environmental monitoring.

4. Advantages of odorant system

4.1 System Advantages

Basic network: Through the combination of two network technologies, NB-IoT and eMTC, the sniffing system has achieved full coverage within the city, forming a situation of complementary differences and collaborative development. Such a network architecture provides a stable and reliable communication network for iot sensing devices, enabling the sniffing system to measure, monitor and analyze

the city's core system.

Flexible monitoring: The terminal device layer uses a combination of multi-functional sensors that are able to comprehensively monitor multiple parameters of the environment, such as light intensity, temperature, humidity, gas concentration, etc. Through the combination of multiple sensors, the system can obtain more comprehensive and accurate environmental data, providing more detailed and comprehensive odor monitoring and analysis. Some sensors can be flexibly arranged in different positions to cover different areas and environments. The multi-aspect and multi-type atmospheric grid monitoring can be realized.

Intelligent application: The sniffing system can monitor the environmental odor in real time, and through intelligent control and adjustment, automatically adjust the environmental conditions according to the detected odor changes, so as to provide a more comfortable and healthy living or working environment. Through the comprehensive perception of the smell in the city, the sniffing system can find abnormal situations in time, and instant alarm.

4.2 Core Advantages

(1) Using NB-IoT technology, the network deployment eliminates the original intermediate link, and directly jumps the Internet to reduce the intermediate link that may fail;

(2) the cost of installation and deployment is greatly reduced, and the installation and commissioning of the Internet are solved in 1 minute;

(3) Multi-dimensional and multi-role timely notification, through the Internet of things can be connected to the cloud platform, can also notify the owner's family, property company, easy to find in time;

(4) It is easy to collect big data and take effective measures for supervision.

4.3 Summary

The Internet of Things plays a key role in the construction of smart cities and plays an important role in urban fire safety management and air pollution control. In terms of urban fire safety management, the Internet of Things provides an effective means to ensure the reliability of fire fighting equipment when in use. The atmospheric gridding monitoring technology based on MEMS sensing technology provides a strong support for air pollution control, and provides accurate air pollution data and information support for decision makers through real-time monitoring and data analysis. The application of the Internet of Things and atmospheric gridding monitoring technology will provide strong support for the construction and sustainable development of smart cities.

5. Future trends of gridded monitoring systems

Further development of intelligent equipment and sensor technology With the continuous progress of science and technology, intelligent equipment and sensor technology will be more innovative and applied. Sensor equipment will be more miniaturized, portable, and have higher accuracy and sensitivity. Intelligent devices will have more powerful data processing capabilities and network connectivity to achieve more efficient data collection and transmission.

Cloud computing and big data analysis system application expansion Cloud computing and big data analysis system will become an important support for grid monitoring technology. With the popularization of cloud computing technology and the improvement of big data analysis capabilities, the storage, management and analysis of larger-scale data can be realized. The application of big data analysis system will further improve the accuracy and real-time performance of data analysis, and provide more powerful support for decision-making.

Integration of Artificial intelligence and automation technology The development of artificial intelligence and automation technology will further promote the innovation of grid-based monitoring technology. Through the introduction of artificial intelligence algorithms and automated control technology, intelligent analysis of monitoring data and abnormal early warning can be achieved. For example, predictive models can be built using machine learning algorithms to predict the concentration change trend of atmospheric pollutants based on historical data and environmental parameters, and measures can be taken to treat them in advance.

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