Analysis and design of intelligent environmental protection IOT system architecture based on GIS

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Abstract: With the third great change of the world's information industry, IOT will open an information age of interconnection of all things. The environmental protection Internet of things combines the traditional environmental protection industry with the Internet of things technology, realizes the practice of environmental protection informatization, is conducive to the construction of an all-round environmental protection governance system, speeds up the process of China's environmental protection informatization, and promotes the rapid transition from "digital environmental protection" to "intelligent environmental protection". With the continuous progress of cloud computing, big data and other cutting-edge technologies, environmental protection Internet of things has begun to integrate these technologies to better meet the needs of the public. In this paper, through the analysis and research of the application example of environmental protection Internet of things, summarizes the overall architecture of intelligent Internet of things system based on GIS for environmental protection. The overall architecture of the intelligent Internet of things system can be divided into four levels: field equipment, transmission network, IOT equipment management platform, environmental protection big data analysis and application platform. Using the IOT system architecture to design the IOT system platform can solve the repeated construction of infrastructure and software application system in the field of environmental protection, improve the traditional environmental governance mode and meet the public's right to know the environmental conditions. People can understand the real-time environmental information through mobile terminals or environmental protection cloud platform, and enterprises that cause pollution can use the network Anonymous reporting is carried out so that the public can participate in the national cause of ecological environment governance.

1. Introduction
Environmental protection is closely related to people's life. The traditional environmental management mode needs to be transformed and upgraded to better serve the public. The environmental protection Internet of things emerges as the times require. The application of Internet of things in environmental protection has obvious representativeness and demonstration. Environmental protection field has become the best entry point for the development of Internet of things technology because of its most advanced development conditions. The Internet of things technology mainly includes sensor technology, wireless communication technology and embedded technology, which is used to realize the information interaction between things and people. Environmental protection Internet of things is not limited to the introduction of Internet of things technology into the field of environmental protection, but also includes the Internet of things technology and other cutting-edge technologies, such as big data, cloud computing, geographic information system (GIS), The application of the
Internet of things in the field of environmental protection focuses on the realization of gathering the environmental data information collected by environmental protection equipment to the cloud service platform. Through the analysis and integration of a large number of environmental data information by using big data, cloud computing and other technologies, various intelligent applications for environmental protection can be realized.

With the continuous progress of cloud computing, big data and other cutting-edge technologies, environmental protection Internet of things has begun to integrate these technologies to better meet the needs of the public. In this paper, through the analysis and research of the application example of environmental protection Internet of things, summarizes the overall architecture of intelligent Internet of things system based on GIS for environmental protection. The overall architecture of the intelligent Internet of things system can be divided into four levels: field equipment, transmission network, IOT equipment management platform, environmental protection big data analysis and application platform.

2. Field equipment analysis
As the skin and five senses of the Internet of things, the perception device is at the bottom of the Internet of things architecture. It is mainly composed of various monitoring devices, sensing devices and data acquisition terminals, responsible for sensing and collecting external environment information. The common technologies of perception layer include RFID, sensor network and embedded technology. The perception and collection of environmental protection data is the basis of intelligent environmental protection applications. All environmental protection data come from the perception layer. Environmental protection equipment is responsible for the perception and collection of environmental data. At present, the environmental protection equipment in the market mainly includes air quality monitoring equipment, sewage treatment equipment, soil testing equipment, noise control equipment and various environmental protection instruments and meters. Environmental protection equipment through the use of a variety of sensors, chemistry, physics and other technologies to complete the perception and collection of environmental information. With the improvement of manufacturing technology of environmental protection equipment, the accuracy of environmental information collection is also constantly improved. The equipment responsible for sensing and collecting environmental protection data is often deployed in the vicinity of pollutant monitoring points and process nodes that will affect pollutant emission, which is used to monitor and monitor the emission status and process parameters of specific pollutants. It usually does not support network communication, but needs to use data acquisition and transmission instrument or gateway equipment for industrial monitoring to complete the communication with the host computer. The connection between field monitoring equipment and industrial monitoring gateway usually adopts one master multi-slave connection mode. Figure 1 shows the RS485 bus system structure of one master and multiple slaves between field environmental protection equipment and environmental protection monitoring gateway.

The field equipment mainly realizes the collection, processing and transmission of environmental protection data, sensor data and monitoring video data. The common types of environmental protection equipment include sewage treatment equipment, toxic gas detection equipment, air pollution monitoring equipment, soil monitoring equipment, etc. Sensors usually include temperature and humidity sensors, geographic location information sensors, wind direction sensors and so on. In practical application, the gateway equipment developed according to the business requirements of the system is usually embedded in the environmental protection monitoring equipment, which is installed and deployed as a whole in the operation site.
3. Transmission network

In the overall framework of the environment-friendly intelligent Internet of things, the transmission network mainly realizes the remote information interaction between the field equipment and the IOT device management platform. The transmission network layer can choose the corresponding data transmission mode according to different application scenarios and business requirements. For example, for some business scenarios with low power consumption, wide coverage and relatively small data transmission volume, Nb IOT called low power Wan, EMTC based on LTE air port optimization, and Lora, which is committed to building an open ecosystem with industrial alliance as the core Can provide effective solutions. For some business scenarios such as audio and video with large data volume or high real-time requirements, 3G, 4G LTE or WiFi should be used to meet the application requirements. For some special application scenarios, wireless sensor networks need to be built, and some short-range wireless transmission technologies, such as ZigBee With the rapid development of Internet of things and embedded technology, wireless sensor network has been widely used in environmental monitoring, intelligent transportation and other fields.

TCP and UDP are commonly used in the transport layer of the environment-friendly Internet of things. TCP needs to establish a reliable connection before sending and receiving data, also known as "connection based protocol". UDP does not need to know the state of the other party or establish a connection first, which is also called "connectionless protocol". Because UDP message does not provide reliable delivery, sequential delivery and flow control fields, it has small delay and high data transmission efficiency in the process of data communication. It is generally used in the application scenarios where the reliability of data transmission is not high and the amount of data transmission is small. TCP uses confirmation mechanism, retransmission mechanism and congestion control mechanism to ensure reliable and orderly delivery of data, which is suitable for application scenarios with high requirements for data transmission quality and accuracy. In the environment-friendly Internet of things, it is necessary to select the appropriate transport layer protocol for specific application scenarios. Generally, the application system of environmental protection gateway needs to support Because of the real-time and reliable interaction of IOT device management platform, the TCP connection supporting reliable transmission is usually used between the environmental protection gateway application system and the IOT device connection management platform. However, for some special application scenarios, such as the low-power intelligent IOT platform based on Nb IOT, due to the high demand for power consumption and the low requirement for real-time data transmission, they tend to choose UDP as a transport layer protocol to provide more efficient transmission. For the application scenarios that require real-time interaction, it is necessary to maintain a long TCP connection between the environmental protection gateway application system and the IOT device management platform. Therefore, it is necessary to add a heartbeat mechanism to detect the abnormal state of the TCP connection in time and recover the connection. TCP itself has heartbeat packet mechanism, but because the default heartbeat frequency is 2 hours, it is usually difficult to meet the actual application requirements, and it can not detect and report the abnormal power failure of equipment, network card or mobile communication module and firewall problems in time, so developers usually need to develop heartbeat module according to actual needs to realize TCP connection protection mechanism.
4. IOT device management platform
In the overall architecture of intelligent Internet of things oriented to environmental protection, IOT equipment management platform mainly realizes intelligent management of field equipment, persistent storage and visual display of data reported by field equipment, and provides data support services for environmental protection big data analysis and application platform. IOT equipment management platform mainly includes IOT equipment connection management platform led by large information technology enterprises, IOT service management platform of large telecom operators and IOT equipment management service platform built by enterprises operating Internet of things related industries. Among them, IOT equipment connection management platforms dominated by large information technology enterprises include Huawei Technologies' oceanconnect IOT ecosystem, and Amazon's AWS IOT service platform. The IOT service management platforms of large telecom operators mainly include the IOT open platform of China Mobile, the M2M IOT card connection management platform of China Unicom, and the IOT open platform of China Telecom. Internet of things gateway equipment access to the IOT device management platform usually requires authentication and registration process. Generally, the third-party plug-in is used to simplify the equipment access operation process and improve the network transmission security.

5. Environmental protection big data analysis and application platform
Environmental protection big data analysis and application platform includes intelligent analysis of environmental protection data and a variety of practical applications. It provides various information services for environmental protection management departments and assists in scientific decision-making, so as to comprehensively grasp all kinds of environmental protection data information, accurately analyze and trace all kinds of pollution sources, timely discover all kinds of environmental pollution signals and provide early warning signals, and long-term management and control of environmental quality. To give full play to the "wisdom" of environmental protection informatization. The "overall plan for the construction of ecological environment big data" compiled and released by the Ministry of environmental protection describes in detail the analysis and application problems of environmental protection big data, and puts forward the guiding ideology, overall structure and main objectives of ecological environment big data construction, which points out the direction for the development of ecological environment big data. The overall structure of environmental protection big data construction is shown in Figure 2. Among them, the eco-environmental big data management mechanism is at the top of the architecture, mainly including environmental protection data and

The open sharing mechanism of environmental protection business system and the scientific decision-making and social service innovation mechanism of environmental governance relying on the application of environmental protection big data. The two systems (organization guarantee standard specification, unified operation and maintenance information security) are mainly responsible for providing a series of guarantee measures such as talents, funds and technology for the construction of ecological environment big data. The core of ecological environment big data construction lies in the construction of ecological environment big data platform, including big data environmental protection cloud platform providing data support services, big data management platform providing data analysis and integration services, and big data application platform providing comprehensive services for all walks of life.
6. Integration of Intelligent Environmental Protection IOT System Structure

Based on the construction of intelligent environmental protection Internet of things system, based on large-scale commercial database, comprehensive use of mobile office technology, portal technology, GIS technology, GPS technology, data storage technology, network technology, XML, web service and other technologies, SOA technology and EAI technology are applied in the overall architecture, Web2.0 Technology is reasonably applied in the interface display, and B / S is used in the software platform. The operation mode of the architecture. After the above analysis, the overall framework of the system is obtained, as shown in the following figure:

7. Conclusion

With the proposal of "smart environmental protection", environmental protection government departments, university scientific research institutions and environmental protection related enterprises are actively engaged in the research and practice of environmental protection Internet of things, so the environmental protection Internet of things system is gradually known to the public. By using big data, cloud computing and other technologies to analyze and integrate a large number of environmental data information, various intelligent applications for environmental protection can be realized. Therefore, an effective intelligent environmental protection IOT system architecture based on GIS can make the environmental protection business innovation and upgrade, the environmental management more intelligent and the environmental protection service system more perfect.
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Reference:
[1] LV Jun, Luan Wenpeng, Liu riliang, et al. Distribution Internet of things architecture based on comprehensive perception and software definition [J]. Power grid technology, 2018,42 (10): 3108-3115
[2] Chen Hongyan, Wan Junwei, Qi Hongwei. Research on cloud intelligent office integrated management system solution based on Internet of things [J]. Modern electronic technology, 2018,41 (10): 85-89
[3] Liu Shiyun. Preliminary study on the construction of intelligent building health information service management system based on Internet of things and big data [J]. China new communications, 2019,21 (12): 114
[4] Hou Yuemei. Research on the application of Internet of things technology in smart city [J]. Communication world, 2019,26 (08): 212-213
[5] Hao Xingjun. Research on big data storage and management technology of Internet of things [D]. University of science and technology of China, 2017
[6] Wang Jianmin. Policy interpretation of the overall plan for ecological environment big data construction [J]. Environmental protection, 2016,44 (14): 12-14
[7] Liu Youquan, Zhang xumin, Gao Junhai, Feng Yin, Zhou Xusheng. Key technologies of intelligent lighting Internet of things for urban roads [J]. Journal of lighting engineering, 2019 (04): 13-16 + 47
[8] Shi Weisong, sun Hui, Cao Jie, Zhang Quan, Liu Wei. Edge computing: a new computing model in the era of Internet of things [J]. Computer research and development, 2017,54 (05): 907-924