UAV-based Regional Environmental Monitoring IoT System

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Abstract: The UAV regional environmental monitoring system has the characteristics of various functions and simple operation. Relevant staff can ensure effective monitoring of regional temperature and humidity by means of specific mobile networks and flight control of drones. Based on past work experience, this paper summarizes the content of program demonstration and system design, and discusses the software flow design of regional environmental monitoring IoT system from five aspects: process design review, overall structure, topology diagram module, information query display module and system test.

1. Introduction
With the continuous development of the Internet of Things technology and industry, it is necessary to take the IoT-related technology as the core and the information industry as a part of the strategic emerging industry. In this process, the monitoring of the entire ecological environment has become a hot topic in the society. People can comprehensively understand the laws governing the development of the ecological environment by means of real-time monitoring of the environment. In order to ensure economic construction under ecological conditions, it play a higher role and ensure that the monitoring results of the main body are scientific.

2. Program Argumentation and System Design

2.1 Program Argumentation
The main purpose of the design system studied by itself is to carry out on-line detection and long-term monitoring operations on the regional environment. The main monitoring contents include regional temperature and humidity, etc., and the environmental ecological dynamic changes are displayed, and corresponding alarm measures are taken to the monitoring center.

In addition, due to the large-scale composition of IoT sensors, communication distance and environmental adaptability will be greatly affected, which will increase maintenance costs and consumption, resulting in unfavorable results. To this end, designers began to use the drone as a platform for the coordinator, which in turn broke the traditional network communication distance limit. UAVs can power the entire system and can be carried in a variety of mission equipment, so that the actual unmanned aircraft can be reused, becoming an important means of spatial data acquisition, high efficiency and high resolution features are displayed.

Once the coordinator is mounted on the drone platform, it is very complicated and impractical to read the data directly after all the data collection is completed. In order to ensure the implementation of data monitoring, the relevant staff needs to ensure that the coordinator can transmit the information data to the monitoring terminal in a short time. At this time, people can use GPRS to transmit the coordinator data instantaneously. China's main GPRS signal coverage area is very wide, and the cost of consumption is limited, which can facilitate the server to read the relevant data content, and send it to the control interface after finishing, to ensure the effective display of the real-time monitoring function.
2.2 System Model
The actual system model diagram is shown in Figure 1. During the operation of the system, the main functions include monitoring information collection and visual monitoring. First of all, in the environmental monitoring information collection function display, the specific content is as follows. First, the collection of simple environmental indicators, such as temperature, humidity, etc., and use a variety of sensors to achieve information collection and processing. Second, environmental monitoring and collection with strong wireless communication capabilities, staff can use this operation to aggregate information to the IoT nodes and let the Internet gateway nodes gather on the platform center server through the GPRS network. Third, we should focus on the drone flight control link. The relevant staff can obtain the corresponding geographical location information by means of the GPS navigation of the drone, and obtain the information of all the sensor nodes and reduce the energy consumption through the comprehensive optimization operation of the route.

![Figure 1 System Model Diagram]

For the display of visual monitoring functions, the main contents involved include the following aspects: First, information query and output. Through this operation, it can help the staff to effectively extract and query the monitoring data, and rationalize the data generation and other generation functions. Second, data analysis, the relevant staff can achieve a comprehensive analysis of massive data according to the data mining strategy, and then present the data change trend, so that the data and conclusions can show the effect. The third one is the automatic warning function. Relevant staff can rationalize the design of the threshold according to the actual environmental parameters. Through the existing data analysis operations, the automatic warning function will be fully displayed, laying the foundation for the subsequent implementation of environmental protection work. The fourth one is the remote operation function. Through the research of the control system, it is ensured that the remote device can perform effective restart and reset operations, which is the essence of the remote server online monitoring function display.

3. Hardware Circuit
The hardware circuit studied in this paper has three types of circuit boards, including temperature and
humidity acquisition board, node module board and GPRS module board. Generally speaking, for the temperature and humidity acquisition board and the node template, the main application is a 3-pin single-row pin insertion connection. At this time, the connection mode between the node module board and the GPRS module board is a DuPont line connection.

### 3.1 Temperature and Humidity Acquisition Board

For the use of temperature and humidity acquisition boards, the main content involved are resistive wetted components and NTC temperature measuring components, which are connected with high-performance microcontrollers. In general, each DHT11 sensor will be accurately checked by the designer before we use it. In addition, when the entire calibration coefficient is presented, it is mainly stored in the form of data, and the actual storage location is concentrated in the OTP memory, and these calibration coefficients can be effectively adjusted on the detection signal processing inside the sensor. The actual temperature and humidity acquisition board circuit is shown in Figure 2.

![Figure 2 Circuit Diagram of Temperature and Humidity Acquisition Board](image)

### 3.2 Node Module Board

In the construction process of the node module, the main components have two aspects, namely the bottom plate and the top plate. Among them, the bottom plate mainly includes the following aspects: First, the temperature and humidity sensor interface is distributed, and the main function is to connect the temperature and humidity collecting plates together. Second, the USB part can provide power supply for the development board, and can also display the entire USB serial port function to achieve comprehensive adjustment of the program. Third, the battery interface can be used to power other modules through the battery compartment. Fourth, the DEBUG debug port mainly acts on the online debugger and downloader. It can also be seen from the actual top plate design work that the main processing core design is particularly important. In addition, for CPU selection, it is necessary to use a single-cycle compatible kernel as the main body, thereby expanding the storage memory, supporting wireless updates and large-scale applications, and demonstrating better design results.

For the entire GPRS module design, the core content is SIM800A module, the most commonly used working frequency band is DCS1800. In the format design, the encoding formats CS-1, CS-2, etc. are supported. During the working process, the module can be integrated with the external power interface and the SIM card interface, and the USB to serial port chip ensures the effective debugging operation of the main module.

### 4. Software Process Design of Regional Environmental Monitoring Internet of Things System
4.1 Process Design Review
In general, the node module and client writing environment in the system are mainly established for Windows. The programming language of the node module is C language, the writing tool is IAR Eebedded, and the programming language of the client is C++. In the entire node module software application process, it is necessary to use the relevant protocol content as the main line, such as CC2530. In addition, the agreement also includes the following two parts: First, through the effective definition of the actual IEEE, to ensure the effective access of the physical layer and the media layer, and then display the content of the media access layer technical specifications. Relevant staff can also effectively design the network layer and applications by means of the ZigBee Alliance, and effectively support the content design of the sub-layer and application layer technical specifications. More importantly, the system is mainly to effectively design the application layer, and then present the software content.

Through the design of the monitoring phase, TCP can parse the topology information and display the content of the visual topology according to the actual topology information. The topology function refreshes the relevant content according to the specific topology information. After the node has an abnormal problem, the system will directly remind the monitoring personnel to query the actual node history information. Through the comprehensive display of the chart, understand the specific trend of the temperature and humidity curve.

4.2 Overall Structure
The system structure of the software mainly involves a lot of content, such as the dynamic display module of the node topology map, and the node history information query module, plus the current information curve dynamic display module, as shown in Figure 3. In order to ensure that the function of the overall structure is effectively presented, the staff must also design the node module. The design mainly includes the coordinator part, the terminal part part and the temperature and humidity sensor.

![Figure 3 Overall Structure of the System](image)

4.3. Topology Diagram Module
In the design process of the whole topology diagram module, the most important one is the design of the receiving data module. By means of the TCP connection, the ZigBee node information data frame sent by GPRS is transmitted to the next module. In addition, in the data parsing operation, the split reception of the data packet is particularly important. The staff can calculate the network order according to the actual data node content and the network information, so that the data in each node can be obtained. Showcase, creating favorable conditions for the execution of subsequent drawing work. The node topology can also be dynamically displayed, and the parsed data is stored in the database to facilitate efficient query operation of subsequent historical information data. Through the drawing operation, the topology maps under different results can be displayed, and different nodes are effectively presented through different colors, such as routers, terminals, etc., to ensure that the network information is parsed, and all the nodes are connected together. In addition, the topology map module can also receive the abnormal data, find the origin of the abnormal data, and remind the monitoring personnel which part of
the data has a problem through the color cycle change of the node, and create more favorable conditions for the execution of the subsequent work.

4.4 Information Query Display Module
The main content of the module is the time segment selection part and the information display part. The designer can display the historical information of the node by selecting a certain time period and then clicking a node in the topology map. This information can be queried through the database to get more new messages. In addition, the relevant departments of our country must also develop an effective air monitoring system based on actual conditions. In the actual monitoring work execution process, there will often be a lot of uncertainty, and the relevant staff members need to implement effective adjustment of the information query display module according to the actual pollution situation. For example, in the analysis of smog components, technicians can choose a variety of monitoring methods and methods to avoid any subsequent impact on the query work. In the actual water resources monitoring process, relevant staff need to strengthen the emphasis on heavy metals and radiation source components to achieve comprehensive monitoring of the surrounding environment. It should be noted that during the implementation of this type of monitoring work, the staff needs to apply the RF device to help the staff lock the pollution source in the first time and present the actual pollution situation better. Once the environmental pollution exceeds the relevant standards, the system will generally issue an early warning message to remind the staff of the problem. In this process, relevant departments and staff need to strengthen the application of Internet technology, establish a sound information sharing platform, and provide stable conditions for the acquisition of monitoring data of the subsequent ecological environment system.

4.5 System Test
In the application process of the actual temperature and humidity sensor, the actual terminal node is mainly in a very complicated environment, and the area is about 300m2. Under this circumstance, the coordination module carried by the drone can carry out regional cruise according to the previously planned route operation, the actual cruising altitude is about 8m, and the speed is 20km/h. In addition, the staff can also obtain the data collected by the drone during the work process from the server, and display the actual working state of the terminal node in the monitoring interface. Therefore the data collection operation becomes more and more perfect, and the displayed effect will get better and better. In addition, when the drone flies over the node, the monitoring interface can also display the data within the allowable range of the delay, which can also explain the successful development of the test.

For the whole monitoring alarm function test, if the entire terminal environment matches the alarm condition, the control interface will issue an alarm message. At this time, it is proved that the system is in a normal working state, and the alarm function can also be used normally. When an abnormality occurs in the actual monitoring interface, the node will show a reddening situation and issue an alarm message. In general, regional environmental monitoring work has urgency characteristics. With the continuous development of related technologies, testing equipment is gradually developing towards miniaturization and diversification, creating more favorable conditions for the implementation of follow-up work.

5 Conclusion
In summary, through the implementation of the regional environmental monitoring system and the Internet of Things technology, the drone can be equipped with a coordinator module to carry out effective data collection operations. Moreover, in the actual monitoring process, the staff can effectively collect the temperature and humidity of the surrounding environment through the effective application of the terminal node. Then transmit the collected data to the coordinator module, and finally display the result on the interface of the monitoring system.

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