Research on Application of Automatic Weather Station Based on Internet of Things

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Abstract. In this paper, the Internet of Things is briefly introduced, and then its application in the weather station is studied. A method of data acquisition and transmission based on NB-iot communication mode is proposed. Introduction of Internet of things technology, Sensor digital and independent power supply as the technical basis, In the construction of Automatic To realize the intelligent interconnection of the automatic weather station, and then to form an automatic weather station based on the Internet of things. A network structure of automatic weather station based on Internet of things technology is constructed to realize the independent operation of intelligent sensors and wireless data transmission. Research on networking data collection and dissemination of meteorological data, through the data platform for data analysis, the preliminary work of meteorological information publishing standards, networking of meteorological information receiving terminal provides the data interface, to the wisdom of the city, the wisdom of the purpose of the meteorological service.

1. A brief introduction about the Internet of Things
The Internet of Things (IoT) is the combination of communication network and Internet communication. There are two meanings: Firstly, the core and foundation of IoT is still the Internet, it’s the extension and expansion of the network based on the Internet; Secondly, the user terminal extends to each item for information exchanging and communicating. Which means everything is related. Internet of Things has three key technologies in application, such as follows [1-2]:
   a) Sensor technology. It’s also the key technology in computer applications.
   b) RFID tag, which is also a kind of sensor technology. RFID technology is a comprehensive technology which combines radio frequency technology and embedded system technology as a whole.
   c) Embedded system technology. It is a complex technology combining computer hardware and software, sensor technology, integrated circuit technology and electronic application technology as one whole.

2. The IoT automatic station

2.1 Overview on the IoT automatic station
The IoT automatic station is automatic weather station based on the Internet of things, which fully embodies the real-time data interoperability, data fusion and other characteristics of the IoT technology. With the advent of the IoT, it will become increasingly widespread. The structure of the meteorological observation network is shown in Figure 1.
2.2. Features of the IoT automatic station [3]

1) High quality meteorological data
   A. Intelligent perception: sensor self-calibration, sensor co-integration algorithm.
   B. Multi-quality control: single-factor quality control, multi-factor joint quality control, time and space consistency check.

2) Reliable meteorological equipment: intelligent sensor, wireless transmission, micro-power, self-organizing network.

3) Comprehensive monitoring information: self-test and self-diagnosis, multiple monitoring.

4) Efficient maintenance and protection: fault warning, alarm and diagnosis, operating status information.

5) Convenient deployment: equipment distributed, power supply diversification, transmission of wireless.

6) Standard interoperability: follow the Internet of things communication protocol standards and data formats, barrier-free dialogue.

7) Flexible Scalability: City, Province, Region, National.

3. Technical route of IoT automatic station

3.1. Technical overview

The architecture model that the existing automatic weather station uses is sensor plus collector mode.
The IoT automatic station should break it completely: eliminate power supply cables and communication cables, take the digital and independent power supply of sensors as foundation, and at the same time introduce Internet of things technology to compose the Internet-based automatic weather station.

3.2. Equipment composition
The IoT automatic station consists of power supply, wireless communication system, digital sensor, integrated controller and business software platform. Figure 2 shows the structure of the the IoT automatic station system [4].

1) Power supply system: use distributed power supply, digital sensors and integrated controller were equipped with independent solar power supply unit.
2) Wireless communication system: consists of two parts: WSN network and GPRS network, in which WSN network is based on Zigbee network.
3) The digital sensor is responsible for front-end data acquisition and preprocessing.
4) Integrated controller as a system gateway, responsible for the establishment of WSN network and summary of WSN data information, while taking the automatic station and business software platform data interaction.
5) The business software platform is responsible for the human-computer interaction of the IoT automatic station system.

![Figure 2. The structure of the the IoT automatic station system.](image)

3.3. Device deployment

3.3.1 Cooperative deployment model of sensors
1) The front end takes the station as a unit, and a variety of intelligent sensors work together in the station. The location and deployment of the automatic weather station is compatible with the traditional station building mode, and the observation elements in the station are comprehensive and diversified.
2) The station uses the intelligent sensor + wireless sensor network architecture, intelligent sensor with a "dialogue" function and collaboration capabilities, increase the comprehensive quality control of the data fusion algorithm based on single sensor element quality control algorithm, to
improve the data quality; at the same time using data fusion technology for data calibration, improve data accuracy.

3) On the basis of network access mode of traditional automatic station, 4G/wifi and other network access methods are extended so as to make full use of the public resources of smart city network. Figure 3 shows Cooperative deployment model of sensors.

**Figure 3.** Cooperative deployment model of sensors.

### 3.3.2 Intelligent sensor independent deployment mode

1) The front end, with intelligent sensors as the unit, supports any element combination in space.

2) Single station deployment is simple, mobile fast and flexible, easy to fine, comprehensive monitoring [5].

3) Single station support 4G/wifi and other network access methods, smart city in the basic network coverage area, to achieve fast access.

4) Cloud server monitoring data information of different single stations can be classified and aggregated according to type, GPS location and application, relying on large data technology to process monitoring data and information fusion. Figure 4 shows Intelligent sensor independent deployment mode.
4. Building of the IoT automatic station

4.1. Construction object

1) Should be based on a small Internet data automatic transmission station, massive data collection and analysis, to achieve intelligent temperature and humidity sensor and rain sensor independent work and send data through the NB-iot communication mode, reduce power consumption, extend equipment life cycle. In the cloud to achieve data integration, and through intelligent data analysis algorithm to determine the sensor running state, to enhance the ability of meteorological data interaction and information technology level.

2) Intelligent sensor independent work, data transmission wireless. Research on networking data collection and dissemination of meteorological data, through the data platform for data analysis, the preliminary work of meteorological information publishing standards, networking of meteorological information receiving terminal provides the data interface, to the wisdom of the city, the wisdom of the purpose of the meteorological service.

4.2. The contents of the building

1) Build the IoT automatic station including conventional six elements (temperature, humidity, pressure, rain, wind direction and wind speed) based on digital sensors and Zigbee wireless network technology.

2) Find the deficiency of existing equipment through the trial run. Enhance the intelligent level of the sensor and the overall reliability of the Internet of things comprehensively through the diversity of observation, the existing data fusion between sensors and integrated quality control and other technical means.

3) Finally explore a kind of IoT technology that suitable for automatic weather station mostly: the next generation of IoT technology represented by NBiot is different from the Zigbee, wireless network current Internet of things model, try to build Internet of things automatic station based on NBiot.
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