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Retraction

Retracted: Design and Implementation of Node of Wireless Network Environment Monitoring System Based on Artificial Intelligence

Wireless Communications and Mobile Computing

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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[1] P. Zou and G. Ji, "Design and Implementation of Node of Wireless Network Environment Monitoring System Based on Artificial Intelligence," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 5911476, 9 pages, 2022.

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Research Article

Design and Implementation of Node of Wireless Network Environment Monitoring System Based on Artificial Intelligence

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In order to effectively solve the problem of traditional environmental monitoring system due to high sensor cost, difficult deployment, and high maintenance cost, the node design and implementation of a wireless sensor network-based environmental monitoring system are proposed. Simulation experiments show that the time-consuming running time is 14.210361 s. After adding the action force of the grid point on the node, the running time is 11.257740 s, and the operation efficiency of the algorithm is significantly improved. The improved virtual force algorithm optimization improved node coverage by 5.2%.The system is easy to deploy, reduces the development and maintenance cost, and can obtain data or monitor through wireless communication. It is convenient to use and maintain.

1. Introduction

To create a content instrumentation and network monitoring system and to provide users with remote indoor environment monitoring information services, modern science and technology involves various fields, and the interdisciplinary intersection between various fields constructs new technologies. WSN is a perfect combination of sensor technology, embedded system, wireless communication technology, and other fields, which can maximize human vision and help people monitor the changes of external things [1]. WSN has the ability of self-organization and long-distance communication and is widely used in all walks of life [2–5]. The traditional environment detection system has certain limitations. It needs to initialize the sensor network and can only understand the environmental changes through local accuracy. In addition, the monitoring range of wired sensor network is small, there is a monitoring blind area, and the fault-tolerant performance of the network system is also poor [6, 7].

The main categories include RF technology, infrared technology, and Bluetooth technology, which have been common in mobile phones and other devices in the past decade. These technologies have different characteristics and different costs. The acquisition node in wireless sensor network is one of the most basic elements of the network. It is used to collect, preprocess, store, and transmit the data in the covered area in a multihop manner. Various types of sensors can be installed on the acquisition node, and the soil temperature, soil humidity, noise, light intensity pressure, air humidity, air temperature, and many other material phenomena of interest to us [8, 9]. At the same time, it must have the characteristics of simple, easy to use, reliable work, and low price, and Zigbee advantage lies in the interconnection between equipment in a certain environment and low power consumption; obvious advantages is shown in Figure 1. Wireless sensor network has several remarkable features: first is the high node density, a wide range of distribution. Due to the large number of sensor nodes, the maintenance of the wireless sensor network is more difficult than the traditional wireless network, and the software and hardware of the sensor network must be high robustness and fault tolerance: second is the strong network dynamic. Since the nodes in the network are randomly distributed, the three elements of sensor, perception object, and observer may be

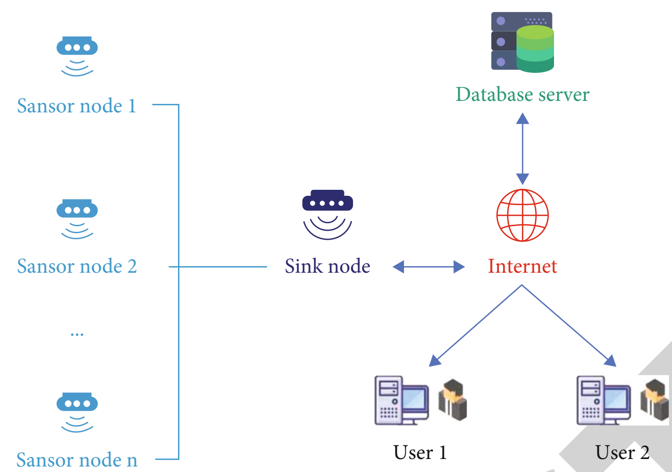


Figure 1: Wireless sensor network system architecture.

mobile, and often new nodes join or existing nodes fail, resulting in the sensor network is very dynamic: third is that the node energy is limited. Sensor nodes are mostly distributed in sparsely populated areas and harsh environment, making the energy problem, so sensor nodes are mostly microembedded devices, whose processing capacity, storage capacity, communication bandwidth, and carrying energy are very limited: fourth is low cost. Sensor nodes should be cheap, because a large sensor network often consists of hundreds of sensor nodes, so each node should be low cost, low price: fifth is wireless transmission. Sensor nodes transmit data wirelessly: sixth is node self-organization. Wireless sensor network system is mostly distributed in areas where people cannot or cannot reach, and the deployment of nodes is implemented in a random manner. This requires the communication protocol of the wireless sensor network system to complete the automatic network: the seventh, multijump. A sensor node may not have direct access to the base station, so the data should be transmitted to the base station in a multihop manner. In WSN, the deployment of nodes is usually random. WSN with random layout has some problems, such as low node utilization and small network coverage. Due to the consistency between the virtual force algorithm (VFA) and the network coverage problem, the algorithm is widely used in WSN [10, 11].

Sensor nodes are often a miniature-embedded system that have weak processing, storage, and communication power due to volume, price, and power supply, usually exchanging data only with neighbor nodes within the white body communication range, powered by carrying batteries with limited energy. To access nodes outside the communication range, you must use multihop routes. In order to ensure that the collected data information can be multiple jumped to the converged nodes, the distribution of the nodes should be quite dense. In terms of network function, each sensor node has the dual function of information collection and routing. In addition to local information collection and data processing, they should also store, manage, and integrate the data forwarded by other nodes, while cooperating with other nodes to complete some specific tasks. Convergent nodes usually have strong processing capacity, storage capacity, and communication capabilities. They can be either a sensor node with enhanced function, sufficient energy supply and memory and computing resources, or a special gateway device without a monitoring function and only a wireless communication interface. The convergence nodes connect the sensor network with the external networks such as the Internet to realize the communication protocol transformation of the two networks, send the detection tasks of the management nodes, and forward the collected data to the external network. Compared to traditional single-sensor devices, the sensor network can change the control objectives and monitoring content to suit the researcher's interests. Users can send instructions to the sinking node via the Internet, and the sinking node is very flexible as it can change the function of the node in the network by providing these instructions to the sensor network. The receiving node is responsible for collecting all the collected data, sending it to the Internet, and storing the collected data in the sensor database. The database provides remote data services and allows users to connect to the Internet and view data.

2. Literature Review

Microsensor technology and the wireless communication capability of node inquiry give broad application prospects for the wireless sensor network. Not having the application fields of wire sensor network include military investigation, environmental monitoring, medical treatment, and building monitoring. With the continuous development and improvement of sensor technology, wireless communication technology, and computer technology, various sensor networks will be spread at all levels of life, especially in areas such as environmental monitoring. Modern environmental control systems usually adopt a line control system. There are two defects in such systems: on the one hand, the wiring control system is highly dependent on the line, and the layout of the system will affect the wiring. On the other hand, in the wired way, the node distribution is fixed; the distribution density is not high; and when some nodes fail, it will lose the local control function. This article collects ambient temperature and humidity information using a wireless sensor network and transmits this information to the monitoring center in a timely manner. The use of wireless sensor networks compared to traditional monitoring methods has three important advantages: (1) The number of sensor network nodes is high, the distribution density is high, and each node can monitor the details of the local environment. To the information center, therefore, the sensor networks are characterized by high data collection and high accuracy. (2) Because the size of the sensor node is small and the entire network needs to be deployed only once, the deployment of the sensor network has little human impact on the controlled environment. (3) Wireless sensors have the ability to monitor, self-calculate, and store in more complex ways. The sensor may not be desired to connect to physical changes, monitoring, or control. The order is being executed. This topic aims to help protect forests and disrupt traditional methods of environmental monitoring. Environmental monitoring aims to take advantage of a stationary sensor network to provide environmental monitoring information [12]. Mohapatra, H. and others used different filtering methods for different scenes. The data processing of temperature, humidity, and light intensity sensors adopts the amplitude limiting average filtering method, and the data processing of particle concentration sensors with large sampling variation adopts the first-order lag average filtering method [13]. Li, P. and others proposed correlation based data coding mode, distributed algorithm for determining node location in wireless sensor networks and method for reconstructing sensor node location, and developed an operating system based on wireless sensor networks [14]. Li, J. and others developed a wireless sensor network simulation system to study the problems in wireless sensor networks [15]. Y Jia. and others studied methods and technologies for ultralow power wireless sensor networks. According to the particularity of wireless sensor network communication protocols, new routing protocols based on negotiation protocols, directional release protocols, energy sensitive protocols, multipath protocols, and propagation routing protocols are proposed [16]. Watt, A. J. and others believe that wireless sensor network system can also play a great role in traffic. Through various sensors on the node, vehicle speed and traffic flow can be monitored, providing strong support for traffic management departments to better manage urban traffic [17]. Rahman, G. and others conducted data fusion processing on the collected data, and the reliability has been enhanced, but the fusion algorithm is complex, and the real-time performance is not strong [18]. Sharma, H. and others improved wireless sensor network routing protocol algorithm and reduced node power consumption [19]. Li, K. and others established a wireless sensor network test group, specializing in the research on the hardware implementation of wireless sensor networks [20]. Ranjan, A. and others believe that the wireless sensor network system can also be used for forest environmental monitoring and fire alarm. The nodes are randomly densely distributed in the forest and regularly report environmental data under normal conditions. In case of fire, the nodes will transmit the specific address of the fire source, fire size, and other information to relevant departments in a very short time through cooperation [21, 22].

Based on this research, we propose a node design and implementation of an environmental monitoring system for a wireless sensor network based on artificial intelligence. The WSN environmental monitoring system based on ZigBee can be well applied in various environmental monitoring fields such as clean plant and is an effective solution. The traditional environment detection system has certain limitations. It needs to initialize the sensor network and can only understand the environmental changes through local accuracy.

3. Research Methods

3.1. Sensor Node Design. First, wireless sensor node is the way and means to realize the connection of things. Internet of Things is the extension of wireless sensor node to the connection of things in the real world, which is an important basis and component of the realization of this technology. Second, data exchange and transmission are carried out between any objects with the function of signal exchange. The range of network and goods involved is extensive. The Internet of Things is not only a network but also a product of the in-depth development of wireless sensor nodes. It is a brand new innovation in the application of wireless sensor nodes. All kinds of terminals create brand new forms of use and bring more industrial revolution with better operation experience to users.

3.1.1. Design Principles of Sensor Nodes. The device driver is the interface between the operating system kernel and the machine hardware. It protects the software hardware details. In general, Linux device drivers must perform the following functions: start and remove the device, and transfer data from the kernel. Read data from hardware and hardware; read the data sent by the application to the device file; and return the requested data to the application; check. Measure and resolve errors during equipment operation. Networking is a necessary module for many embedded systems, and Ethernet is a high-speed, open, wide-ranging communication interface that plays an important role in the development, debugging, and use of installed systems. An important role is that in order to enable the designed wireless sensor node to form a wireless sensor network with long service life, stability, reliability and superior performance, the node design must consider the following aspects:

(1) Miniaturization. Miniaturization is the ultimate goal of sensor networks. Only when the size of the node itself is small enough can it ensure that it will not affect the target system environment or the impact can be ignored. In addition, in some special occasions, it is even required that the target system can be small enough to be imperceptible

(2) Low-power consumption. Due to the particularity of wireless sensor network application environment, it is difficult to replace the power supply, and the requirements for node power consumption are very strict. During normal operation, the power consumption of wireless transceiver is the main part of

node power consumption, so advanced algorithms and protocols must be adopted as far as possible to shorten the duration of wireless transceiver working state

(3) High stability. In order to meet the requirements of service life in applications, each node must have high stability. The method of modular system design can reduce the mutual interference of circuits and improve the stability of nodes. To coexist with other wireless systems, wireless sensor network nodes must also be able to adapt to external interference. The method to improve the anti-interference performance of nodes is to use multichannel wireless transceiver. This wireless transceiver can make the system work in multiple frequency bands to avoid mutual interference of multiple wireless systems due to sharing a certain frequency [23, 24].

(4) Rapid development of market economy and the development strategy of “Internet +” also for the new period of production start-up provide a good platform and make the informatization, digitalization, and intelligence, and the network is gradually applied to all walks of life of entrepreneurship development; for all kinds of production environment to implement intelligent real-time monitoring, low cost, and easy operation, business can effectively improve production quality and efficiency. With open market space, this is the subject to adapt to market demand, according to the development of the starting point

3.1.2. Design Concept of Wireless Sensor Node. The chip integrates a radio frequency transmitter and controller to provide high-performance, complex functions.

This kind of communication control is only applicable to power systems, as long as there are wires, data can be transmitted, so this kind of transmission technology is already widely used. The pin description is shown in Table 1.

3.1.3. Calculation of Humidity. The sensor developed from the energy gap material PTAT (proportional to absolute temperature) has excellent linearity, which can be used as follows:

Convert the digital output to the temperature value, as shown in

$$T = d_1 + d_2 \times SO_T, \tag{1}$$

where d_1 and d_2 are specific coefficients, the value of d_1 is related to the working voltage of SHT10, and the value of d_2 is related to the resolution adopted by the internal A/D converter of SHT10.

Since the digital output characteristic of relative humidity is nonlinear, in order to compensate the nonlinearity of humidity sensor, the humidity value can be corrected according to the following formula, as shown in

$$\mathrm{AW}_{\mathrm{linear}} = T_1 + T_2 \times CO_{\mathrm{AW}} + T_3 \times CO_{\mathrm{AW}}^2, \tag{2}$$

Table 1: Pin description.

Pin	Name	Notes
1	GND	Land
2	DATA	Serial data, bidirectional
3	SKC	Serial clock, input
4	VDD	Power supply 2.2~5.5 V
5~8	NC	The remaining pins are not connected

where AW_{linear} is the humidity value after linear compensation, sorh is the measured value of humidity, and T_1, T_2, T_3 are the linear compensation coefficients.

The compensation formula is as follows:

$$\mathrm{AW}_{\mathrm{true}} = (D - 25) \times (d_1 + d_2 \times CO_{\mathrm{RH}}) + \mathrm{AW}_{\mathrm{linear}}, \tag{3}$$

where AW_{true} is the humidity value after linear compensation and temperature compensation, D is temperature, and d_1 and d_2 are the compensation coefficients.

3.2. Overall System Scheme Design. In the indoor environment combined with simple equipment to achieve the required environmental quality data collection function. Figure 2 shows the overall block diagram of the system.

The improved VFA is used to optimize the node layout and obtain high network coverage, which provides a reference for the placement position of practical engineering application nodes. The gateway module transmits the data to the external network and gives an early warning of the equipment operation.

3.3. System Hardware Design

3.3.1. Sensor Module. According to the design specifications of the clean workshop, the selected sensor model and its parameters are shown in Table 2, taking volume and cost into consideration.

Figure 3 shows a design flow chart of the hardware structure of the sensor module.

The sensor of digital output is directly connected with STM32 microprocessor, and the sensor of analog output is connected with STM32 microprocessor.

3.3.2. Zigbee Networking Module. Figure 4 shows the design diagram of the hardware structure of the ZigBee network module.

ZigBee networking module consists of CC2530 processor, antenna unit, and power module. Coordinator nodes are connected to gateway modules through serial ports.

3.3.3. Hardware Design of Gateway Module. Figure 5 shows the hardware design structure of the gateway module.

The gateway module includes STM32 microprocessor, serial port, and esp8266 serial port to WiFi module. The module is connected to the coordinator node through serial port.

3.4. Wireless Sensor Network Environmental Monitoring. The ARM processor as the core of coordinated processing and the measured data are recorded and the managed by

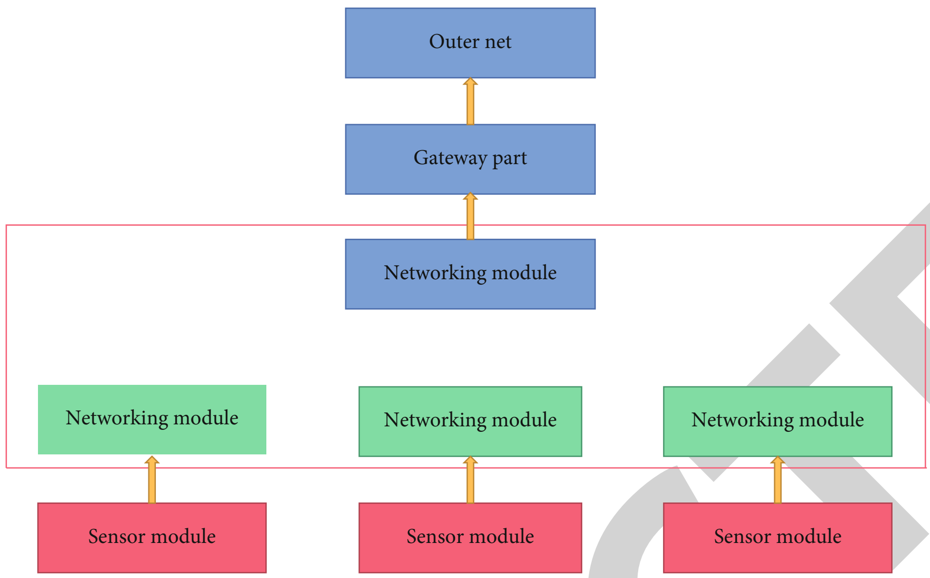


FIGURE 2: Overall system block diagram.

TABLE 2: Model and parameters of sensor.

Sensor	Model	Measuring range
Temperature and humidity	DHT10	0~40°C; 10%~85%~
Pressure	BMP160	300~1000 hPa
PM2.5	DSL-02	0~999.9 $\mu g/g^3$

database technology. Figure 6 shows the flow chart of the environmental monitoring.

3.4.1. Sensor Module. Figure 7 shows the flow chart of the design of the sensor module software.

Firstly, the temperature, humidity, dust concentration, and air pressure in the environment are collected and cached in a queue. To effectively remove the interference of various factors on the collected data, the data were processed by a combination of median filtering and sliding mean filtering algorithm. The filtering algorithm flow is shown in Figure 8.

3.5. ZigBee Networking Module. Its application in life is very common; there are a lot of assemblies in display equipment, light sensing equipment, and food image acquisition equipment.

3.6. Sensor Network Node Layout Optimization Algorithm

3.6.1. Traditional VFA. Due to the consistency between VFA and node coverage technology, VFA is used to optimize the node layout. The specific virtual force modeling is as follows: set any two nodes s_i and s_j, and the force of node s_i by node s_j meets the following force relationship, as shown in

$$F_{ij} = \begin{cases} k_1/{d_{ij}}^{\alpha 1}, 0 < d_{ij} < r_s\,; \\ 0, d_{ij} = r_s or d_{ij} > d_{th}\,; \\ k_2/d_{ij}^{\alpha 2}, \text{otherwise}, \end{cases} \tag{4}$$

where k_1 and k_2 are gain coefficients; d_{ij} is the distance between nodes s_i and s_j; d_{th} is the distance threshold between nodes; and r_s is the best distance between nodes.

Each sensor node will update the node position according to the total resultant force. The update formula is shown in

$$x_{\text{new}} = \begin{cases} x_{\text{old}}, F_{xy} = 0\,; \\ x_{\text{old}} + \dfrac{F_x}{F_{xy}} \times d_m \times e^{\frac{-1}{F_{xy}}}, F_{xy} \neq 0, \end{cases} \tag{5}$$

$$y_{\text{new}} = \begin{cases} y_{\text{old}}, F_{xy} = 0\,; \\ y_{\text{old}} + \dfrac{F_x}{F_{xy}} \times d_m \times e^{\frac{-1}{F_{xy}}}, F_{xy} \neq 0, \end{cases} \tag{6}$$

where d_m is the maximum moving distance of the sensor node; F_{xy} is the resultant force of the virtual force acting on the node; and F_x and F_y are the x-axis and y-axis components of F_{xy}.

3.6.2. Improvement of VFA. Traditional VFA only considers the force between nodes. In order to reduce the time loss of nodes in the process of location update, the force of grid points on nodes is added, and its definition is shown in

$$F_{\text{grid}} = \begin{cases} \omega d_{ig}, r < d_{ig} < R \\ 0, \text{other} \end{cases}, \tag{7}$$

where ω is the gain coefficient; r is the perceived radius; R is the communication radius; and d_{ig} is the distance between the node and the grid point.

In the actual environmental monitoring process, nodes will gather on the boundary, as shown in Figure 9.

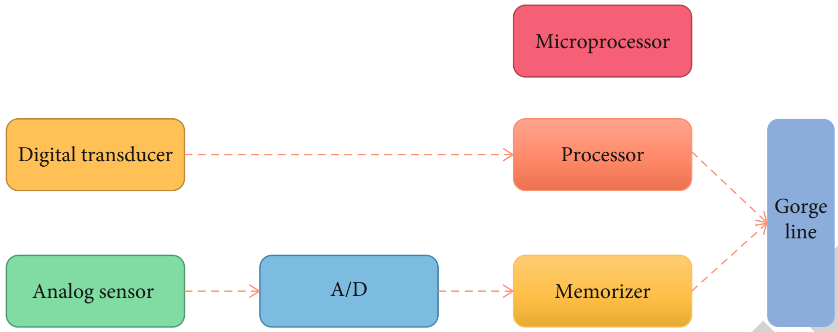


FIGURE 3: Hardware structure design of sensor module.

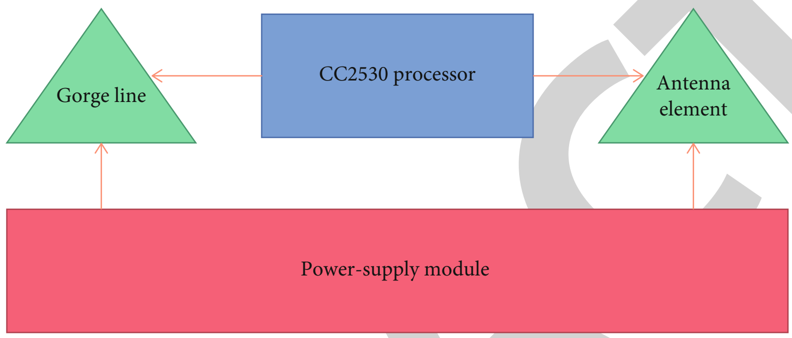


FIGURE 4: Hardware structure design diagram of ZigBee networking module.

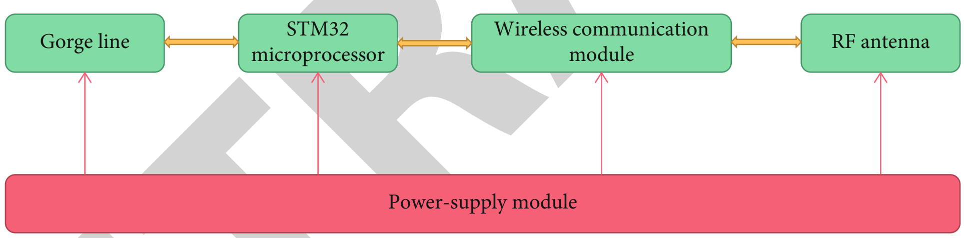


FIGURE 5: Hardware structure design of gateway module.

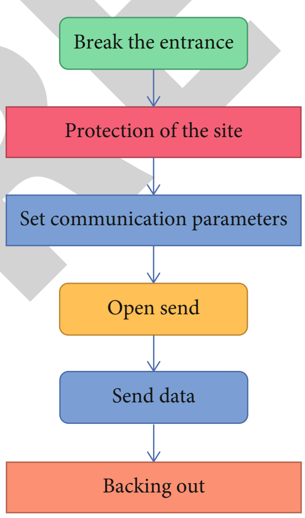


FIGURE 6: Environmental monitoring flow chart.

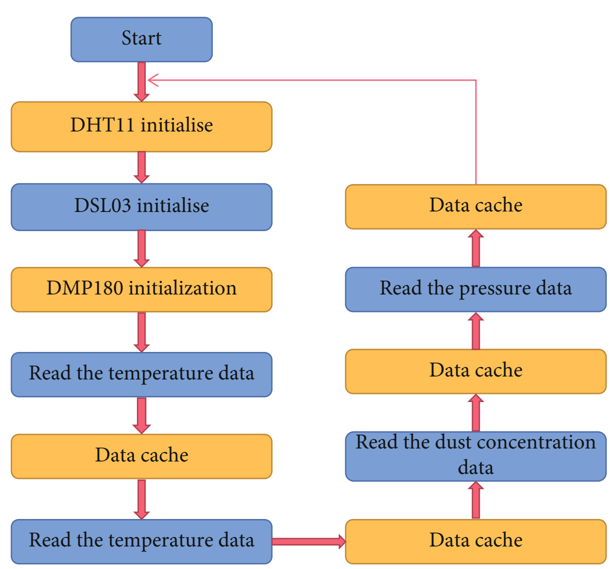


FIGURE 7: Data acquisition software design.

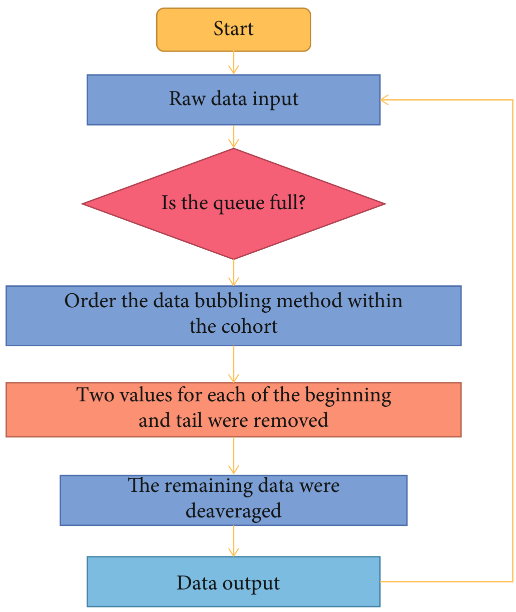


Figure 8: Software design of digital filtering algorithm.

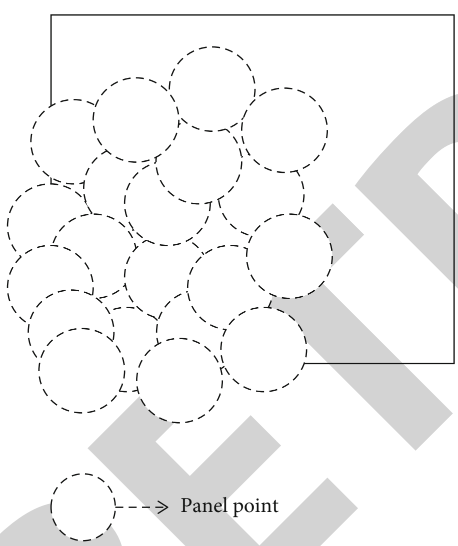


Figure 9: Case of a large number of boundary nodes.

In this case, if the nodes move according to the above rules, some nodes will be excluded from the boundary, resulting in the weakening of node coverage of wireless sensor networks.

Let the boundary of the region of interest also have a constraint F_b on the node, so that the node will not be "excluded" outside the region. The expression of the force is shown in

$$F_b = \begin{cases} \dfrac{\phi d_i}{d_i^{\,3}}, d_i \geq d_{\mathrm{bth}} \\ +\infty, d_i < d_{\mathrm{bth}}, \end{cases} \tag{8}$$

Table 3: Android APP data receiving information.

Ambient temperature	25
Ambient humidity	47
PM2.5	40
Pressure	988
Air conditioning box	Normal operation
Filter screen	Normal operation
Fan coil unit	Fault

where d_i is the distance from the sensor node i to the boundary; ϕ is the gain coefficient; and d_{bth} is the boundary distance threshold.

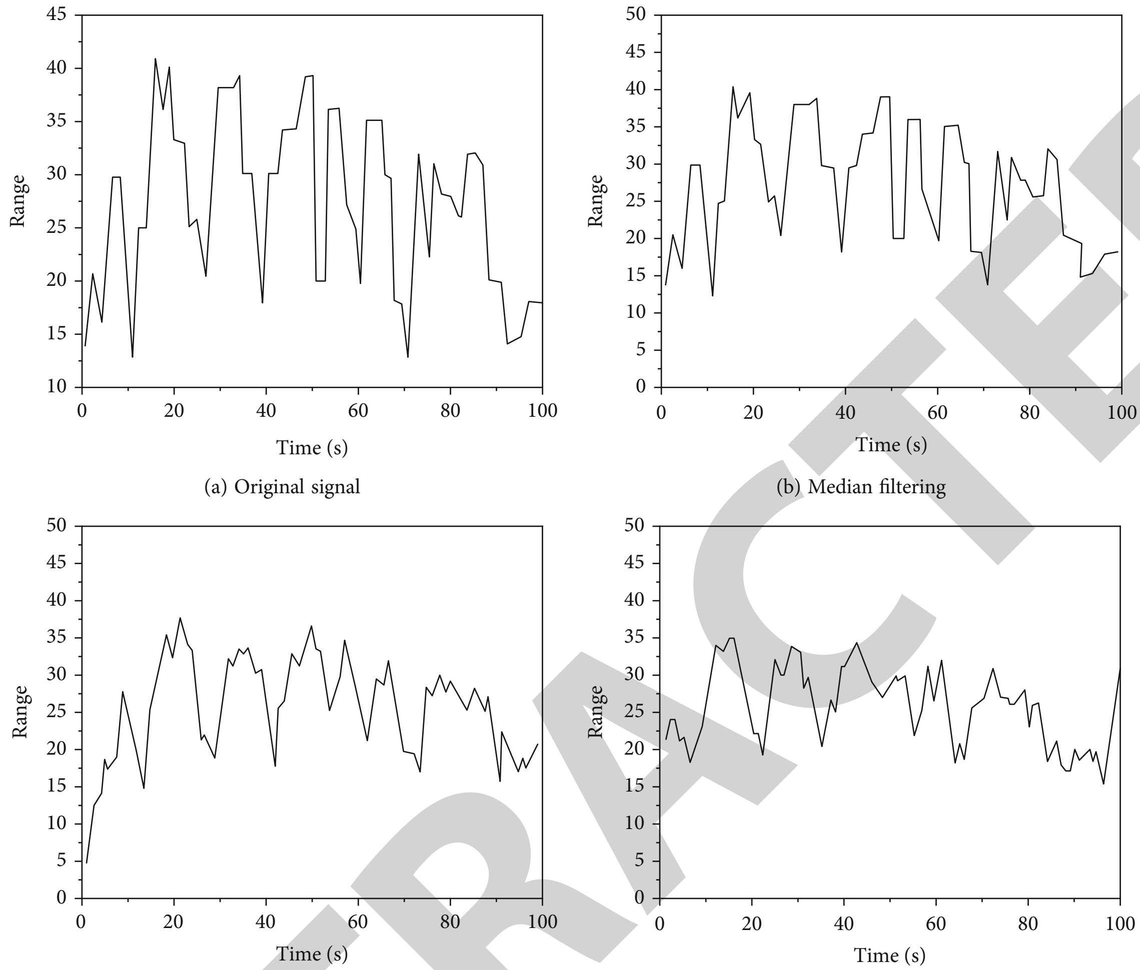
3.7. Gateway Module Software Design. The WiFi module loads the smart cloud firmware, establishes corresponding data points on the smart cloud platform, and realizes the data interaction between the gateway module, smart cloud server, and applications. Firstly, the gateway module receives the data from the coordinator node through the serial port, then gives an early warning on the operation of the clean equipment, and finally sends the data to the WiFi module through the serial port to the external network.

4. Result Discussion

4.1. System Practicability Test. Conduct a complete test on the data sending and receiving in the environmental monitoring system, and the data receiving information is shown in Table 3. The system can normally display the monitored environmental parameter information, and can make a judgment on the operation status of various components in the fresh air and air conditioning system, which greatly saves the consumption time of manual investigation, troubleshooting in a very short time, and making the normal operation of the equipment.

4.2. Effectiveness Test of Filtering Algorithm. The data detection module is related to the final embodiment of the data collected by each sensor, storing the core data of the environmental quality monitoring system as shown in Figure 10.

The simulation test is carried out on matlabr2013b, and the relevant parameters are set as follows: the monitoring area of wireless sensor network is 800 m ×700 m; the grid size is set to 2 m×2 m; the number of sensor nodes is $n = 36$; under the action of grid points, the sensing radius is $r = 90$ m; the maximum step is d_{th}=2.5 m; and under the action of sensor nodes, the maximum step is d_m=3.5 m. When there is no grid point force, the operation takes 14.210361 s. After adding the force of grid points on nodes, the running time is 11.257740 s, and the operation efficiency of the algorithm is significantly improved. The improved virtual force algorithm improves the node coverage by 5.2%. As can be seen from Figure 10, compared with the initial random distribution of nodes, the nodes are evenly distributed by using this filtering algorithm, and the task of overall regional monitoring is well completed.



(a) Original signal

(b) Median filtering

(c) Mean filtering

(d) This filtering

Figure 10: Filtering effect.

5. Conclusion

Through the research and the analysis of wireless sensor network, the system designed the sensor module, ZigBee networking module, gateway module, and Android APP monitoring interface and studied the accuracy of the system data collection and the coverage rate of the wireless sensor network. The environmental data collected by the sensor module was filtered, the improved virtual force algorithm was used to optimize the network module layout, and finally the system was tested. The experimental results show that the system has good communication and the signal is stable and can be widely used in various environmental monitoring fields. Wireless sensor network technology has a very broad application prospect, which will profoundly change people's lives. With the further research of wireless sensor network technology, it can be predicted that the products based on wireless sensor network technology will enter more and more into people's lives in the near future.

Data Availability

No data were used to support this study.

Conflicts of Interest

These no potential competing interests in our paper.

Authors' Contributions

And all authors have seen the manuscript and approved to submit to your journal.

Acknowledgments

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