Research Article

The Key Technology of Wireless Sensor Network and Its Application in the Internet of Things

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At present, sensor networks and the Internet of Things have made rapid development and received more and more attention. Wireless sensor network technology is widely applied in many industries. As an important part of IoT sensor layer, it is an important infrastructure for IoT development. The purpose of this paper is to enhance the existing wireless sensor networks on the basis of existing technologies for better application in IoT. In this article, we introduce the structural features, key techniques, and some specific applications of wireless sensor networks in the IoT. Secondly, this paper studies and analyzes the principle of the cell membrane algorithm and its own characteristics. Aiming at the problem of energy constraint in wireless sensor network, an energy equilibrium clustering algorithm based on the cell membrane optimization algorithm is proposed in order to realize energy balance of nodes and distribution of network cluster heads. This algorithm divides the nodes by concentration and energy factors and divides them into globally balanced clusters by combining distance factors, which can well solve the problems of uneven distribution of cluster heads and unbalanced global power usage in sensor networks. On the basis of a lot of previous researches, this paper presents a QoS model, which is based on the routing protocol, clustering protocol, and data fusion scheme discussed in this paper. Through analysis and experiments, it is proved that this scheme improves energy consumption and flexibility by 78\% compared with the previous one and achieves better network performance.

1. Introduction

The so-called IoT, which is something connected to the Internet, founded in 2009 in China “experience China” center, and also, developing the IoT of the national IoT “twelfth five-year” development plan is also in the process of development; this move is to determine that IoT has an irreplaceable role in the new era, which is a significant position in the emerging technology sector. Wireless sensor network technology, as the backbone of the Internet of Things, needs continuous development to promote the whole IoT and even Huliang network and becomes a catalyst for global economic development.

A wireless sensor network is a distributed sensor network with sensors at the tip that can sense and inspect the outside world. Sensors in WSN communicate wirelessly, so network settings are flexible, device locations can be changed at any time, and wired or wireless connections to the Internet are possible. A multihop self-organizing network formed by wireless communication.

The Internet of Things is an emerging technology that connects various forms of wired and wireless networks with the Internet, thus connecting objects to each other and forming a huge network for monitoring, analysis, and control. Wireless sensor technology is used in many applications like battlefield surveillance, ambient and traffic detection, and industrial and agricultural production. Wireless sensor network is an essential component of the sensor layer of IoT, which is a deep extension of the original network and an important material basis for the growth of IoT. Applying
the key technologies of wireless sensor networks in the Internet of Things will greatly improve the performance of related applications of the Internet of Things.

An appropriate sensor node clustering algorithm can improve the efficiency of sensor networks in terms of power. Nevertheless, clusters require extra expenses, like the selection and assignment of cluster heads and the building of clusters. Leu et al. proposed a wireless sensor network area energy perception clustering method based on isolated nodes, which is called isolated node area energy perception clustering. To extend the lifespan of the network, the mean energy of the area and the proximity of the sensors to the confluence are employed to decide if individual nodes send data to the CH node or the confluence in the preceding round [1, 2]. Wang and Jiang presented a detailed comparison of the design and protocol architecture [3, 4]. To facilitate the monitoring of dissolved oxygen in large-scale aquaculture ponds, Ma et al. have realized distributed measurement, intelligent control, and centralized management [5]. IoT is ubiquitous in our daily life. It is used in our homes, hospitals, and deployed outdoors to control and report changes in the environment. It prevents fires, and it has many other beneficial functions. Yang et al.'s investigation consists of four parts. The first part will explore the most relevant limitations of IoT devices and their solutions. The second will introduce the classification of IoT attacks. The next section will focus on the mechanisms and architecture of authentication and access control. The final part will analyze security issues at different levels [6]. To sum up, most of the literature cited in this paper is about sensors, which is insufficient in the Internet of Things. Next, this paper will focus on the application of wireless sensor networks in the Internet of Things.

Firstly, the thesis gives an overview of wireless sensor network. Then, the constraint relationship between the key technologies of wireless sensor network is analyzed. Then, the route management scheme based on clustering is described, and the detailed process of SCBRP algorithm and JAQ algorithm is given. Second is mainly based on the clustering of head inherit the protocol (ICBPWSN) which is described in detail, and the results of simulation experiment are given: first, it discusses the related data fusion technology and routing and topological structure, describes the data fusion (ALBDA) scheme based on the application layer, and finally gives the simulation and analysis results, and the fifth chapter is summary and outlook [7].

2. Proposed Method

2.1. Wireless Sensor Network

2.1.1. Wireless Sensor Network. The wireless sensor network originated in the cold war period and was initially used in the military field to monitor the activities of the enemy. Wireless sensor network (WSN) technology is highly valued and widely used in many countries. It can be expected to play a greater part in industrial and farming production, urban planning as well as management, environmental monitoring, and battlefield monitoring in the future [8, 9].

As wireless sensor network has a very broad range of uses, especially in the military and smart home applications, it has become an international concern, involving a high degree of interdisciplinary and knowledge integration of the forefront of the hot research field; there are many technical issues to be further studied. Many developed countries have invested heavily in research on wireless sensor networks and are eager to apply them to a broad range of uses [10].

2.1.2. Architecture of Wireless Sensor Network. Wireless sensor network is a kind of wireless ad hoc networks: it has several dozens to hundreds of even more a sensor node, through wireless communication links into a dynamic, more mobile peer-to-peer networks, usually including sensor node, the node, and the management node. The sensor node transmits the sensed data to the sink node in some way through wireless communication in the monitoring area and then finally reaches the user through other communication links. Through dynamic routing and mobile management technology, the network protocol stack of the whole network transmits information flow up to a certain level on unreliable and unstable channels. Figure 1 shows the architecture of the wireless sensor [11, 12].

2.1.3. Wireless Sensor Network Nodes. Sensor node is a kind of miniature embedded device, which requires low price and low power consumption. These constraints will inevitably lead to the relatively weak processor capability and small memory capacity carried by it. Generally, the sensor node supplies energy through the battery pack. The architecture of the node is presented in Figure 1. However, the energy of nodes, the constraints of various computing resources, the dynamic change of network topology, and the unstable connection status of links all make sensor networks more challenging, as shown in Figure 2.

2.1.4. Characteristics of Wireless Sensor Network

(1) Limited Resources. Extreme finite availability of resources for sensor nodes is shown in Table 1.

(2) Large-Scale Networks. Large scale is reflected in two aspects: the sensor network covers a larger area, and the sensor nodes are deployed in a larger density. In this way, the sensor network can obtain more real and comprehensive information. Collecting information from a large number of nodes can increase the information precision and decrease the accuracy requirements for individual node sensing data [13]. The existence of redundant nodes in large-scale multi-node distributed deployment can make wireless sensor networks more fault tolerant.

(3) Self-Organizing Dynamic Adaptive Network. Because of the wireless sensor network (WSN) is in most cases were randomly deployed (such as by aircraft or from animals carried) to the object to be observed environment, this requires that the sensor network nodes have the capability of self-organization as well as the ability to collaborate on network information transmission [14].
In addition, existing roofing structures of wireless sensor systems may fail as a result of external interference (environmental elements and vandalism) or power depletion. The capacity of a wireless connection can change depending on the environment or its own conditions. Sensor nodes, observed objects, and observers may change their positions. Sensor nodes, observed objects, and observers may change their positions; and dynamic human intervention to the control center (e.g., militarily preventing certain sensor nodes from falling into enemy forces). In order to effectively use energy to prolong the life of nodes, the nodes can be added or withdrawn dynamically. All these require wireless sensor networks to have dynamic adaptive capability [15].

(4) Bad Environment. Wireless sensor networks typically work in the wild or at least unattended and often work

![Diagram of wireless sensor architecture](image1.png)

![Diagram of sensor node components](image2.png)

**Table 1: Limited representation of sensor node resources.**

| Limited aspects               | The specific performance                                                                 |
|-------------------------------|------------------------------------------------------------------------------------------|
| Energy Co., Ltd.              | Nonrecyclable, button battery powered and nonreplaceable, energy must be used efficient  |
| Induction ability             | A single node has only partial inductive capability, such as acceleration, electromagnetic field, sound, light intensity, and some other characteristics, and must make full use of inductive data |
| Ability to calculate          | The memory is generally less than 100 KB, and the main frequency is less than 1000 MHZ, but there are also 128 K, such as Atmega128 |
| The ability to communicate    | The coverage range of node radio waves is less than 100 meters, and the communication bandwidth of dozens of kbps will also have uncertain changes |
without interruption but can also be subject to malicious human interference, information leakage, or the transmission of bug messages (similar to Byzantine errors, the implication is that trying to achieve consistency by means of message passing on an unreliable channel with message loss is impossible).

(5) Data-Centric Networks. General networks, network devices, and other resources are located by the unique port address in the network in different ways. Sensor networks are event and mission networks, and it is meaningless to talk about a single node without sensor networks. The uniqueness of the node number in a wireless sensor network is determined by the designing of the specific network traffic agreement. The upper application of wireless sensor network only tells the network whether there is an event happening in the area it is concerned about monitoring, or the network actively notifies the upper application of an event, and the user will not give a query task to a node. In this way, the wireless sensor network is a data-centric network because of the way to query or communicate with data [16].

The wireless sensor network is in a harsh environment, and its storage and energy are strictly limited. Therefore, when designing a WSN security solution, storage overhead must be considered. In Yeh, the gateway node needs to save the public keys of all users. In this solution, the smart card only needs to save the GWN identification data [17]. GWN only needs to save its own private key and public key, and each sensor node only needs to save the public key, which greatly reduces the storage space. The LED light block cipher was proposed at the CHES 2011 conference. The LED algorithm has a block length of 64 bits, supports a key length of 64/128 bits, and has 32 encryption rounds. At the same time, the encryption algorithm used in this scheme is an LED lightweight encryption algorithm, which does not require the use of a private key, and is simple and efficient. Sorting out and summarizing the memory space required by several lightweight block encryption algorithms under different plaintext lengths, the outcomes are presented in Table 2. The Advanced Encryption Standard in Cryptography, also known as Rijndael encryption, is a block encryption standard adopted by the US federal government.

| Encryption algorithm | 63     | 126    | 252    | 504    | 1008   |
|----------------------|--------|--------|--------|--------|--------|
| AES                  | 10090.25 | 10234.3 | 10120.34 | 10254.31 | 10234.63 |
| TWINE                | 2661.38  | 2354.01 | 2415.65 | 2365.21 | 3651.13 |
| LED                  | 2569.34  | 2145.21 | 2136.36 | 2145.35 | 3425.12 |

2.2. Application of Wireless Sensor Network Technology in the Internet of Things

2.2.1. Application in the Military Field. Wireless sensor networks have many features that are useful in the military, such as rapid deployment, free organization, high concealability, and high fault tolerance, which make them popular in the battlefield and can work great in extremely harsh environments. Aimed at this one big advantage, there will be a huge amount of sensor nodes, through the mode of transportation, including aircraft artillery, around the goal of all kinds of parameters, such as temperature humidity, terrain, voice, and coordinates, such as information acquisition, and then through the secret transmission channel, the information back to the processing, in this way, the real-time monitoring of the enemy’s movements and battlefield assessment, and implementation of simulation way work out a plan for the best, make the combat forces and its effectiveness, and reduce the unnecessary loss [18].

2.2.2. Application in Industrial Field. Wireless sensor network is very popular in the industrial field; it eliminates the artificial instability, making it possible to work every day, in the field of industrial safety, traffic control, security systems, logistics management, and so on. The application in the field of industrial safety is the most. In after dealing with the explosion of sensor node and the optimized technology, it can be put on people have hurt environment, real-time monitoring of the safety of staff, and process line for dangerous working environment environmental parameters in time and can let a person even remote control instead of people to work; therefore, wireless sensor network technology can optimize industrial process, reduce the probability of safety accidents in industrial production, and can ensure the quality of industrial production under the premise of improving the quality of the products.

2.2.3. Application in the Field of Medical Care. China has begun the aging of the population; in the medical care, problems are increasingly prominent, and real-time attention to the disease of patients has become a major problem to be solved. However, wireless sensor network monitoring system plays a significant role in this respect. Doctors can install tiny and precise sensors on patients to detect and collect real-time physiological information of patients, so as to understand the development of patients’ conditions at any time. On the other hand, real-time monitoring also provides more reference materials for medical institutions. Through the analysis and processing of various parameters, the root causes of diseases can be found, so as to develop effective drugs and save more people [19].

2.2.4. Application in the Field of Smart Home. In the last few years, the Internet of Things is developing into a smart home. Intelligent home means highly intelligent home automation system, the application of a lot of high-tech system products and equipment, and artificial intelligence, improves the safety and comfort of the home environment, and in this premise achieves energy conservation and environmental protection. The principle is to use a large number of wireless sensor network nodes to make it self-organizing interconnection, so as to achieve the interconnection and control of home devices; this is the smart home [20].

2.3. Ant Colony Algorithm and Its Application in Wireless Sensor Network Routing. Ant colony algorithm has the
characteristics of distributed colony computing, positive feedback of information, and heuristic search and is essentially a heuristic global optimization algorithm in evolutionary algorithms. To illustrate the ant colony method better, we use the figure below to illustrate it in detail. As shown in Figure 3, assuming that the ant starts from point A of the ant nest and the food source is at point D, the ant walks at the same speed. The length of ACD path is 20 units of distance, while the length of ABD path is 10 units of distance. As the ant departs from site A, it does not have prior knowledge of which route is optimal (no pheromone), so the probabilities of ABD and ACD are the same. After a distance of 10 units, the ants on the ABD route have managed to find food, and the ants on the ACD route have arrived at point C just now. After 40-unit distance, the ants of ACD path have successfully returned to point A of the ant nest, and the ants of ABD path have reached point D and found food. After 40-unit distance, the ants of ACD return from food source D to ant nest A, and they have a concentration of 2 units of pheromone, while the concentration of the pheromones in the ant nest A, and they have a concentration of 2 units of pheromone, and the ants of ACD route have arrived at point C just now. After 40-unit distance, the ants on the ABD path have successfully returned to point A of the ant nest, and the ants of ACD path have reached point D and found food. After 40-unit distance, the ants of ABD route have returned from food source D to ant nest A, and they have a concentration of 2 units of pheromone, while the concentration of the pheromones in the ABD path changes to 4 units, that is, the pheromone concentration of ACD path = 2 : 1. Then, when the subsequent ant colony selects the ABD and ACD paths, two ants will be sent to the ABD path, and one ant will be sent to the ACD path. After 40-unit distance, the concentration of the ABD path pheromone is equal to 3 : 1. If this is repeated, the ratio will increase from 4 : 1.5 : 1.6 : 1, that is, positive feedback will be formed, and finally, the route ABD will be chosen by every ant in the colony [21, 22].

2.3.1 Implementation of Ant Colony Algorithm. The connecting route pheromone among city i and city j at time t was set as \( t_{ij}(t) \), and the pheromone concentration on each city path was the same at the initial moment, set as \( t_{ij}(0) = t_0 \).

When the ant k determines the next city to arrive based on the pheromone intensity of intercity connectivity routes, the probability of ant k choosing the route \( ij \) is:

\[
p^k_{ij}(t) = \begin{cases} 
\frac{[\eta_{ij}(t)]^\alpha}{\sum_{u \in N_k(i)} [\eta_{iu}(t)]^\alpha}, & u \in N_k(i), \\
0, & \text{otherwise.}
\end{cases}
\]

(1)

After all ants finish a period, the information of pheromones on each city route is updated according to Equation (2):

\[
t_{ij}(t + 1) = (1 - p)t_{ij}(t) + \Delta t_{ij}, 0 < p < 1.
\]

(2)

Among them,

\[
\Delta t_{ij} = \sum_{k=1}^n \Delta t^k_{ij}.
\]

(3)

According to different pheromone update strategies, the basic ant colony algorithm has different models:

\[
\Delta t^k_{ij} = \begin{cases} 
\frac{Q}{L_k}, & ij \in l_k, \\
0, & \text{otherwise},
\end{cases}
\]

(4)

\[
\Delta t^k_{ij} = \begin{cases} 
\frac{Q}{d_{ij}}, & ij \in l_k, \\
0, & \text{otherwise},
\end{cases}
\]

(5)

\[
\Delta t^k_{ij} = \begin{cases} 
Q, & ij \in l_k, \\
0, & \text{otherwise.}
\end{cases}
\]

(6)

In the above three models, Q is a constant, representing the total amount of pheromone released by the ant once in a cycle, \( L_k \) is the path length of ant k between city i and city j, \( L_k = \) the path taken by the ant, and \( d_{ij} = \) the side length. The simulation experiment is programmed and tested using MATLAB2010b; the algorithm uses various parameters to be derived from experience and trial calculations, and the initial value settings are shown in Table 3.

2.4 Relationship between Key Technologies of Wireless Sensor Networks. The critical wireless sensor network technologies include network topology control, network protocols, data fusion, data management, QoS assurance, embedded operating system, time synchronization, and location information. Key technical issues, such as low-power short-range wireless telecommunication technique 1171 and security, have some challenging relationships.

2.4.1 Topology Control and Other Key Technologies. Topology management in wireless cell networks is used to

![Figure 3: Ant colony algorithm path diagram.](image-url)
eliminate unnecessary communication links between nodes by power management and selection of backbone web nodes and finally form a network topology structure of efficient data forwarding under the premise of satisfying the coverage and connectivity of the network. Its relationship to other key technologies is shown in Figure 4.

Due to the relatively large size of wireless sensor network (WSN), the node number is numerous, and adopting the method of plane management will become very difficult with the increase of network scale and at the same time make data in order from the sensor nodes for data management and integration. MAC protocol and time synchronization protocol are needed in the formation of hierarchical topology control. The MAC protocol determines when a node is allowed to send packets and generally controls all access to the physical layer. Conversely, when topology control is formed, a good topology will also improve the efficiency of MAC protocol and time synchronization protocol. In other words, they have a two-way relationship [23, 24].

The same is true for target location. With hierarchical structure, when a node detects the occurrence of an event, it will immediately obtain the bit yellow of the event or the location of the node, so that cluster cooperation can obtain the location information to locate the event. Topology structure also has a great impact on routing protocol. After the formation of hierarchical structure, the node only needs to know the routing information of the neighbor node, that is, it needs to know that the neighbor node can relay to the cluster-head node, and the cluster-head node needs to maintain the routing information of the base station and all its member nodes. Hierarchical structure refers to a structure of automated test code. The feature of this structure is that the complex test code is divided into three levels of one-way dependencies, and the test logic in the test code built with the hierarchical structure becomes clear and easy to understand and maintain [25].

After the formation of the hierarchical topology structure, in order to save energy, the induction data in each cluster can wait for the induction data of the downstream node and then forward to the upstream node after fusion, while the cluster head periodically waits for the induction data of all members in the cluster to arrive and send back to the base station through fusion. For the data management requests required by the application layer, the corresponding logic layer semantics can be mapped to the corresponding physical entity semantics, and then, the requested cluster makes the final response to the request through the cluster head.

3. Experiments

3.1. Experimental Environment. In the experimental scenario, more than 100 sensor nodes are randomly deployed in a grid of 100 × 100. The energy of each node is set to the same initial value, and the communication radius of the nodes is 50. In other words, only two nodes with a distance of less than 50 are considered as adjacent nodes. The formula for calculating energy consumption was tested with the previous data. Channel of the data transfer rate of 2.5 Kbps, the length of each packet is 40 bytes, and every node looms induction data at a time.

In order to demonstrate the performance of ALBDA data fusion scheme through experimental comparison using the above experimental environment settings, we chose two other data fusion schemes. No fusion scheme (NoAgg): each node does not know the existence of other nodes, and the data is not sent back to the base station through fusion; PerfectAgg: the node knows the optimal fusion node without additional communication and sends it to the base station after fusion. We recorded the event response latency, energy consumption, packet latency, packet loss rate, and the number of packets received by running each experimental scheme separately.

3.2. Experimental Parameters. Each node in the wireless sensor network is abstracted into nodes in the algorithm. If there are \( n \) nodes, the total number of nodes is \( n \). The maximum iteration times of each selected cluster head is \( \text{Gmax} \). The radius coefficient used to calculate the node concentration is \( r \). The critical value is \( \text{pa} \) for the current optimal node to stop searching. The shrinkage of the search radius is \( \text{pb} \).

\( n \) nodes were randomly deployed in the wireless sensor network, and the concentration \( \text{con} \) of the surviving nodes within the radius of each node was calculated according to the radius coefficient \( r \). For example, the concentration \( \text{con} \) of node \( I \) is defined as the sum of the distance from all valid nodes contained in the radius to node \( I \) and the percentage of the total number of nodes \( n \) times the radius, namely, formula (7):

\[
\text{con} = \frac{r \ast Y}{n \ast \sum \sqrt{(X - X_1)^2 + (Y - Y_1)^2}},
\]  

where \( Y \) is the total number of nodes within the radius coefficient \( r \). It can be seen from this that the higher the concentration of the node, the greater the number of nodes around the node radius, or the smaller the sum of the distances from all nodes to this node if the number is the same. \( E \) is the ratio of the energy of each node to the mean power of the web. The factor value \( (p) \) of each node is determined by the concentration \( \text{con} \) of the node and the energy ratio of the node, \( e \), that is, \( p = a \ast \text{con} + b \ast e \), where \( a + b = 1 \) and both \( a \) and \( b \) are greater than 0. Carrier factors are introduced to regulate the trajectory of node motion. The carrier factor of each
the di-
mal solution can only emerge through multiple iterations, so di-
vided, where $X$ represents the distribution ratio. The opti-
mal solution can only emerge through multiple iterations, so the different allocation ratio will not have a great impact on the number of cluster heads and the optimal solution in each round. However, if $X$ is too low or too high, it will lead to a large proportion gap between the three kinds of node groups and frequent jitter between the three kinds of node groups, which will extend the iteration times of the optimal solution and the iteration times of the three kinds of node groups and increase the calculation amount. In combination, the proportion of $X$ is 15-20% in the experiment.

We use the standard variance formula to evaluate the resource load. According to the resource load, calculate the total time for task scheduling and execution, as shown in Table 6 below.

| Parameter                                | Value                          |
|------------------------------------------|-------------------------------|
| Network coverage area                    | 140°90 m²                     |
| Number of sensor nodes                   | 100                           |
| Initial energy of node                   | 8 J                           |
| Packet size                              | 465 bytes                     |
| Metadata size                            | 18 bytes                      |
| Energy consumption per unit of data      | 1 nJ/bit                      |
| Maximum distance of communication between nodes | 30 m                      |

Among them, $g$ is the average distance parameter, which means that the distance between nodes within 2 search radius and this node is small and vice versa. The routing algorithm was simulated in the simulation environment of MATLAB7.0, and the convergence of the algorithm was ana-
yzed. The relevant test data are displayed in Table 4.

### 3.3. Initialization of Experimental Nodes

In $n$ nodes, the nodes are sorted according to the size of factor value ($p$), and the nodes are divided according to the following proportion, as shown in Table 5.

According to the above table, three node groups are divided, where $X$ represents the distribution ratio. The optimal solution can only emerge through multiple iterations, so the different allocation ratio will not have a great impact on the number of cluster heads and the optimal solution in each round. However, if $X$ is too low or too high, it will lead to a large proportion gap between the three kinds of node groups and frequent jitter between the three kinds of node groups, which will extend the iteration times of the optimal solution and the iteration times of the three kinds of node groups and increase the calculation amount. In combination, the proportion of $X$ is 15-20% in the experiment.

We use the standard variance formula to evaluate the resource load. According to the resource load, calculate the total time for task scheduling and execution, as shown in Table 6 below.

### Table 4: Experimental parameter setting.

| Parameter                                | Value                          |
|------------------------------------------|-------------------------------|
| Network coverage area                    | 140°90 m²                     |
| Number of sensor nodes                   | 100                           |
| Initial energy of node                   | 8 J                           |
| Packet size                              | 465 bytes                     |
| Metadata size                            | 18 bytes                      |
| Energy consumption per unit of data      | 1 nJ/bit                      |
| Maximum distance of communication between nodes | 30 m                      |

### Table 5: The partition way of nodes.

| The node type                           | Allocation proportion          |
|-----------------------------------------|-------------------------------|
| Low concentration node group (L)        | Sort the first $X$ times $n$   |
| High concentration nonfat-soluble node group (HF) | Sort the first $X$ times $n$ to 2$X$ times $n$ nodes |
| High fat-soluble node group (H)         | All the remaining nodes        |

### Table 6: Task allocation time comparison.

| Algorithm name                       | Task allocation execution time |
|--------------------------------------|-------------------------------|
| ACA algorithm                        | 79.8                          |
| Min–Min arithmetic                   | 89.4                          |
| FOA_ACA algorithm                    | 75.3                          |

node is defined as the ratio of the inverse of the distance between all effective nodes and this node and the total number of nodes $n$ within the 2-search radius ($2r$), as shown in formula (8):

$$g = \frac{1}{n} \sum_{i=1}^{n} \frac{1}{\sqrt{(X - X_i)^2 + (Y - Y_i)^2}}.$$  \hspace{1cm} (8)

 routing control information to increase the network load is small, meanwhile with the increase of transmission speed, while the routing control data increases but essentially unchanged routing control information, so the improved ACO algorithm of routing control information costs will be reduced.

#### 4.1.2. Total Energy Analysis

The lower the overall energy usage of the network, the lower the cabling expense of the network, and therefore, the longer the life-cycle of the system. The overall power consumed by the sensor is used as a measure, and the calculation is evaluated against the flood and basic ACO methods. The outcome is presented in Figure 5.

As can be seen from Figure 6, the energy consumption of this algorithm is higher than that of the flood model and the ACO algorithm. However, due to the flooding, all nodes in the model are involved in the benefit and the detection data of the flooding, and with the extension of time, energy consumption presents sharp steep increase: MAC OS used the network time delay information update paths, and optimizing the path requires more ants work together. The improvement of ACO algorithm can prolong the life cycle of the path by taking into account the energy balance characteristics of ant dynamic optimization, avoid cyclic ant proliferation, and save the power consumed by the network.

#### 4.2. Multicore Wavelet Vector Machine Algorithm Analysis

Statistical learning theory is a small-sample learning theory proposed by Vapnik et al., focusing on the study of statistical laws and learning method properties in the case of small samples. Based on the characteristics of known samples, it finds the interdependent relationship between data through learning methods, so as to predict the future data or judge its properties.

Suppose the practice model set of size $n$ is $\{x_i, y_i\}_{i=1}^{n}$, $\{x_i\} \subset \mathbb{R}^n$, where $x_i$ represents the sample input data, and if it belongs to the first category, then $y_i = 1$. If you are in the second category, then $y_i$ is equal to minus 1.

If there is a classification hyperplane,

$$wx + b = 0.$$  \hspace{1cm} (9)
Figure 5: Routing information overhead.

Figure 6: Comparison of energy consumption.
If samples can be separated without error, that is, samples of the same category are on the same side of the classification hyperplane, the sample set is said to be linearly separable, namely, to meet

\[
\begin{align*}
wx_i + b &\geq 1, \quad y_i = 1, \\
wx_i + b &\leq -1, \quad y_i = -1,
\end{align*}
\]

where \(W\) is the weight vector and \(b\) is the bias.

The distance from the point \(x_i\) of the sample to the categorical hyperplane is defined as follows:

\[
\Delta_i = y_i (wx_i + b) = |wx_i + b|,
\]

\[
\delta = \min \delta_i, \quad i = 1, 2, \cdots, n.
\]

4.2.1. Comparison of the Results of Three Diagnostic Models. Figure 7 shows a comparison of the diagnostic results for MKWRVM, RVM, and SVM. It can be seen that the number of error nodes diagnosed by the three diagnostic models is 4, 16, and 30, respectively, and the accuracy rate is 98.18%, 92.73%, and 86.36%, respectively. The results show that wavelet multicore correlation vector is better than RVM and SVM in diagnosis of wireless sensor nodes.

4.2.2. Comparison of Node Consumption Capacity. In the nonfusion scheme, the sensor data of the nodes are not fused and sent directly to the base station, so the transmission of a large amount of redundant data will consume too much energy. More importantly, due to the different distance between the nodes and the base station, some nodes will consume too much energy, so the energy consumption of the nodes is uneven. We can also see from the energy consumption of the node in Figure 8 that in addition to the energy consumed by selecting the cluster head, the energy consumption of ALBDA is close to the ideal fusion scheme, far less than that of the nonfusion scheme. In moreover, the power consumption of each node in ALBDA is relatively uniform.

5. Conclusions

Wireless sensor network as a new special distributed system can be obtained from its environment, several characteristics, so as to realize the remote sensing, fundamentally
changed the process of human to obtain information, process information, and in this sense, the wireless sensor network (WSN) is extended to its tentacles in the natural environment. Wireless sensor networks tend to focus more on the data itself and less on other information, somewhat like grids. From its birth, it is destined to have huge application prospects, not only in the current fields of military, industrial, environmental, and scientific research, but also in our lives. This puts forward more challenges to our research. As a key technology for wireless sensor nets, the research will face more formidable challenges.

This article first detailed analysis of the key technology of wireless sensor network’s (WSN’s) several aspects of the relationship between interdependence and mutual influence between them; thus, we are thinking about the key technology of any time; on the one hand, it cannot be isolated; we must consider other relevant aspects at the same time and provide the theoretical basis for our discussion later. The proposed SCBRP routing protocol provides the routing basis for the following clustering protocols, data fusion schemes and QoS schemes. Based on the features of wireless sensor networks, hierarchical network organization can be adopted for specific applications, and a clustering protocol ICBPWSN based on cluster head inheritance is proposed, which can quickly and energy-saving make the network form a hierarchical structure and avoid the random cluster head selection conflict in LEACH. Due to data fusion to the induction of network data processing, remove redundant, save energy, and increase the accuracy of the data, but due to limited resource extreme in the wireless sensor network (WSN), abnormal operating conditions may, with the time sensitivity of the handling of data cannot be too complicated, so in view of the existing research results, we suggest a fusion scheme based on a simple fusion function ALBDA; experiments show that it has obvious energy saving and the advantages of low bandwidth consumption and fast response data. With the progress of various related technologies of wireless sensor network, it is far from enough to only provide the classical wireless sensor network with the best possible service. This is the same with QoS in effect as in traditional networks, but it is a very difficult challenge to achieve this goal under the harsh conditions of wireless sensor networks. After the previous research in this paper, according to the previous research results, we proposed an energy-saving service scheme to provide QoS assurance, and we analyzed its advantages of energy saving and better adaptability.

Wireless sensor has attracted great attention from the whole academic circle. However, due to the extremely restricted working environment of wireless sensor network, the research progress largely depends on the progress of electronic technology, communication technology, micro-electromechanical technology, and computing technology. Under the current technical conditions, resource constraints make the research of key technologies very difficult, and the research of one aspect must also consider other relevant aspects. This paper only considers four aspects. If we can combine all aspects of key technologies, then we can more reasonably meet the demand, which is also the next step of research. For the clustering protocol, it is necessary to consider the optimization of the number of clusters. The flexibility of data acquisition and processing in data fusion needs further study. At present, QoS guarantees have the largest research space and the most formidable challenges, but it is also most affected by resource constraints. In addition, another important research topic for wireless sensor networks is network security, and more research is needed in the next step, especially the consideration of security policies and security mechanisms when considering other key technologies.

**Data Availability**

No data were used to support this study.

**Conflicts of Interest**

There is no potential conflict of interest in this study.

**References**

[1] J.-S. Leu, T.-H. Chiang, and Y. Min-Chieh, “Energy efficient clustering scheme for prolonging the lifetime of wireless sensor network with isolated nodes,” *IEEE Communications Letters*, vol. 19, no. 2, pp. 259–262, 2015.

[2] L. Ma, B. Wang, S. Yan, and X. Gu, “Temperature error correction based on BP neural network in meteorological wireless sensor network,” *International Journal of Sensor Networks*, vol. 23, no. 4, p. 265, 2017.

[3] Q. Wang and J. Jiang, "Comparative examination on architecture and protocol of industrial wireless sensor network standards," *IEEE Communications Surveys & Tutorials*, vol. 18, no. 3, pp. 2197–2219, 2016.

[4] Y. Zhang, D. Upton, A. Jaber et al., "Radiometric wireless sensor network monitoring of partial discharge sources in electric substations," *International Journal of Distributed Sensor Networks*, vol. 11, no. 9, Article ID 438302, 2015.

[5] C. Ma, D. Zhao, and J. Wang, "Intelligent monitoring system for aquaculture dissolved oxygen in pond based on wireless sensor network," *Transactions of the Chinese Society of Agricultural Engineering*, vol. 31, no. 7, pp. 193–200, 2015.

[6] Y. Yang, L. Wu, G. Yin, L. Li, and H. Zhao, "A survey on security and privacy issues in internet-of-things," *Internet of Things Journal, IEEE*, vol. 4, no. 5, pp. 1250–1258, 2017.

[7] S. Galmès, “Markovian characterization of node lifetime in a time-driven wireless sensor network,” *Numerical Algebra Control & Optimization*, vol. 1, no. 4, pp. 763–780, 2011.

[8] C. Xu, M. Zheng, and W. Liang, “Cooperative spectrum sensing of the cognitive wireless sensor network,” *Information and Control*, vol. 44, no. 4, pp. 430–435, 2015.

[9] S. Zahurul, N. Mariun, I. V. Grozescu et al., “Future strategic plan analysis for integrating distributed renewable generation to smart grid through wireless sensor network: Malaysia prospect,” *Renewable & Sustainable Energy Reviews*, vol. 53, no. 1, pp. 978–992, 2016.

[10] Y. Li, Y. Zuo, H. Song, and Z. Lv, “Deep learning in security of Internet of Things,” *IEEE Internet of Things Journal*, vol. 99, p. 1, 2021.

[11] V. Henriques and R. Malekian, "Mine safety system using wireless sensor network," *IEEE Access*, vol. 4, no. 4, pp. 3511–3521, 2016.
[12] H. Li and J. Liu, “Double cluster based energy efficient routing protocol for wireless sensor network,” *International Journal of Wireless Information Networks*, vol. 23, no. 1, pp. 40–48, 2016.

[13] B. Dou, J. Wen, X. Li et al., “Wireless sensor network of typical land surface parameters and its preliminary applications for coarse-resolution remote sensing pixel,” *International Journal of Distributed Sensor Networks*, vol. 12, no. 4, Article ID 9639021, 2016.

[14] M. Singh and P. M. Khilar, “An analytical geometric range free localization scheme based on mobile beacon points in wireless sensor network,” *Wireless Networks*, vol. 22, no. 8, pp. 1–14, 2015.

[15] G. Rajeshkumar and K. R. Valluvan, “An energy aware trust based intrusion detection system with adaptive acknowledgement for wireless sensor network,” *Wireless Personal Communications*, vol. 94, no. 4, pp. 189–192, 2016.

[16] J. Chen, G. Wang, and J. Sun, “Power scheduling for Kalman filtering over lossy wireless sensor networks,” *IET Control Theory & Applications*, vol. 11, no. 4, pp. 531–540, 2017.

[17] T. Hong, W. Zhao, R. Liu, and M. Kadoch, “Space-air-ground IoT network and related key technologies,” *IEEE Wireless Communications*, vol. 27, no. 2, pp. 96–104, 2020.

[18] X. Li, H. Liu, W. Wang, Y. Zheng, H. Lv, and Z. Lv, “Big data analysis of the internet of things in the digital twins of smart city based on deep learning,” *Future Generation Computer Systems*, vol. 128, pp. 167–177, 2022.

[19] Z. Lv, Y. Han, A. K. Singh, G. Manogaran, and H. Lv, “Trustworthiness in industrial IoT systems based on artificial intelligence,” *IEEE Transactions on Industrial Informatics*, vol. 17, pp. 1496–1504, 2020.

[20] T. Olofsson, A. Ahlen, and M. Gidlund, “Modeling of the fading statistics of wireless sensor network channels in industrial environments,” *IEEE Transactions on Signal Processing*, vol. 64, no. 12, pp. 3021–3034, 2016.

[21] I. Cvitić, D. Peraković, M. Periša, and M. D. Stojanović, “Novel classification of IoT devices based on traffic flow features,” *Journal of Organizational and End User Computing (JOEUC)*, vol. 33, no. 6, pp. 1–20, 2021.

[22] B. Zhang, K. Wen, J. Lu, and M. Zhong, “A top-K QoS-optimal service composition approach based on service dependency graph,” *Journal of Organizational and End User Computing (JOEUC)*, vol. 33, no. 3, pp. 50–68, 2021.

[23] M. Shuai, N. Yu, H. Wang, L. Xiong, and Y. Li, “A lightweight three-factor anonymous authentication scheme with privacy protection for personalized healthcare applications,” *Journal of Organizational and End User Computing (JOEUC)*, vol. 33, no. 3, pp. 1–18, 2021.

[24] R. S. Bhadoria and N. S. Chaudhari, “Pragmatic sensory data semantics with service-oriented computing,” *Journal of Organizational and End User Computing (JOEUC)*, vol. 31, no. 2, pp. 22–36, 2019.

[25] L. Li and J. Zhang, “Research and analysis of an enterprise E-commerce marketing system under the big data environment,” *Journal of Organizational and End User Computing (JOEUC)*, vol. 33, no. 6, pp. 1–19, 2021.