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Research Article

Digitalization and Information Management Mechanism of Sports Events Based on Cooperative Sensing Model of Multisensor Nodes

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This paper provides an in-depth study and analysis of the optimization of sports event management systems using wireless sensor networks. Aiming at the monitoring task of a directed wireless sensor network in a three-dimensional environment, the directed sensing nodes scattered inside the designated monitoring area in a random deployment manner usually have uneven distribution and other problems; we analyze the characteristics of the directed sensor nodes, probabilistic sensing model, and the cooperative sensing model of multiple sensor nodes for monitoring target points and propose a sensing optimization strategy in polar coordinates to guide the three-dimensional plane directed orientation adjustment and sensing optimization of sensor nodes, thus enhancing the sensing capability of network nodes. The experimental results confirm that the algorithm can improve the coverage of the area to be monitored and the quality of sensing service, and it reduces the overall energy consumption of the network by using the distributed node synchronization scheduling mechanism to extend the life cycle of the network to maintain good monitoring capability under the premise of the limited total usage of the directed nodes in wireless sensor networks. The application of wireless sensor network technology in sports competition management mainly includes the application of smart wearable devices in sports competition training, the application of goal-line technology in sports competition, and the application of eagle eye technology in sports events, all three technologies have certain advantages in the application of sports competition, and all of their help to promote the improvement of sports event management and the development of sports industry; the second aspect is wireless sensor. The second aspect is the application of wireless sensor network technology in sports event information management, which is mainly used to collect information related to sports events and fully utilize it to make sports event management more informative and digital, which is helpful to improve the level of sports event management; the third aspect is the application of wireless sensor network technology in sports event stadium management, which is mainly based on intelligent stadiums to create a more spectator-friendly and good experience for the audience, a more ornamental and good experience viewing place, to promote the development and growth of sports industry.

1. Introduction

The research task of this paper is mainly based on the current development of wireless sensor network technology and the application of wireless sensor network technology in the management of sports events, analyze and study the current situation of the application of wireless sensor network technology in the management of sports events, through the collation and analysis of literature to know the current wireless sensor network technology and the management of sports events, and analyze the wireless sensor network [1–3]. The application of wireless sensor network technology in the management of large sports events, the analysis of the necessity and importance of the application of wireless sensor network technology in sports events, given the important role of wireless sensor network technology for the application of sports event management, the management of sports events should improve the application of wireless sensor network technology and then effectively promote the reform and development of the sports industry, to achieve the improvement of the level of sports event management and promote the development of sports [4]. The

deployment optimization of sensor nodes is one of the most fundamental research work in the process of WSN construction; deployment strategy in terms of sensing data correctness and integrity characteristics not only directly affects the adaptive capacity of WSN, stability, and monitoring performance but also in improving network connectivity, communication quality and sensing quality, reducing application costs and node energy consumption and extending the network life cycle, etc., play an important role in improving network connectivity, communication quality and sensing quality, reducing application costs and node energy consumption, and extending the network life cycle, thus ultimately determining the ability of WSNs to efficiently acquire physical information from the objective environment and the integrated quality of service.

To accomplish large-scale environmental monitoring, a very large number of sensing nodes can be placed inside the monitoring area using both deterministic and random deployment. In areas where the external environment is ideal and maneuverable, they are usually deployed deterministically based on a precalculated location, while in specific areas such as military battlefields, ocean exploration, volcanic and seismic disaster sites, which are high-risk, complex, and dynamic or unattended, deterministic deployment is very difficult to achieve [5]. This approach is less restricted by geographic location and relatively low cost and is an important complement to existing monitoring means, which is of great significance. Since sensor nodes are constrained by their energy load, computing power, wireless communication range, etc., whether WSNs are built using deterministic or random deployment, local node failures or network topology changes may occur due to energy depletion of sensors, physical failure of hardware, or changes in the external environment, target movement, obstacle occlusion, and malicious attacks. This leads to "coverage holes" in the monitored area, such as blind areas that cannot be sensed or targets cannot be tracked in a timely and effective manner. In addition, inappropriate network node deployment schemes or node failures can also affect network connectivity and the integrity of data collection information. The many obstacles that exist in the development of sports have many negative effects on the development of competitive sports. It is necessary to improve the environment of sports development, optimize the unfavorable factors of sports development, and overcome these obstacles to promote the development of the sports industry. The tertiary industry is affected by macro factors as well as internal factors. It is necessary to fully recognize the internal and external obstacles of competitive sports, overcome the constraints of the microenvironment, improve the general social environment, and effectively use the political, economic, and cultural characteristics to bring into play the economic potential of the sports business.

WSN routing protocols play a very critical role in sensor node work because, in most WSN practical applications, the resources of sensor nodes are subject to environmental factors that can lead to varying degrees of limitation, and sensor nodes can work for months or even a year without getting recharged, especially in places where nodes are relatively densely distributed, and different nodes may collect multiple data about the same event and send it to the end nodes, which without a proper routing protocol will lead to serious problems such as data redundancy and radio channel contention, thus significantly shortening the life cycle of wireless sensor networks. Wireless sensor networks are very different from traditional networks, which are more focused on quality of service, while wireless sensor network nodes are limited in terms of communication, computation, wireless bandwidth, battery power, and storage space, which leads to the fact that traditional routing protocols do not work directly on wireless sensor networks. The energy consumption of sensor nodes consists of three parts: data sensing, data processing, data sending, and receiving. Because of the respective characteristics of the K-means algorithm and the artificial bee colony algorithm, a K-means clustering algorithm based on the improved artificial bee colony, IABC-Kmeans, is proposed. The algorithm first improves the artificial bee colony algorithm: the proposed maximum minimum distance product method is used to initialize the bee colony to ensure that the initial points are chosen to represent the distribution characteristics of the data set as much as possible; the new fitness function and the position update formula are used in the iterative process to complete the optimization-seeking evolution. Then, the improved artificial bee colony algorithm is applied to the K-means algorithm to complete the clustering. Therefore, we should fully consider the factor of limited node resources in the process of designing routing protocols.

2. Current Status of Research

It is analyzed that in the modern intelligent system, wireless sensor network technology plays an indispensable role in the development of information technology construction as one of the key components. Wireless sensor network technology covers a range of technologies such as storage and computer sensing, which are widely used in production and life in society and play an active and efficient role [6]. The basic condition of the wireless sensor network application is Internet technology, using the information technology on the Internet to establish a certain connection between things and things and then complete the interlocking three-dimensional network, so that the false world and the real world establish a certain relationship [7]. In this literature, the main concern is the awareness and understanding of wireless sensor network technology, taking the cognitive mechanism as the starting point and using the mode of combining information technology and wireless sensor network technology to explore the characteristics of wireless sensor network technology and the cognitive approach [8]. The main discussion includes the establishment of wireless sensor network technology from the cognitive perspective and the level of cognition that has been available for the functions of wireless sensor network technology [9]. It is mentioned that today, wireless sensor network technology is getting increased attention from the government, enterprises, and society at large. The current wireless sensor network technology has a wide range of applications and has

been involved in agriculture, commerce and industry, and service industries and has a growing influence in society. Although the application of wireless sensor network technology is relatively wide, wireless sensor network technology is still not mature enough; in terms of technology, it still needs some help and support from the government [10]. Artificial intelligence can be learned over time and discover how it differs from traditional behavior. Deep learning and machine learning algorithms can identify patterns and changes and understand them over time. The self-learning capabilities of artificial intelligence can help security teams quickly spot differences in regular network traffic. At present, the application of wireless sensor networks in related industries is still in the primary stage, and the lack of government support for wireless sensor network technology has led to the slow and unstable development of wireless sensor network technology. How to develop and grow wireless sensor network technology efficiently, with the current status quo, it is necessary to analyze and explore the wireless sensor network technology in related industries [11].

Several universities and research institutions in China for wireless sensor networks have been launched, research is progressing very rapidly, and a large number of research results have been achieved. In our country in the next 20 years foresee the technology of the survey report, the information field 157 technology topics have 7 directly related to sensor networks [12]. It can be expected that the research and application of wireless sensor networks is an inevitable trend; with the solution of various key issues and the gradual reduction of the price of sensor nodes, it will bring great changes to human society [13]. Sports event refers to the general term of a series of related activities centered on sports competition, and sports event contains sports competition [14]. At present, sports competitions of a certain scale were generally comprehensive athletic activities with a variety of factors and cameras, including organization, marketing, human management, coordination management, and event execution. Therefore, it can also be seen that the current sports competition is not simply a comparison of athletic skills, but a comprehensive activity involving economic, cultural, and other factors. The definition of the sporting event itself is not known [15].

In common sense, a sports event is a special activity in which the event organizer takes sports competition as a carrier to achieve certain purposes and brings competition-style art performance and related service products to the audience according to the rules, regulations, and schedule of sports competition. With the advent of the Internet era, sporting events have long broken through territoriality and limitations, and it can be said that where there are human beings, there are sports. In the context of today's Internet era, the Internet covers the entire industry while also injecting new vitality and vitality into sporting events; using the power of wireless sensor network technology to promote the progress and development of sporting events has become a reality. The value and significance brought by this industry are also incalculable. Each big event can also be divided into smaller events, for example, modern track and field sports are classified differently; most of them are divided into three categories: track and field, field events, and all-around, or into five categories: walking, running, jumping, throwing, and all-around.

3. Optimal Design of Sports Event Management System for Wireless Sensor Networks

3.1. Wireless Sensor Network Management System Design. The perception model can intuitively and graphically portray the range of node perception, the intensity characteristics of perception capability, and the geometric relationship between the nodes and their perception range and the target object and express and influence the overall perception range, perception intensity, perception effect and monitoring capability of the whole wireless sensor network, and other characteristics, reflecting the node perception capability and perception quality [16]. In different fields of wireless sensor network applications, it is usually necessary to use the sensing model to represent physical and spatial location of each sensor node in the environment to be monitored, the relative position relationship between each node, and the geometric relationship between the sensor node and the target object, to facilitate the visual representation of the node sensing capability and range and to facilitate the deployment and optimization of sensor network nodes. Optimization problems for the accurate and correct intuitive description of the sensor sensing quality of service metric. Among them, the disc perception model, probabilistic perception model, statistical model, and directed perception model are more commonly used; in addition, there are some derived perception models. In practical application scenarios, since most of the external environments where wireless sensor networks are deployed are usually harsh, influenced by external noise, humidity, temperature, and other interference factors as well as the fading characteristics of the wireless communication signal itself during the transmission process, essentially, the sensory strength of most sensor nodes has a disc model characteristic of continuous decay associated with the sensing distance [4]. The application of wireless sensor networks is mainly focused on smart wearable devices, door line technology, and eagle-eye technology, although the application of wireless sensor network technology is relatively small, but also basically to achieve fairness, speed, and efficiency of sports event management, in the future development of sports events. And the probabilistic perception model precisely characterizes this decaying asymptotic process, thus better representing and reflecting the uncertainty characteristic of the sensor element's constantly changing sensing capability in practical applications. Nodes are arbitrarily distributed in a square area, and the nodes will be left unattended for a long time after placement. Nodes are arbitrarily distributed in a square area, and the nodes will be left unattended. Each node is identical and can vary its own transmit power to communicate directly with the base station. The nodes have some computational as well as storage capabilities; the nodes have data fusion capabilities; the base station location is fixed and energy unconstrained, and 100 WSN nodes are distributed arbitrarily in a square area as shown in Figure 1. Peng Weiyong said that the

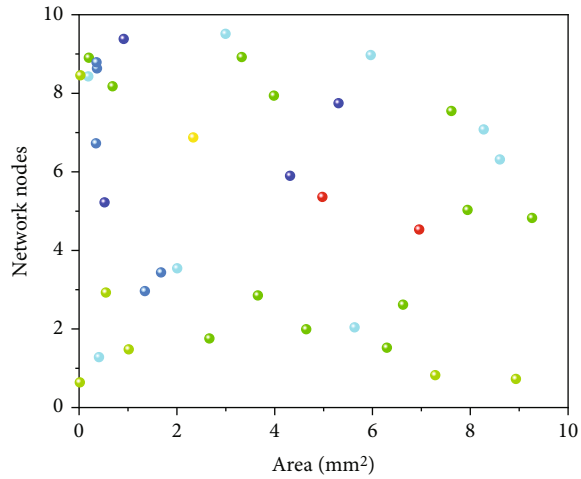

Figure 1: Arbitrarily distributed 100 wireless sensor network nodes.

General Administration of Sports will support the development of intelligent sports events with ice and snow, basketball, soccer, racing, and other sports as the main content. The continuous growth of these new industries, new models, and new consumptions will have a greater promotion effect on the development of the sports industry.

Many sensor nodes that can communicate by wireless communication are randomly deployed in the monitoring area. After the sensor nodes collect the data, the data is transmitted to the aggregation nodes through multihop routing, and then, the data is sent to the task management console through Internet transmission, and finally, the user can obtain the data through the control center for subsequent data analysis and operation, and the transmission network is managed and configured accordingly [17]. Generally, the functions of sensor nodes include sensing, collecting, forwarding, and processing information, and its capacity size, communication capability, and ability to process data are less than that of aggregation nodes, which can connect wireless sensor networks to external networks. Each sensor node consists of four modules as shown in Figure 2.

The physical layer is related to the data transmission, energy consumption in the network; the data link layer not only handles the data coming up from the physical layer but also uses MAC protocols thus reducing the energy loss; the network layer mainly uses the appropriate routing protocols for the transmission of packets in the network and thus the communication between the nodes; the transport layer mainly controls the transmission of data; the application layer mainly uses some protocols to complete the network required time synchronization as well as node positioning requirements. The traditional communication network simply focuses on network connectivity and communication service quality, while the wireless sensor network is concerned with the execution and feedback of the user's task requirements, how to choose the appropriate node organization, information interaction methods, and network resource allocation according to different task requirements, to efficiently complete a variety of tasks is the challenge facing the wireless sensor network.

$$P_r(d) = P_t \frac{G_r G_t}{d/\lambda^2},$$
$$\text{HopSize} = r\left(1 - e^{n_{\text{local}}}\right) + \int_{-1}^{1} e^{n_{\text{local}}} dt, \tag{1}$$
$$d_i = \text{HopSize} \times \text{hop}_i^2.$$

Node energy in wireless sensor networks generally comes from small, energy-limited microcells, so the energy carried by each node is limited. However, the arrangement of nodes in the area is often random and the number of nodes is so large that it is difficult for manual management and maintenance of sensor nodes. Therefore, during the work of wireless sensor networks, the focus should be on the efficient utilization of node energy and reduction of node energy consumption aspects.

$$W_i = \frac{1/N_i}{\sum_{j=1}^{n} N_i^2}. \tag{2}$$

Since wireless sensor networks are based on user requirements, even if the nodes in the network have different processing capabilities and life cycles in the network, users do not care about which numbered node the data is obtained from, how the terminals subsequently process the collected data, but only the data that directly reflects the properties of the target object after comprehensive processing. In this process, the propagation path of sensor nodes is dynamically changing and the network topology is also dynamically changing. Since networks were originally used in the military to facilitate military modernization, the characteristics of network security also need to be considered. Intelligent sensors are sensors with information processing functions, integrating sensing. Current sensing technology to the intelligent, networked, miniaturized, integrated development of intelligent sensors as networked, intelligent, systematic, and autonomous sensing devices is the basis for the realization of intelligent manufacturing and the Internet of things. To consider in case of external attacks, eavesdropping, or damage to the nodes, techniques such as authentication of visitors to set questions, more secure routing mechanisms, and timely alerts to outsiders intruding into the network are needed to secure the network.

$$e_i = \frac{1}{N \times R} \sum_{j=1}^{n} N_i^2. \tag{3}$$

Tight coupling means that the anchor nodes are deployed in advance in the network and are connected to other nodes by wire. The advantages are fast transmission speed, high accuracy, and more security. The disadvantage is that the anchor node in a normal wireless sensor network not only knows its location information but also can change its position at will, while the anchor node in a tightly coupled network cannot change its position at will, and the

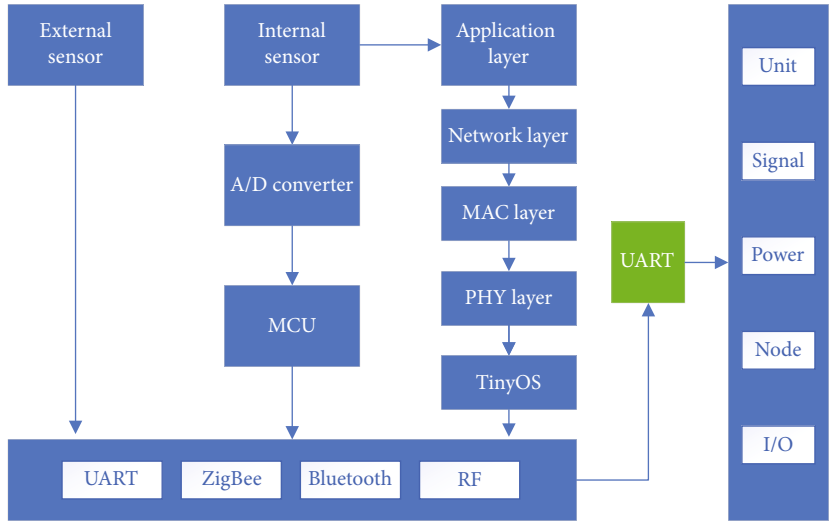

Figure 2: Sensor node module composition.

wired communication method also brings additional hardware requirements and inevitably puts pressure on network maintenance during operation, so it is often used in indoor environments with a narrow communication range [18]. The loose coupling has a high degree of autonomy and flexibility compared to tight coupling and can achieve positioning through information interaction between nodes, but at the expense of accuracy. In practical applications, loosely coupled networks are easier to maintain, and their research and application are more frequent. A single-hop algorithm is one in which two nodes can communicate directly with each other. The multihop algorithm is the case where the distance between two nodes is too large to communicate directly, and so communication is done with the help of the nodes between them. In comparison to multihop algorithms, single-hop algorithms are simpler to operate and easier to implement, but the communication range may be more limited, while the actual application often requires a wider range of measurements, so multihop algorithms are more widely used. In this context, UAVs, with their advantages such as high mobility, flexibility, and economy, have attracted attention. Deploying UAVs as aerial mobile base stations for alleviating temporary mismatches between supply and demand is an attractive solution.

3.2. Experimental Design for Optimizing Sports Event Management Systems. Sports event management is the whole process of planning, planning, organizing, and controlling the sports events provided to the society using certain human, material, financial, information, and technical resources. Sports event management involves a series of related industries and activities. The application of wireless sensor network can improve the level of sports event management, the current application of wireless sensor networks mainly focuses on other related processes, and links, such as sports media services, sports event organization, and planning links are also involved, but the application is relatively small [19]. The relationship between wireless sensor network technology and sports events is mutually beneficial, good wireless sensor network technology can improve the level and quality of sports event management, increase the fairness of competitive sports, appreciation of entertainment, etc. And the vigorous development of sports event management also promotes the development and application of wireless sensor network technology. The application of wireless sensor networks in competition management, information management, and venue management is selected for illustration and analysis.

In sports competitions, smart wearable devices are used to transmit athletes' body data back to the computer of sports health care personnel, and the health care personnel, after analyzing and comparing the data, make dietary and other adjustments to the specific body conditions of athletes, improve the situation of physical fatigue of athletes in competitions, and establish corresponding models for in-depth analysis, and through the above analysis and adjustments. The athlete's body can be maintained in the best competitive state in the sports competition. After collecting and organizing the data in the athletes' competition, big data processing is carried out. The athlete will wear the smart wearable device, collect the data of the sport, model and analyze the body condition before the athlete is injured, and the medical personnel can easily track the athlete's body condition and send an alert before the athlete is injured, to effectively prevent the athlete's injury, as shown in Figure 3.

In recent years, the marathon has gradually started to rise in the country, and the number of times the sport is held is also increasing, but the important issue that comes with it is the safety of athletes, especially the case of the sudden death of athletes because marathon running happens from time to time and shows a rising trend, therefore, the application of wireless sensor network technology in the marathon, using wearable smart devices to collect. Once the athlete's data shows the danger area, the system will automatically make a warning and alarm and pass the information to the emergency center, which will quickly respond and take corresponding measures so that the safety of the athlete can be effectively protected [20]. This can effectively protect the

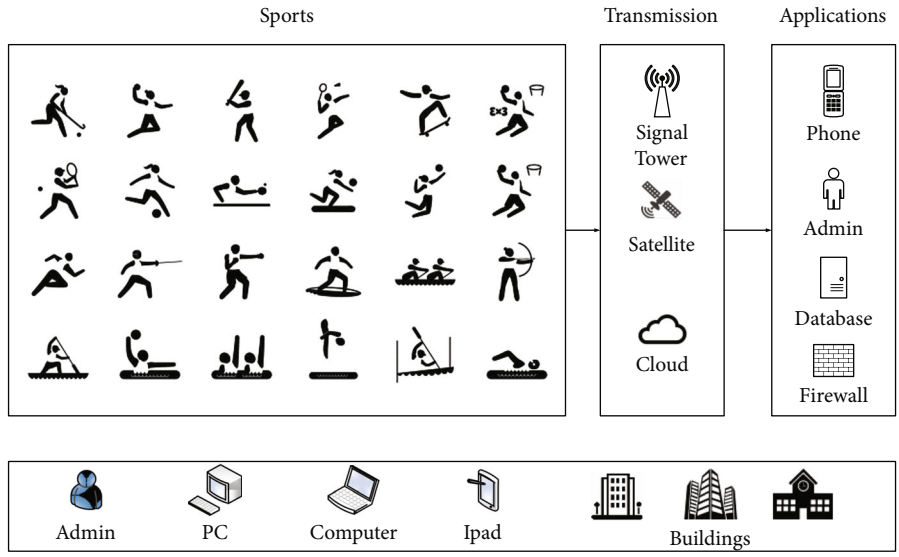

Figure 3: Example of a target-aware deployment.

safety of the athletes and prevent sudden death in the marathon system, so that the marathon can be carried out smoothly. In the marathon, wireless sensor network technology is widely used in the safety of the sports monitoring system, collecting, and monitoring the changes in the trajectory of the marathon athletes, changes in the movement of the situation, effectively guaranteeing the safety of the lives of marathon athletes in the race, to avoid injuries to athletes.

In some specific monitoring tasks, instead of complete monitoring of the entire area to be monitored, only a limited number of discrete key target points located at certain locations inside the area to be monitored are targeted and locally focused, based on deployment examples of target point awareness. These key target points are typically points of interest or target objects of interest to the user whose location information is known, and randomly deployed sensor nodes inside the network can be scheduled and woken up to work state to complete the monitoring task and ensure that the minimum number of nodes is used. A result can lead to loss of important monitoring data, and for applications such as motion tracking and military monitoring, where data accuracy and precision are required, it is required to achieve sensing of any location within the monitoring area by at least k nodes to tolerate the sensing quality of the network in case of failure of at least k-1 nodes, as shown in Figure 4.

The dynamic node deployment problem has two main dynamic characteristics; on the one hand, if the network is joined with movable sensor nodes, when the redeployment demand occurs in the network, the deployment algorithm will control the relevant nodes to move to the best deployment location autonomously to optimize the network structure, and the network nodes remain stationary after redeployment; on the other hand, for dynamic wireless sensor networks in which the nodes are all movable. The deployment algorithm will move and schedule the nodes appropriately according to the monitoring needs of the target area [21]. The strategy of joining dynamic multi-intelligent body robot formations is usually applied to centralized algorithms in dynamic network deployment optimization problems and does not apply to ordinary sensor networks where nodes have limited computational power. In addition, the mobility capabilities of the deployed nodes themselves differ: mobility-constrained nodes can usually only move horizontally or vertically, while free nodes can displace freely.

The various types of users are classified in the system in a certain way, using a combination of type, system, and level, while the personnel of each unit using the system is managed hierarchically. Each unit has independent management authority to manage the personnel and data of the unit, respectively, while each user uses the corresponding functions of the system according to different authorization specifications. The system adopts a combination of centralized authorization and hierarchical authorization, and the system administrator can directly authorize the application system, or the submodule administrator can manage the authorization of the corresponding module to meet the needs of applications of different scales and nature. The system provides multilayer authority for functional management, which can be divided into system, functional module, business form, and field-level authority division and control. Management of the system: user management, organization management, extension management, and other authorization management can be carried out. Management of function module: you can manage and authorize the functions and contents in the function module. Management of business forms: you can only create, read, delete, and archive files within the authorized form templates and other permissions.

4. Analysis of Results

4.1. Wireless Sensor Network Management System Performance. As shown in Figure 5, as the node communication distance increases, the signal strength continuously attenuates causing the node to perceive the target object with

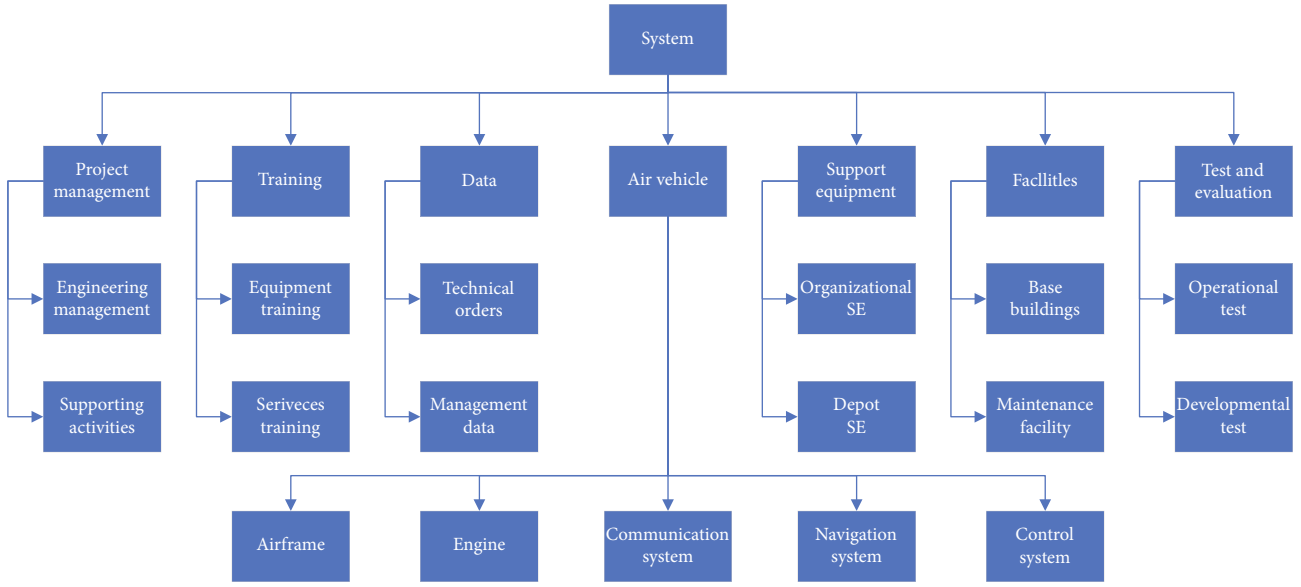

Figure 4: Structure of the information management system.

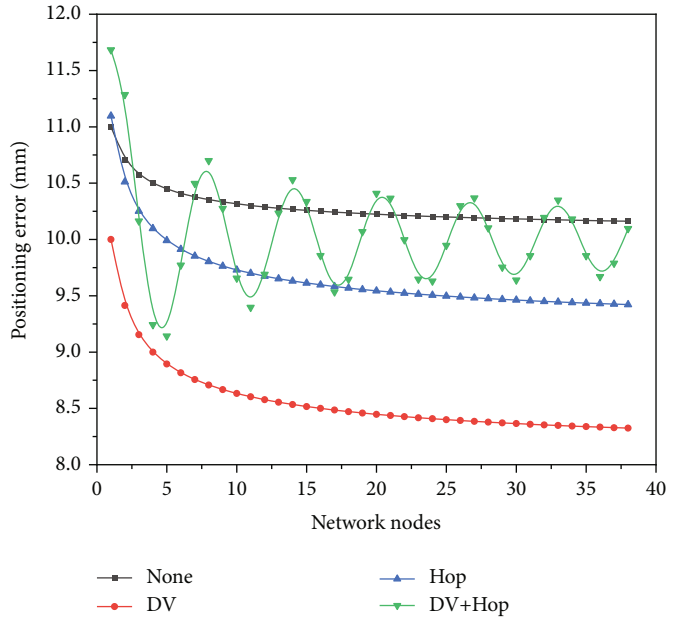

Figure 5: Effect of the total number of nodes on positioning accuracy.

less strength and accuracy, which affects the perceived quality and monitoring accuracy. In addition, the perception ability of the directed sensor nodes to the target object is not only closely related to the distance between the two but also depends on their event if a target object is located inside the sensing radius of two different sensor nodes at the same time, due to the influence of factors such as the node's sensing perspective; these two sensor nodes may not be able to sense the appearance of the target object and events, resulting in a situation where the sensing capability of the same target is very different, so appropriate adjustment and optimization of the node position or sensing direction may be required. The wireless sensor network is a wireless network composed of a large number of stationary or mobile sensors in a self-organized and multihop manner, which can monitor and collect information of various detection objects in the distribution area of the network in real-time and send such information to the gateway nodes to achieve complex detection and tracking of targets within a specified range, with the characteristics of rapid deployment and strong resistance to destruction, and has a broad application prospect.

When the target object or grid location point lies inside the deterministic sensing range of a directed sensing node,

the target object or the target event at that location can be fully sensed by the directed node. If the target object or grid location point lies inside the uncertain sensing range of a directed sensing node, only uncertain sensing is possible, and the perceived intensity is correlated with the geometric distance between the two. If it is too large, beyond the minimum threshold of the sensing capability of the directed sensor node or the field of view of the directed sensing node, the target object or the target event at that location cannot be effectively monitored. In the cooperative mode of multiple sensor nodes, if the target object or grid location point is located inside the sensing range of multiple directed sensing nodes at the same time, all these sensing nodes can sense the target object or event at that location, then the joint sensing probability of several directed sensor nodes present around the target object in the cooperative sensing mode can be calculated as shown in Figure 6.

4.2. Experimental Results of System Optimization. In the application of wireless sensor network, especially in the sports industry, it should be established to government departments as the leading position, due to the application of wireless sensor network involved in the technology; funding and other aspects of the requirements are relatively high, the need for the government as the leading support and guidance for the application of wireless sensor network to provide substantial help and support. In the wireless sensor network in the application of sports events, the government needs to improve and introduce relevant policies and regulations, etc., to promote the participation of domestic enterprises and increase investment in research and development of the wireless sensor network industry and references to the sports industry for market-oriented operation, to promote the sports industry chain of cooperation, based on the background of the wireless sensor network, the government as the leading, sports industry chain of all walks of life as an aid. Vigorously promote the application and development of wireless sensor network technology in the sports industry. In this regard, it is necessary to clarify the division of labor between the government and the industry. In particular, the government needs to develop the application of wireless sensor network technology in sports events into a constructive national policy and law and then form a complete system.

The monitoring confidence value of each partition is used to determine the density of sensing node deployment in each partition and the overall number of sensing nodes required for the network deployment during the initial deployment. Sensor nodes set monitoring trustworthiness values based on their performance status. The sensor nodes determine the direction of their position adjustment by comparing their monitoring trustworthiness values with the monitoring trustworthiness values of the blocks until the monitoring trustworthiness values of the nodes within each block meet the preset interval range so that the sensing nodes reach the optimal relative distribution position, thus using the evidence to inspire and guide the node displacement, the initial deployment of the network, and the optimization of the sensing coverage, as shown in Figure 7.

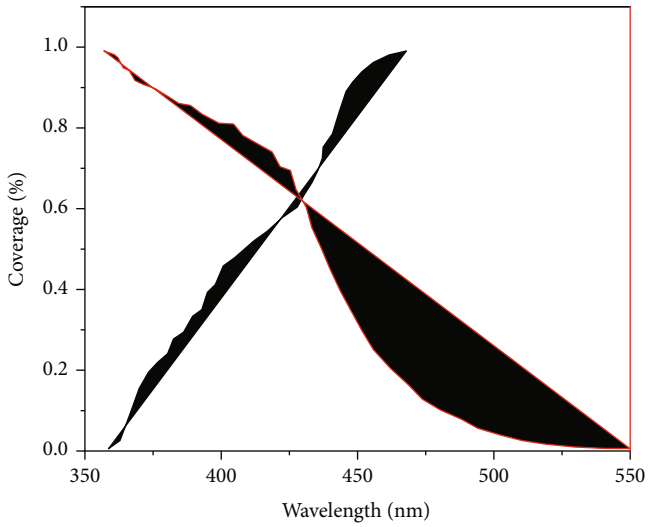

Figure 6: Relationship between edge length and coverage of the target area.

Inside the monitoring partition, the sensing nodes are placed at the vertices of the grid model so that the effective coverage of each sensing grid cell reaches the h-trusted sensing effect. After activating and initializing the grid nodes, the node energy heterogeneity feature is considered, and the sensor node with higher residual energy is dynamically selected as the cluster head based on the node energy level, which is responsible for fusing the raw sensing data obtained by each sensing node within the corresponding cluster of the grid under the guidance of evidence theory, and then forwarding and transmitting the aggregated sensing information. The cluster head is responsible for fusing the raw sensory data obtained by each sensory node in the cluster under the guidance of evidence theory, and then forwarding and transmitting the aggregated sensory information until the whole network is terminated. This not only achieves the energy balance of each node within a cluster but also significantly reduces the network data and communication load balance between clusters and improves the comprehensive sensing service quality of network monitoring by deploying knowledge to meet the differential characteristics of multiple network monitoring requirements.

As shown in Figure 8, with the increase in the scale of deployed sensing nodes, the algorithm in this chapter produces an overall lower average displacement length of nodes than the IMPROVED-VFA algorithm, because the algorithm in this paper uses the existing hotspot depth of the target object distribution and the distribution probability prior knowledge information, considers the differential setting of the trustworthiness value of the regional chunk monitoring in which the target object is located, and combines the improved evidence theory approach. The 3D-DVFA algorithm and VFA algorithm, with a better level of energy efficiency. Moreover, when the number of sensing nodes deployed in the network reaches a certain scale, the average movement distance of sensing nodes corresponding to each algorithm tends to be relatively stable.

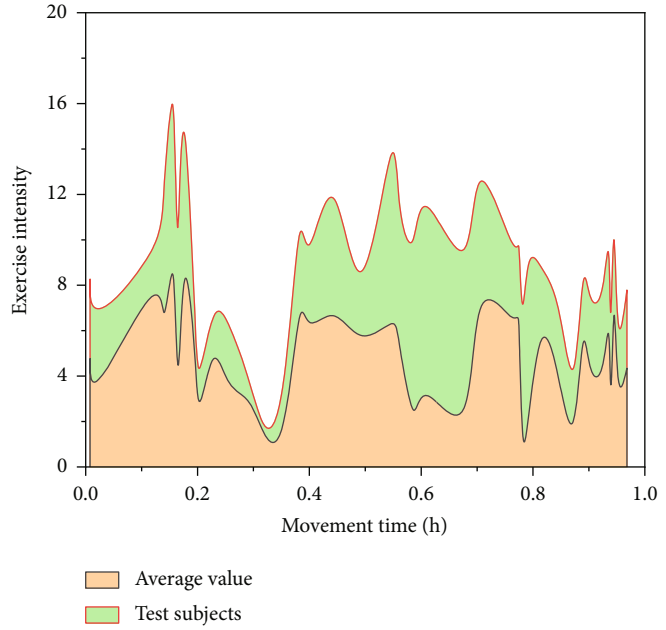

Figure 7: Effectiveness of interventions with different exercise indicators.

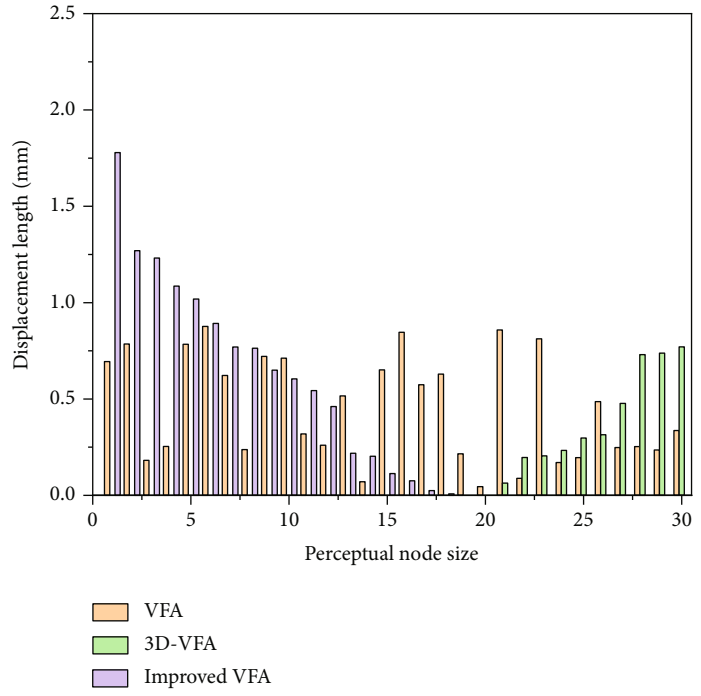

Figure 8: Node displacement length versus perceived node size.

From the above simulation results, the 3D underwater wireless sensor network node deployment algorithm proposed in this chapter fully analyzes the laws and characteristics of the environment to be monitored and introduces the improved D-S evidence theory to fuse the trusted sensory data monitored by sensor nodes with the support of a priori knowledge, combined with the "virtual force" mechanism and node rotation. The strategy of fusion, virtual force, and node rotation can significantly improve the effective sensing range, the trustworthiness of sensing quality, and the efficiency of passive sonar wireless sensor nodes. It can improve the network sensing capability and quality of service and effectively reduce the number of nodes and node energy consumption in the wireless sensor network, saving the overall network overhead.

5. Conclusion

In the uniform clustering routing protocol, when the cluster head node chooses to relay the cluster head node for multihop data forwarding, the cluster head node closer to the base station will converge and forward the data in its cluster to the base station, and also, it needs to act as a relay node to forward the data of other cluster head nodes many times, which causes the cluster head nodes close to the base station to consume more energy than other cluster head nodes, and accelerates the death speed of these cluster head nodes. This is also a uniform cluster routing. The "hot spot" problem prevails in the agreement. The distance between the node and the base station and the current remaining energy is used as input parameters, and the cluster radius is used as the output parameter. Fuzzy logic control is used to obtain the optimal cluster radius so that the cluster range close to the base station is smaller than other clusters. Reduce the burden of cluster head nodes close to the base station. In terms of routing mechanism, the cost function is constructed according to its remaining energy, the current remaining energy of the neighbor cluster head node, the distance between the neighbor cluster head node, and the distance between the neighbor cluster head node and the base station, and the cost function is selected from the neighbor cluster head nodes. The node with the smallest cost function is used as a relay node, effectively solving the "hot spot" problem. Between clusters, a cost function is established according to the current remaining energy of each cluster head node and the distance between the cluster head node and the base station. The simulated annealing algorithm is used to select multiple cluster head nodes with the smallest cost function from the candidate cluster head nodes and allows load balancing within and between clusters to achieve the goal of load balancing across the entire network.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The author declares no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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