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Research Article

Construction of Wireless Underground Footwork Mobile Training and Monitoring Sensor Network in Venues of Major Sports Events

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At the Summer Olympics in Tokyo, technology was used extensively in major sports events. The level of foot movement ability greatly affects the performance of sports technology. Modern sports are developing in the direction of high speed, high skills, flexibility, and rapidity, and more and more reflect the important position of reasonable and accurate foot movement ability in sports. This article uses wireless sensor technology and wireless communication technology to design the overall architecture of the wireless underground footwork mobile training and monitoring network in venues of major sports events. According to the determined monitoring parameters and data transmission plan, a wireless remote monitoring data acquisition system is designed, and the hardware design, software design, and networking of the wireless monitoring node are completed, so as to realize the real-time monitoring and remote transmission of the underlying data. This paper proposes a wireless sensor network management architecture and method based on multiagent cooperation and combines active and passive wireless underground footwork mobile training and monitoring for experimental verification. A multitask allocation strategy optimized for network working life is proposed. A genetic algorithm is used to model and optimize the task data report routing of cluster head nodes. The simulation experiment results show that the wireless sensor network management method based on multiagent cooperation can effectively coordinate different monitoring sensor nodes to complete the assigned monitoring tasks; the multitask assignment strategy based on a genetic algorithm can optimize the working life of the application network.

1. Introduction

Footwork is the carrier of techniques and tactics. When the legwork is effectively implemented, avoiding the opponent's offense to make corresponding defenses, the footwork becomes the basis for linking each technical action [1]. Athletes can adjust their own closed positions through the footwork or open style to ensure that they are on a certain advantage, and they can also use footwork ingeniously to make corresponding adjustments in response to sudden attacks. When the athletes are in a confrontation on the field, the leg technique is equivalent, and when the tactics are equivalent, the athletes can effectively connect the various links of the game and the technique and tactics by moving quickly and sensitively, so as to implement their own technical level [2–4]. Therefore, whether to have a high level of footwork mobility will directly determine the athlete's competition results. There is an inseparable connection between the movement of footwork and the performance of the game [5]. The strong mobility of footwork has a certain impact on the performance of athletes' skills and tactics and the performance of the game. Footwork is the carrier of skills and tactics and an important guarantee for victory in the game. Flexible footwork movement is the key factor to achieve "integration of technology and tactics" and "integration of offense, defense, and counterattack." To break through the performance of high-level athletes, the combination of footwork and legwork must be effectively improved, and tactics must be used throughout the game through footwork [6].

With the increase of national power, the number of large-scale events held has increased, and the number of large-scale events hosted by the world has also increased [7]. The requirements for the promptness, efficiency, and stability of information transmission are also increasing. Large-scale stadiums are often part of the central area of the event, as well as part of the construction of mobile communications. The central area is composed of several venues and supporting auxiliary buildings [8]. To solve the continuous coverage of the central area and the venues is the most basic requirement. The most important thing is the deep coverage of the central area of the large venues. With the general popularization of 5G communication technology, the traditional standards for measuring wireless network quality have also undergone major changes from the previous 3G and 4G networks [9]. It has become very important to discover and solve the impact of users' perception of 4G use through wireless network optimization methods. The so-called user perception optimization improves the wireless network coverage quality, such as coverage rate, signal strength, upload and download rate, and other indicators to meet the personalized needs of users, such as instant communication services, video services, and game services. Through perception optimization, it can improve user satisfaction during use and, on the other hand, tap the potential of existing resources to maximize network resource efficiency, improve resource utilization and efficiency, and enhance the competitive advantage between operators [10].

This paper studies the collection and transmission of health monitoring data and designs a wireless remote access health monitoring system. Using sensor technology and wireless communication technology, we complete the overall architecture design of the health monitoring system and then determine the main monitoring parameters according to the content of the structural health monitoring and design and develop the hardware system and software system of the health system. Specifically, the technical contributions of this article can be summarized as follows:

(1) The debugging of the wireless monitoring node has been completed, and the real-time collection of monitoring data from the sensors at the bottom of the monitoring system has been realized

(2) This article proposes a wireless sensor network management architecture and method based on multiagent cooperation and uses active and passive structural health monitoring as an example to conduct experimental verification

(3) The distributed underground footwork training and monitoring method of wireless sensor network is studied, and a multitask allocation strategy optimized for network working life is proposed

(4) We use a genetic algorithm to model and optimize the task data reporting route of cluster head nodes. The experimental test results show that, compared with the direct transmission of the star network, the multitask optimization of the method in this paper can greatly improve the working life of the network

2. Related Work

Relevant scholars pointed out that footwork, as a link between offense and defense in actual combat, is an unchanging law through the ages [11]. Footwork skills are concentrated on foot movement. In specific competitions, flexible foot movements can be effectively adjusted. The distance between the opponent further realizes the offensive and defensive skills through footwork, which directly affects the success or failure of the game. In actual competitions, when encountering opponents that are difficult to deal with, when the skills and tactics are equivalent, the athlete analyzes the characteristics of the opponent, observes the opponent's body movements, and responds through footwork [12]. At this time, the ability of footwork movement is very important. The definition of athlete's mobility is mainly to define athlete's mobility in actual situations from the aspects of athlete's movement speed and reaction ability. Relevant scholars pointed out that mobility is the ability of athletes to initiate and complete specific actions in the shortest time during actual competitions [13]. The composing factors of this project's ability are mainly composed of two parts: reaction ability and movement speed ability. Researchers believe that mobility refers to the ability of the batter to obtain the best hitting point through the movement of footwork [14]. It also requires athletes to choose and apply flexibly and accurately according to the on-the-spot situation in a constantly changing competition environment.

Due to the uneven distribution of base stations, too many base stations in a local area will cause overcoverage and even coverage confusion [15]. However, there are fewer base stations in some areas, which will result in areas with weak coverage. The so-called overcoverage refers to the phenomenon of multiple network coverages in a certain area, which is also called cross-area coverage. Confusion of coverage is caused by network interference due to too many networks. Weak coverage refers to the phenomenon of weak network coverage in a certain area. In response to the above problems, using coverage optimization technology, the system can perform radio frequency optimization and optimization of related parameters according to the location environment of the area and the characteristics of the base station, thereby controlling the coverage of the base station antenna and reducing the occurrence of the above events. In LTE networks, hard handover is used to complete the handover of mobile users between base stations [16, 17]. The handover involved includes intrafrequency handover, interfrequency handover, and different system reselection. When a user moves to a different location, the network will be handed over according to the neighboring cell selection to ensure good signal quality and network speed. Therefore, through handover optimization technology, network handover can be realized, thereby ensuring network quality.

However, in the handover process, the number of networks should be appropriately selected, and the handover threshold should be set to ensure that the quality of the wireless network after handover optimization can meet the optimization goal [18].

In the early stage of LTE construction, the layout of base stations was carried out according to the physical location of the area [19]. However, after it is built, there may be a problem of insufficient capacity caused by too many users. In addition, the reason for the mobility of mobile terminal users is that the user is in a mobile state and the location is not fixed, which causes the problem of unbalanced capacity of surrounding base stations. Therefore, the use of load balancing optimization technology can achieve a balanced adjustment of traffic. The principle is to solve the capacity problem according to the cell resources and traffic capacity, through the setting of handover and reselection parameters and through the increase of FDD-LTE 2100M equipment and TDD-LTE equipment, so as to achieve the load balancing technology for different carriers. The traffic capacity is balanced to finally achieve the optimization goal of the wireless network and improve the network quality and user perception [20–22]. Currently, test instruments and related software can be used to discover the range of network interference and then use interference optimization technology to make statistics on the network layout in the area and analyze the causes of interference to formulate measures to optimize LTE wireless network optimization to ensure network quality. At present, the principle of interference optimization technology is to maximize the reduction of mutual interference between base stations while ensuring that all areas are covered by the network, so as to achieve the goal of improving the quality of the base station network [23–25].

3. Design of the Health Monitoring System for Venues of Major Sports Events

3.1. Overall Design. Most large-scale space structures are large in scale, complex in structural design, and remote. It is not suitable to use on-site wiring methods to obtain data collected by sensors. The main reason is that there are many monitoring points arranged, and on-site cable wiring not only is difficult but also has a relatively high cost. Second, the wiring is messy and complicated, which is not conducive to later management and maintenance, and there are hidden safety hazards. Therefore, this article combines wireless sensor network (WSN) technology and wireless communication technology, takes venues of major sports events as the research object, uses advanced health monitoring methods to design the overall health monitoring system, and establishes a set suitable for the long-term spatial structure. An effective health monitoring system ensures the monitoring of the entire process of construction, operation, maintenance, and repair of the stadium. Adopting the management system of “distributed monitoring, centralized and hierarchical management,” the entire health monitoring system is mainly composed of three parts: the perception layer, the communication layer, and the management layer. The overall health monitoring system design architecture of the system is shown in Figure 1.

In the design of the health monitoring system, the bottom layer of the monitoring system is the perception layer, which is composed of WSN. The main task is to collect real-time health monitoring data in the monitoring area. It is the basic core part of the entire health monitoring system. With their own advantages, wireless sensor networks are widely used in various engineering structural health monitoring fields. They have the characteristics of low power consumption, self-organization and multihop, and strong network transmission reliability, which effectively solves the problems caused by traditional cable layouts. The problem solves the problems of large-span spatial structure data transmission, sensor energy supply, and later maintenance and management, laying the foundation for future large-scale spatial structure health monitoring and providing a new set of health monitoring technical means. When designing the perception layer in this paper, ZigBee technology is used to build the entire wireless sensor network, which has flexible networking and low power consumption functions, and then deploys corresponding sensors in the key parts of the steel structure canopy of large-scale sports venues, such as stress sensors, temperature sensors, displacement sensors, wind speed, and direction sensors; these sensors can communicate normally with wireless communication devices, so as to realize the analysis, storage, and preprocessing of monitoring data and finally complete the ZigBee network configuration. It can be seen that the perception layer is the core and basic part of the entire health monitoring system. So, this article adopts the ZigBee structure to complete functions such as data collection of wireless monitoring nodes.

The communication layer is the middle layer of the monitoring system. It is mainly responsible for the conversion of the data transmission protocol of the monitoring system. It is the key to realizing the wireless remote health monitoring system. It mainly includes the ZigBee communication network, embedded gateway, and GPRS communication network. In order to meet the long-distance transmission of monitoring data, this article uses the embedded gateway to convert the ZigBee communication protocol to the GPRS communication protocol and realizes the conversion of the wireless monitoring data communication protocol. It can be said that the GPRS communication network is a bridge for data transmission between the perception layer and the management layer. In the entire health monitoring data transmission process, the data collected by the sensor passes through the embedded gateway of the communication layer, and the data collected by the ZigBee node is connected to the GPRS network through the GPRS module in the form of IP and then uploaded to the Web of the Internet by the GPRS base station. In the server, the monitoring data collection and transmission process is completed. With the help of switches and routers, the monitored data is uploaded to the health monitoring information management system to complete the real-time display, storage, and management of the monitoring data.

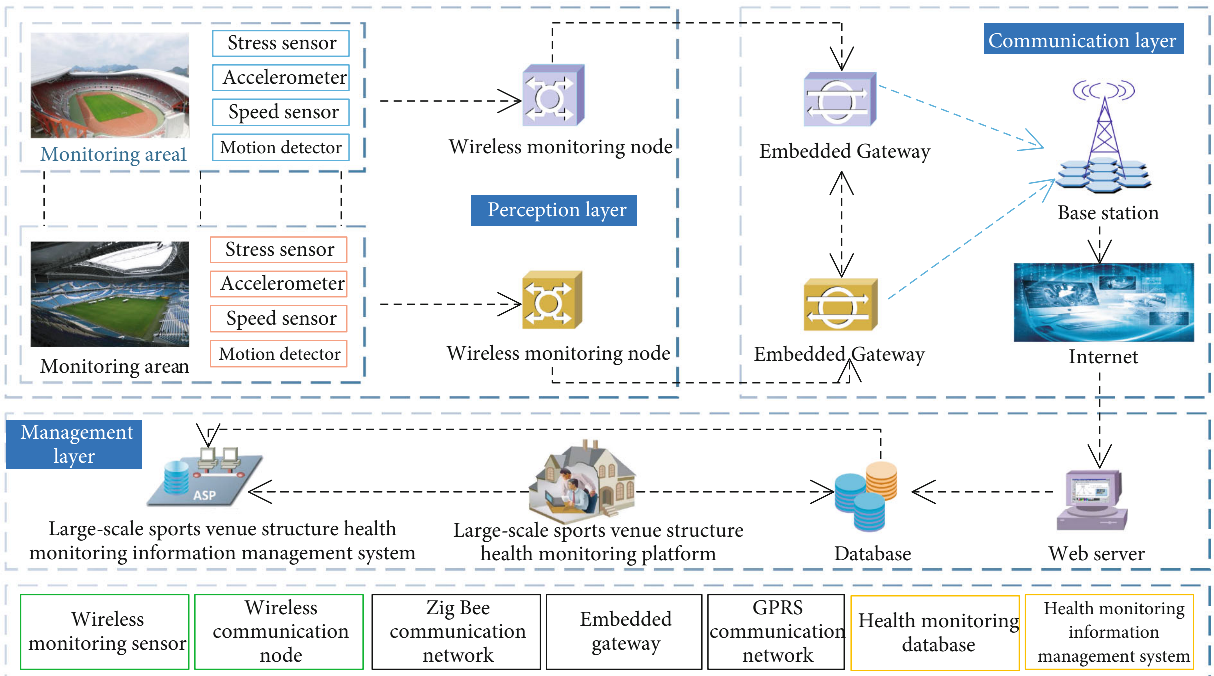

Figure 1: Overall design architecture diagram of the health monitoring system of venues of major sports events.

The management layer is the management center of the monitoring system. It can provide management personnel with monitoring information of each measuring point in the monitoring system and provide a platform for the next step of intelligent analysis of monitoring data, intelligent diagnosis of the structure, and hierarchical warning prompts of the system. This article adopts the form of IoT-level architecture to design the overall health monitoring system architecture, and it can meet the decentralized monitoring of large-scale spatial structures in different monitoring areas. Since traditional detection technology cannot meet the current detection requirements, in order to achieve real-time monitoring of data, it is necessary to further systematic, scientific, and intelligent processing of real-time monitoring data and finally provide preevaluation diagnosis results and transformations for the monitored objects.

3.2. Monitoring System Hardware Design. Since most large space structures are in the natural environment all year round, they are susceptible to the adverse effects of environmental factors, leading to the early degradation or failure of the performance of the microprocessor and sensor monitoring nodes used in the monitoring system, which affects the entire wireless remote health monitoring system. Therefore, in the field of practical engineering applications, the design and research of wireless monitoring nodes and the selection of hardware are very important, which determine the stability and scalability of the entire monitoring system. Figure 2 shows the hardware composition of the wireless underground footwork mobile training and monitoring system in venues of major sports events. This mainly uses ZigBee technology and GPRS technology to complete the remote transmission of wireless sensor monitoring node data and finally displays the monitoring data collected by the sensor in the health monitoring system in real time.

3.3. Wireless Communication Program Design. When the wireless communication module transmits the data collected by the sensor to the sink node via the ZigBee router module, the coordinator needs to be networked. This is because the coordinator module is always in a working state after power on. If there is a communication request, the module will immediately send instructions to the router module to make the router module continuously send requests until the coordinator module responds. When the coordinator is networking, it needs to initialize the hardware configuration, protocol stack, network configuration, and external interface. After the initialization is completed, the coordinator module will keep the network monitoring and waiting state until the monitoring node has a network access request and then allocate the network address of the monitoring node and update the information of the neighbor node, and finally, the coordinator module will perform the received data packet, determine whether the received information is data information, and discard if it is not the required data packet.

When the router module sends monitoring data to the coordinator module, it needs to initialize the network design of the router module. After the initial setting is completed, the router module is associated with the coordinator module, and then, a network access beacon request is sent to the network. After the coordinator responds, it needs to determine the response of the connection. If the coordinator responds correctly, it means that the binding address is correct and the coordinator is successfully connected to the network; otherwise, the network connection fails.

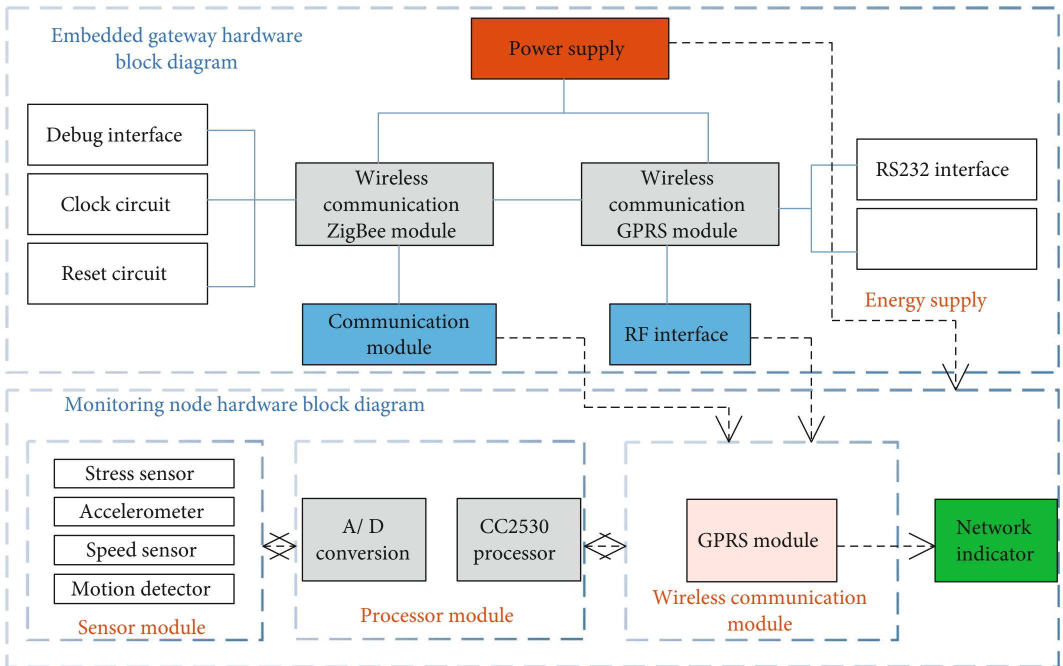

FIGURE 2: The hardware composition of the wireless underground footwork mobile training and monitoring system in venues of major sports events.

When the router module is successfully connected to the network, when sending data, it will call the data processing subroutine request to wake up the low power consumption mode of the router module and then package the data information collected by the sensor and send it byte by byte. If the router does not find the data sending command, it will always be in a low-power sleep state. Only when there is a data sending command inside or outside, the router returns to the working state from the dormant state and begins to complete the task processing.

4. Multitask Allocation Strategy for Footwork Movement Training and Monitoring

4.1. Wireless Sensor Network Collaboration Method Using Multiagent Collaboration Technology. The mobile subject is a program that moves to the node with the required resources for calculation according to its own goals and the conditions of the required resources and can interact with other agents or resources; it can greatly reduce the data traffic in the network. It runs autonomously, encapsulates the tasks to be completed in the mobile agent, and dispatches them through the network. After that, the connection between the source node and the target node can even be disconnected. Therefore, the mobile agent has strong resilience, and fault tolerance is conducive to parallel distributed processing. Due to the characteristics and advantages of mobile agents, it is very suitable for wireless sensor networks used in large-scale underground footwork mobile training and monitoring applications.

In SHM and test monitoring applications, wireless sensor network nodes often monitor the structural strain, vibration, displacement, etc., in different areas in the form of clustered subnets. Through local signal processing and regional information fusion, the structural feature data required for different monitoring tasks are obtained. Therefore, the wireless sensor network management architecture proposed in this paper includes three main types of network nodes: sensor nodes, cluster head nodes, and base station management nodes.

The sensor node has the functions of sensor data collection, local signal processing, and wireless communication. It is the smallest unit that forms a clustered network and can become the cluster head of the subnet according to different monitoring application requirements. The cluster head node is selected from the sensor nodes to be responsible for data fusion and forwarding tasks. In time-sensitive applications, it is also responsible for managing the synchronization operation of local subnet monitoring. The base station management node is connected to the user monitoring terminal equipment; has unlimited processing, storage, and power supply performance; and is responsible for the division, distribution, and management of different application tasks.

This paper combines the application requirements of wireless sensor networks for underground footwork mobile training and monitoring and designs a wireless sensor network management architecture based on multiagent cooperation, as shown in Figure 3. The framework extension of this article defines the following six types of software main body: underground footwork mobile training monitoring main body, data management main body, monitoring application main body, interpretation main body, central coordination main body, and user interface main body.

The main body of underground footwork mobile training and monitoring refers to the main body of software used to obtain structural data, which resides in each sensor node;

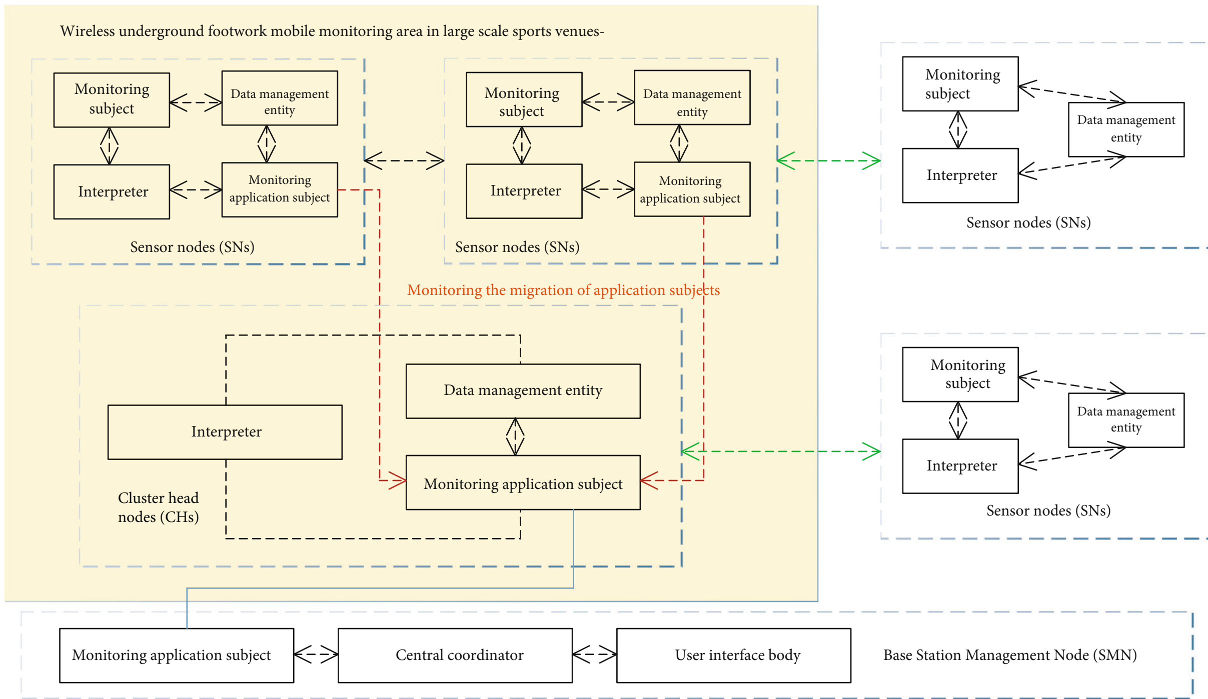

Figure 3: Wireless sensor network management architecture based on multiagent cooperation.

in active structural health monitoring, the main body also provides driving signals for active structural excitation. The data management body is used to manage and mine the sensor data acquired by the underground footwork mobile training and monitoring body and is also responsible for the clustering of sensor nodes and the routing of network data. The monitoring application subject is the software mobile subject directly connected with the central coordinating subject and is responsible for the distribution, integration, and migration of specific monitoring tasks. Its software implementation includes four components: identity, data space, fusion method, and migration path, which are used for the mobile identification of the subject, storage of intermediate results, selection of fusion method, and determination of migration path. The main body of interpretation is the main body of software function that transforms specific application task operations into operations performed by local nodes. The existence of this software main body makes the network system have good scalability and heterogeneous compatibility characteristics. The central coordinator distributes monitoring tasks through mobile agents and integrates the intermediate results of different SAAs to get the most reliable and accurate conclusions. The main body of the user interface is responsible for obtaining monitoring instructions from users, forwarding and displaying monitoring conclusion data, etc.

4.2. Multitask Assignment Method Based on Genetic Algorithm. In the multitask allocation process of underground footwork mobile training and monitoring, the main energy consumption process of the cluster head is in the report sending stage of the task data. Therefore, the multitask allocation of underground footwork mobile training and monitoring can be simplified to the optimization of the task data report route for the cluster head node. If there are n cluster head nodes in the network, and on average each node has d one-hop neighbor nodes (all cluster head nodes), then there are dn possibilities for possible task data reporting routes. When the network scale is large, the number of such routing schemes will be massive. Therefore, this paper chooses the genetic algorithm which belongs to the heuristic search technology to find the optimal multitask assignment scheme.

We establish a list Ni from n to 1, $1 \leq i \leq n$, representing the set of all neighboring nodes j of cluster head node i; here, the link $i \longrightarrow j \in Ni$ is used to indicate that cluster head node i passes through node j to the destination node routing. In this way, the initial population constitutes multiple genes and initial chromosomes by randomly selecting j in Ni.

After the initial population is generated, the fitness function value of each individual needs to be calculated; because the goal of the underground footwork movement training monitoring multitask allocation described in this article is to maximize the working life of the network, according to the definition of the working life of the network, the life fitness function is defined as

$$L_{\text{net}} = \frac{E_{\text{int}}}{E_{\max} - E_{\min} - E_{\text{int}}}. \quad (1)$$

L_{net} is the network working life expressed in rounds, E_{ini} is the initial energy of each cluster head node, and $E_{\max}$ is the energy consumption value of the cluster head node with the largest energy consumption during a round of task allocation and execution. Here, the calculation of the sending

Table 1: The main body and its functions in the collaborative management method.

Subject name	Function description
Structural monitoring agent (SMA)	Responsible for inferring the location of the concentrated load applied to the structure by monitoring the changes in the static load strain distribution
Data management agent (DMA)	Responsible for the moving average and zero compensation of the sensor monitoring data
Monitoring application agent (SAA)	Based on Euclid's pattern recognition method to identify the strain pattern when the load is loaded to different positions
Interpretation agent (TA)	Realize the mapping of software main functions to hardware execution operations based on TinyOS
Central coordinating agent (CCA)	Responsible for fusing the intermediate results of the pattern recognition method to obtain the judgment result of the loading position
User interface agent (UIA)	Responsible for displaying monitoring network topology, monitoring intermediate results and final judgment results, etc.

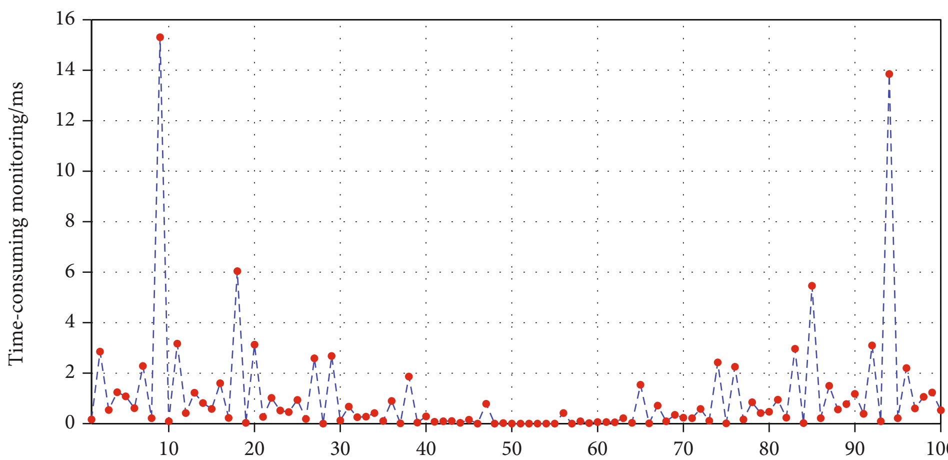

Figure 4: Time-consuming monitoring of wireless underground footwork mobile training.

and receiving energy consumption of the cluster head node adopts the first-order wireless transceiver model:

$$E_{Ti}\left(d_{ij}, b_{ti}\right) = \alpha_T b_{ti} d_{ij,m} - (1-\beta) b_{ti},$$
$$E_{Ri}\left(b_{ri}\right) = \left(1 - a_R\right) \cdot \left(b_{ri} - 1\right). \tag{2}$$

Among them, E_{Ti} represents the energy consumed by the ith node to send data of size b_{ti} in a round of task allocation; d_{ij} represents the Euclidean distance between nodes i and j; α_T is the transmission energy coefficient, β is the amplifier coefficient, and the path loss index m is generally 3-6; E_{Ri} represents the energy consumed by the ith node to receive data of size b_{ri} in a round of task allocation; α_R is the received energy coefficient. Therefore, the node energy consumption considered in this paper is the sum of the energy consumption of sending and receiving.

In this paper, the rotation method is adopted to realize the selection of individuals. According to the different values of the fitness function of the working life of the individuals, the probability of the individuals being selected is also different, which is a proportional selection strategy. We calculate the working life fitness value $L_{\mathrm{net}}(i)$ for each chromosome

Table 2: Simulation test parameter settings.

Test parameters	Set value
The amount of data per task	1000 bits
Amplifier coefficient of wireless transceiver	85 pJ/bit/m^2
The path loss index of the wireless transceiver	3~6
Transmit power coefficient of wireless transceiver	35 nJ/bit
Received power coefficient of wireless transceiver	55 nJ/bit
Initial energy	3 J

of the initial population and calculate the product of the fitness values of all chromosomes in the population:

$$\psi = \prod L_{\mathrm{net}}(i). \tag{3}$$

For each chromosome, we calculate the probability of selection:

$$p(i) = \frac{L_{\mathrm{net}}(i)}{\psi}. \tag{4}$$

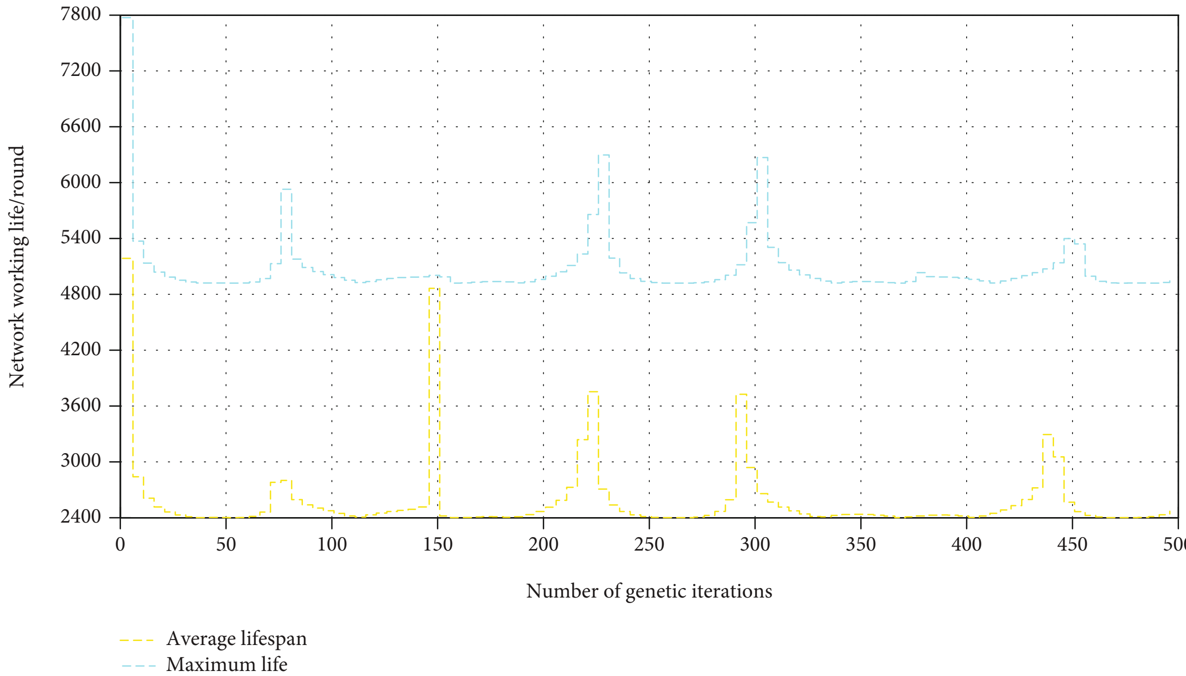

FIGURE 5: The simulation result output of 5 cluster heads for wireless underground footwork mobile training monitoring in venues of major sports events.

For each chromosome, we calculate the cumulative probability:

$$q(i) = \prod p(i). \tag{5}$$

In order to produce new offspring from the selected population, this paper adopts the multipoint crossover method to realize the reorganization of individuals. In the multipoint crossover method, there are m crossover points, and the crossover position Ki $(1 \leq i \leq n-1$, n is the length of the chromosome) is randomly generated in ascending order, and then, the genes between the parent chromosomes Ki are crossed to produce 2 new offspring chromosomes.

5. Simulation Experiment and Analysis

5.1. Simulation Experiment of Wireless Sensor Network Collaborative Management Method. Strain distribution monitoring is to monitor the subject's strain output through underground footwork movement training to monitor the static load position. In the experiment, the strain distribution in the slab structure was changed by applying a concentrated load, and the applied concentrated load was 55 N. In each subarea, the output of the four-way underground footwork mobile training monitoring body reflects the strain distribution of the subsystem. When the position of the concentrated load applied to the structure changes, the strain distribution changes accordingly, and the output mode of the underground footwork mobile training monitoring body also changes. For strain distribution monitoring, the main body and functions of the collaborative management method in this paper are shown in Table 1.

Aiming at the large-scale sports stadium structure, this paper uses the vibration response of the structure and the active monitoring method based on the piezoelectric sensor array to propose an effective cyclic excitation-sequential sensing scheme to realize real-time screw loosening monitoring, that is, to monitor each piezoelectric body in turn and receive the sensing signals of two adjacent piezoelectric bodies at the same time, until the end of the cycle. This method is suitable for large-scale structures where the number of screws is large, and there are many failure modes of the structure, which are easy to alias.

100 piezoelectric sensing nodes are used in the experiment. The excitation signal applied to the structure in the experiment is a sine wave signal with a frequency of 120 kHz and a peak value of 5 V. 120 kHz is determined based on multiple tests, and the structural vibration response is most sensitive to screw loosening under the excitation of this frequency. When the piezoelectric sensor node No. 1 excites its connected piezoelectric sensor, the two adjacent nodes 2 and 100 serve as the child nodes in the cluster, and node No. 1 serves as the cluster head to create the SAA body through the DMA body and merges nodes 2 and 100. The peak value of the collected structure vibration signal; then, nodes 2 to 100 are, respectively, used as the cluster heads of the structure excitation, and SAA sends all the fusion data to the CCA main body to determine the mode of structural screw loosening. Here, SAA adopts a dynamic determination method, and the migration destination is updated sequentially according to the needs of the node.

Figure 4 shows the time-consuming monitoring of wireless underground footwork mobile training. Similar to strain

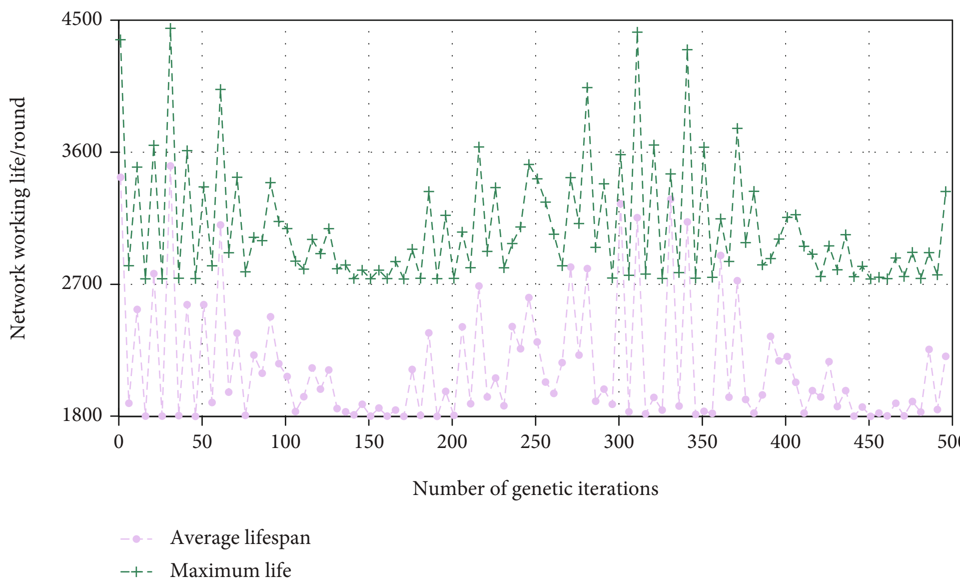

Figure 6: The simulation result output of 95 cluster heads for wireless underground footwork mobile training monitoring in venues of major sports events.

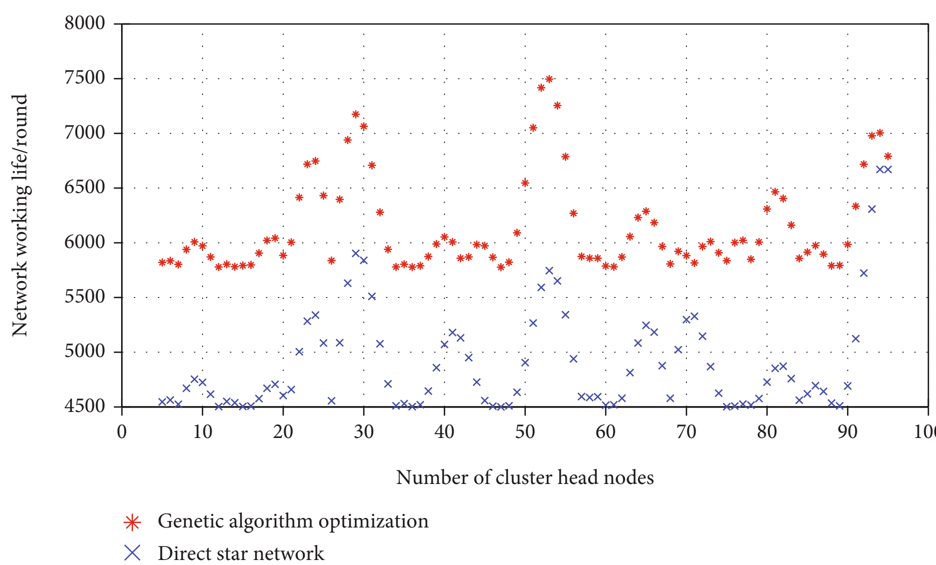

Figure 7: Comparison of working life between genetic algorithm and direct star network transmission in this paper.

distribution monitoring, the training samples corresponding to the loosening of each screw need to be monitored first. When the periodic monitoring moment is triggered or the user monitoring command is received, the CCA main body will take the data and training samples obtained by the SAA main body to the Okirid. For distance measurement, the calculated minimum value is the corresponding screw loosening position.

5.2. Simulation Experiment of Genetic Algorithm Multitask Assignment. The coordinates of the base station location are set to (0, 0), and the other cluster head nodes are distributed in order according to the first quadrant distance of 10 meters. The simulation test parameter settings are shown in Table 2.

The working life simulation results of 5 cluster heads in the wireless underground footwork mobile training and monitoring network in venues of major sports events are shown in Figure 5. When the network contains 95 cluster heads, the simulation results of the network working life are shown in Figure 6. Figure 7 shows the comparison of the simulation results of the network working life when the network contains 5~95 cluster heads, using the genetic algorithm optimization method in this paper and the direct star network transmission. It can be seen from Figure 7 that the multitask optimization based on the method in this paper can effectively improve the working life compared to the direct transmission of the star network.

We set the path loss index of different wireless transceivers $m = 3 \sim 6$, and then, the simulation results of the

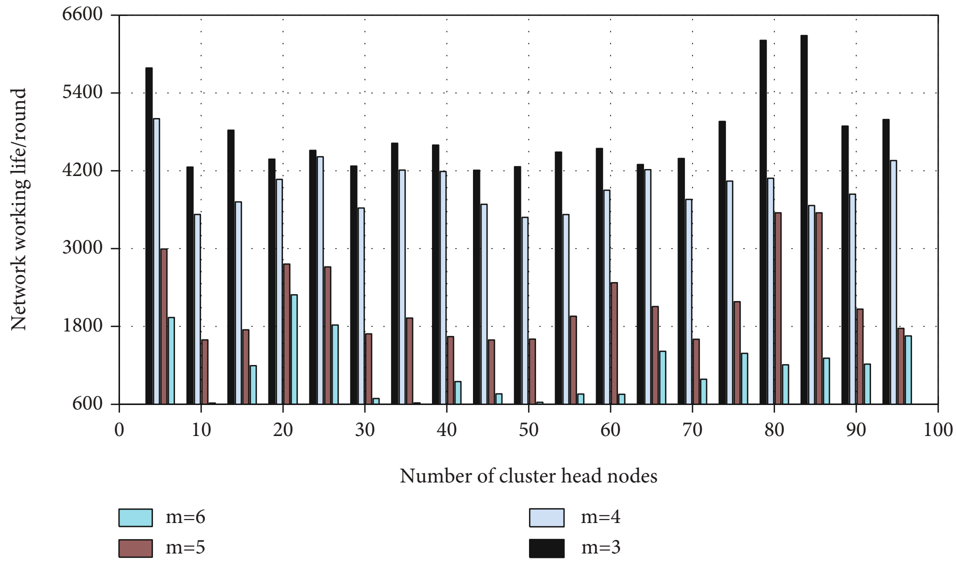

Figure 8: Comparison of simulation results of network working life under different loss environments of venues of major sports events.

network working life under different application environments of venues of major sports events are obtained, as shown in Figure 8. It can be seen from the figure that the greater the loss of the environment (i.e., harsh environment applications), the lower the network working life.

6. Conclusion

As a kind of large-scale space structure building, venues of major sports events are characterized by not only large investment amount, long design life, large scale of construction, etc., but also long-term exposure to factors such as natural environment, aging of their own materials, uneven foundation settlement, and loads. The impact of the impact on the structure will cause structural damage. When the structural damage accumulates to a certain level, a serious sudden accident will occur. Therefore, in order to ensure the safety, durability, and applicability of large space structure buildings, real-time health monitoring of large space structure buildings under construction or during service is required. This paper takes venues of major sports events as the monitoring object and studies the application of structural health monitoring in the field of large-span spatial structures. Through the analysis of structural health monitoring technology, we combined with ZigBee technology and GPRS technology; the overall architecture of the health monitoring system for venues of major sports events is designed. Through further research on the wireless sensor network, according to the requirements of health monitoring, the overall architecture of the health monitoring system is determined, and the wireless remote monitoring data transmission system based on ZigBee technology and GPRS technology is designed, including hardware design and software design to realize the underlying data real-time monitoring. This paper proposes a wireless sensor network management method based on multiagent cooperation and combines active and passive structural health monitoring examples for experimental verification. A network multitask optimal allocation strategy based on a genetic algorithm is proposed. However, the stability of communication does not consider the complex situation in the venue and the situation of simultaneous multinode collection in the future. Therefore, the signal attenuation test needs to be performed in a normal competition environment, and a bit error rate test and a system power consumption test are also required under stable conditions.

Data Availability

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

Conflicts of Interest

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

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