

Retraction

Retracted: Research on the Construction of Smart Tourism System Based on Wireless Sensor Network

Mathematical Problems in Engineering

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1].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

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

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

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

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

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

References

- [1] W. Sun, "Research on the Construction of Smart Tourism System Based on Wireless Sensor Network," *Mathematical Problems in Engineering*, vol. 2021, Article ID 9950752, 8 pages, 2021.

Research Article

Research on the Construction of Smart Tourism System Based on Wireless Sensor Network

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With the rapid development of information technology represented by the Internet, the economic development of various countries in the world is closely related to information technology represented by computers. As a new growth point of economic development, tourism has attracted more and more attention from all parties. Traditional artificial travel agencies can no longer meet people's needs. In the network information environment, tourists need systematic and large amounts of online travel information to provide support for their decision-making. This article first discusses the research significance and research status of wireless sensor networks at home and abroad and analyzes and optimizes the sensor network algorithms. Based on the existing wireless sensor network hardware experimental system, a tourism management system is designed and developed. Various user interfaces of the tourism management system are designed, including topology tree structure view, node list, program status and program package view, data management, real-time curve display, and node positioning functions. The simulation experiment results show that the efficiency of this system for tourism information integration is 20% higher than other systems, and it has certain practical value.

1. Introduction

1.1. The Background and Significance of the Design of Smart Tourism System Based on Wireless Sensor Network.

Internet of Things technology has been widely used in the field of tourism. Many travel-related businesses increasingly rely on wireless sensor systems. At the same time, the development and application of corresponding tourism service models and related systems have also attracted the attention of the industry. However, in the face of constant updates and diversification of customer needs, the simple structure of traditional travel service websites has gradually exposed the disadvantages of low concurrency, instability, and difficulty in expansion, which are far from being able to meet the growing user base and diverse needs. Changes in tourism, traditional tourism service models, and management models cannot meet the business development needs of tourism operators. Therefore, a safe and reliable tourism information management system is needed to build a tourism service and management system with excellent concurrency, stability,

safety, efficiency, and expandability and integrate services and management to provide reliable services to tourists. There is an urgent need to build high-quality tourism service. Convenient and safe payment methods have important theoretical research significance and practical economic benefits for tourists and tourism practitioners. At the same time, the design and construction of the tourism service management system are of great significance for improving the application status of the tourism service model and management system concurrency, stability, security, and scalability of the application program.

1.2. Related Work on Tourism Management System Design.

With the advancement of science and technology, the development and improvement of Internet technology and smartphones have gradually become popular in daily life, and the world has realized a rapid transition from the traditional Internet era to the mobile Internet era. Digital scenic spots have been established in various tourist areas to

closely integrate the Internet with the tourism industry. The construction of an Internet-based scenic spot marketing system is an important part of the construction of digital scenic spots. Xiao built a mobile Internet tourism marketing system by analyzing mainstream mobile Internet technologies and their application in tourism marketing. The system structure of the marketing system adopts MVC model and a three-tier distributed structure, and the logic layer adopts JavaBean and EJB structures. Xiao also constructed a WeChat marketing model based on MM-TIP [1]. It has a certain reference value for building a tourism marketing system based on mobile Internet. Wireless sensor networks are widely used to collect environmental data from various structural deployments. In densely deployed linear networks, as standard sensor network protocols try to manage the network as a mesh or self-organizing infrastructure, problems related to optimal resource allocation and networking may persist. For linear sensor networks, problems such as recovering from loopholes where a node cannot reach another node or establishing data distribution routing strategies need to be solved intelligently. Ali et al. proposed a linear sensor network deployment application that uses customized sensor boards and algorithms to solve problems related to network creation, leak detection, and routing of high-priority messages [2]. Bapu's research work is to develop a reconfigurable hardware that uses FPGA to enhance the self-healing ability of sensor nodes. Emphasizing engineering, wireless sensor networks play a prominent role in successful applications. When there is a weak link in the node, it is usually discarded, and the network is reorganized to ensure the normal operation of the node. The maintenance cost and function of the wireless sensor network will occasionally drop. Therefore, Bapu decided to design FPGA-based self-healing technology to develop wireless sensor nodes and repair node hardware failures. By introducing a self-reconfiguration method, the system is developed using "backup modules". Bapu considers the encoding process to integrate data, and FPGA-based self-healing includes power consumption components such as data compressors and signal converters. Bapu and Gowd proposed engineering estimates for lightweight compression and fault prediction technology in the latest time [3]. Remote authentication of the application code installed in the wireless sensor network is the first important step in detecting any unauthorized changes through buffer overflow attacks. In the past, software-based remote code verification methods, such as software-based certification and secure code update through certification, have been difficult to be deployed in recent work [4]. Tan proposed and implemented a remote authentication protocol that uses the small, cost-effective, and tamper-proof encryption microcontroller TPM to detect unauthorized tampering of application code running on sensor nodes.

1.3. Innovations in This Article. This article first discusses the research significance and current research status of wireless sensor networks at home and abroad, then analyzes several basic and common target location algorithms in detail, and

finally proposes a weighted centroid prediction algorithm. Based on the existing wireless sensor network hardware experimental system, a tourism management system based on a wireless sensor network is designed and developed [5]. Various user interfaces of the tourism management system are also designed, including topological tree structure view, node list, program status and package view, data management, real-time curve display, and node positioning.

The design and implementation of the tourism management system of the wireless sensor network are introduced in detail. First, the function of the wireless sensor system is designed. The hardware system of the test system is based on the cross-node, and the underlying protocol is designed. The basic software is implemented by NESC programming on the TinyOS system.

The functions of the test system include: serial port control, data processing, real-time data display, historical data query, node ranging, node link quality evaluation, node energy status monitoring, node positioning, and node topology display [6].

2. Design of the Smart Tourism System Based on Wireless Sensor Network

2.1. Wireless Sensor Network. A wireless sensor network (WSN) consists of a large number of extremely small sensor nodes, which are usually deployed in areas that are difficult for humans to reach, such as mountainous areas, battlefields, and disaster areas. The function of the network is to collect the data required by the information coverage area, such as temperature, humidity, and acceleration and transmit the data to the sink node through the multinode multihop mode and then to the monitoring center through the sink node. The staff can analyze and process the uploaded information and obtain the desired results [7, 8]. In addition, the monitoring center can also issue control commands to the nodes for corresponding processing. Therefore, the establishment of a wireless sensor network can reduce the consumption of manpower and material resources and the difficulty of monitoring in high-risk areas. Wireless sensor networks usually consist of sensor nodes, receiver nodes, and monitoring centers [9].

2.2. WSN Tourism Management System Module. The hardware system structure used in this article is divided into a wireless sensor network, a server system, and remote browsing equipment. The node in the wireless sensor network is the coordinator node and acts as the gateway node in the wireless sensor network. The type of node is a router node, and its main function is to improve network coverage and increase wireless sensor network access points. Forward data for terminal nodes and provide data collection functions. The type of the node is terminal and has only the data collection function [10]. At the front end, the information of wireless sensors and storage areas will be analyzed. The remote browsing device is connected to the server to observe, manage, and maintain the network.

The software system is divided into serial communication module, protocol conversion module, data analysis storage module, and visualization system [11, 12]. First, the software obtains the data collected by the hardware through the serial communication module. The protocol conversion module unifies the data packet format of different hardware and then analyzes and processes the data. The processed data are stored in the database system. The user interface system obtains different data from the database according to the requirements of the visualization system. The visualization system is divided into network topology, data packet analysis view, real-time curve, and node data prediction graph.

The use of SQLite databases has a certain range. It is a small database, using embedded devices to complete the specified functions. SQLite database resource occupancy is very low, resulting in high database processing speed. One of the biggest advantages of SQLite is that it has a good dual-purpose and has become a mainstream embedded operating system. It is convenient for users to read and write freely between computers with different byte sequences. It is characterized by the features of fast database operation and source code with good annotations.

2.3. Network Topology. Topology refers to how hardware components are configured and how configuration data are transmitted [13, 14]. These three network structures can be used to realize the application of a wireless sensor network [15, 16]. Some topologies are suitable in some cases but not in other cases. The star topology is a single-hop structure. All terminal nodes communicate directly with the base station. The terminals do not send data and commands to each other, and the gateway is regarded as a coordinator.

The mesh topology is a multihop structure [17]. All wireless sensor nodes in the network are routing nodes. The nodes can communicate with each other. One or more routes transmit data to the gateway. Since the node can have multiple paths to the base station node, it has strong fault repair capabilities. The system uses multihop instead of single-hop transmission, thereby reducing the power required for each node to send data.

The star-mesh hybrid network has the advantages of having not only a simple star network and low power consumption but also long-distance transmission and self-healing. Therefore, the establishment, maintenance, and update of the entire network are more efficient and simple. Hybrid networks organize sensor nodes to form a star topology while routing nodes will self-organize into a mesh network [18, 19]. Because sensor nodes can communicate with each other, the network can be reconfigured if the node fails or the link interferes.

2.4. Introduction to Sensor Nodes. The hardware node used in this system is based on the study in [20, 21]. There are three types of nodes in the network, including coordinator nodes, router nodes, and terminal nodes. The hardware structures of the three nodes are the same, but the

application programs are different. Each node has a unique address with a bit length. The nodes running in the network are identified by short addresses. The address length is in bits, which is also unique in the network. In the experimental network, there is only one coordinator node, which is a full-featured device defined in the protocol. Connect with the host computer through the communication module. Its main features are: it can start and establish a network; it can allow routers and terminal devices to join the network; it can help route; and it cannot use low power consumption. The main goal of the coordination node is to establish a network. When the node starts, it avoids conflicts with other sensor networks and first scans the wireless channel [22]. Choose an available channel, then set up, and start the network. When establishing a network, the coordinator needs to configure the network, channel, and channel duration. If you want to start a secure network, you also need to configure encryption options and keys. After the network is established, the coordinator node will start to listen to the channel. After that, it functions as a router node, which allows other devices to join the network and forward data packets.

2.5. Structure of the WSN Tourism Management System. It collects the data of the wireless sensor network and transmits it to the background management system to manage the wireless sensor network and monitor the operation and environmental conditions of the wireless sensor network. In addition, the background management system can also initiate tasks and notify the wireless sensor network through the transmission network to complete specific tasks [23].

The overall composition of the smart tourism system based on wireless sensor network database is used to store all data, including the configuration data of the wireless sensor network, node attributes, sensor data, and some data of the background management software. The data processing engine is responsible for data exchange, data analysis, and data processing between the transmission network and the background management software. It stores the data in the database, reads the data from the database, and then transfers the data to the graphical user interface in a specific way. Back-end components use the data in the database to implement certain logic functions or graphic display functions, which may include network topology display components, node display components, graphic drawing components, etc. [24].

2.6. Data Processing Algorithm of the Smart Tourism System Based on Wireless Sensor Network. The weighted average method is a real-time processing fusion algorithm. Its essence is to perform a weighted average according to the weight of a single sensor after processing the information from multiple sensors in the future to obtain the final fusion result. This method is suitable for obtaining the fusion value in a dynamic environment. The difficulty lies in solving the weight problem of a single sensor. The algorithm first

analyzes the data set and obtains the information of each dimension of the data set, including the span of each dimension. Analyze the data set to obtain the minimum and maximum values of each dimension in the record set. In order to promote grid clustering, the maximum and minimum values need to be modified. The maximum and minimum values of each size are corrected according to the following formula. Its expression is as follows:

$$\begin{aligned} \min_i &= \min_i - k \times \text{stepen}(i), \\ \max_i &= \max_i + k \times \text{stepen}(i). \end{aligned} \quad (1)$$

Bayesian network reasoning is a tool for decision support and causal discovery in the case of incomplete information. It is based on probability distribution and considers that the values of all variables are controlled by the probability distribution. Based on the observed data, the correct decision can be made by calculating these probabilities. Because it provides a quantitative hypothesis method based on evidence support, it provides not only a theoretical basis for algorithms that directly manipulate probability but also a theoretical framework for analyzing algorithms that do not have a clear probability calculation formula. Therefore, probability inference in Bayesian learning plays an important role in machine learning [25]. The core of Bayesian network inference is to calculate the posterior conditional probability distribution [22, 23]. If the set of all variables is X , the set of evidence variables is E , and the set of query variables is Q , the task of Bayesian network inference is to calculate $Q \in q$ conditional probability distribution under a given set of evidence variables. It can be formally described as follows:

$$p(Q | E = e) = \frac{p(Q, E = e)}{p(E = e)}. \quad (2)$$

Cluster analysis is the process of dividing data objects into subsets. Each subset is a cluster. The objects in the cluster are as similar as possible but different from the objects in other clusters. Clustering analysis divides the data objects into meaningful or useful clusters according to the information describing the objects and the relationships found in the data set to discover the natural groupings hidden in the data set. The cluster analysis of the data set can help us understand more clearly the entire data structure, the distribution law of data objects, and the development trend of the data. Its expression is as follows:

$$d(x_i) = \sum_{j=1}^n d(x_i, x_j). \quad (3)$$

The algorithm divides the data space into a limited number of elements, which form a grid structure. The data set is gathered on a grid. The clustering time of this method does not depend on the number of data objects but on the number of units in each dimension of the partition space, so the calculation speed is faster.

3. Simulation Test of the Smart Tourism System Based on Wireless Sensor Network

3.1. Data Sources. The RESSET Domestic Tourism Database (RESSET/TOUR) has 93 data tables and more than 4,500 indicators, including the number of inbound tourists, domestic tourism complaints, ticket price data for major attractions, listed companies, residents, gold per week, tourists, and travel agencies. The reset international travel database contains travel data from the United States, Britain, Canada, France, South Korea, Japan, Finland, and New Zealand, as well as from the United Nations and ASEAN. The United States includes the number of tourists, tourism economy, tourism import and export, US states and cities; the United Kingdom includes monthly overseas travel, the number of overseas tourists, overseas travel expenditures, etc.; Canada includes Canadian residents' travel surveys, travel accommodation, travel service agencies, and international tourism expenditure, transportation, etc.; Finland includes hotels, hotel accommodation, overnight stays, accommodation capacity of accommodation institutions, travel time of Finnish residents, etc.; United Nations statistics include inbound tourism and outbound tourism of various countries, domestic tourism expenditure and travel expenditures of inbound tourism, transportation expenditures of inbound tourism, outbound tourism departures, volume and expenditures of outbound tourism, and travel expenditures of outbound tourism; outbound tourism data are comprehensive and rich in content.

3.2. Test Procedure. The test mainly involves two aspects: one is the spectrum monitoring function that includes sensor node data collection and transmission and task management center end spectrum data storage, processing, and display, and the second is network management function. There are network initialization of sensing node and network management agent functions, including the collection and upload of node attributes and response to network management commands. The task management center implements management functions, including topology display, node attribute display, and network management command issuance. Network management function also includes system reliability testing.

3.2.1. Network Initialization Function Test. The sensor node will automatically search for the gateway and randomly visit the subnets of the two gateways. These two gateways are automatically connected to the task management center. The sensor node is used together with the module in the gateway node to obtain node attribute values. Then, the agent module automatically reports the attributes to the task management center.

TABLE 1: Comparison of prediction results.

Performance index	Algorithm		
	Weighted average method	Bayesian algorithm	Clustering algorithm
Estimate	93.5	94.2	78.4
Relative error	0.3465	0.2749	0.1748
Actual value	84.3	74.5	79.4

3.2.2. Network Command and Fault Monitoring Test. According to the order of restart, sleep, delete node, attribute query, change, and change gateway, observe the status of the node receiving the command in turn. Test expectations are as follows: command test results are attribute information, and message output boxes displayed according to the corresponding results. For fault monitoring, when a node is restarted, a gateway is replaced, or a node is changed, the node will temporarily disconnect from the network. At this time, the fault monitoring module will notify the task management center in the form of a fault report.

3.2.3. Network Management System Reliability Test. As a reliability test, there are two main aspects. One is that it can be detected when a failure occurs. On the other hand, when the fault can be recovered, can it be repaired correctly? From these two aspects, we use the method of repeatedly connecting equipment and power for testing.

3.3. Hardware and Software Test System. The hardware system adopts a self-developed network joint node station, a sensor node station, and a notebook computer as the task management center, with modules, network cable roots, routers, and DC power supplies. Connect the power supply, insert the module into the slots of the sensor node and the gateway node, and then connect the laptop and the network through the cable of the router.

4. Analysis of Simulation Test Results of the Smart Tourism System Based on Wireless Sensor Network

4.1. Analysis of System Data Processing Results. When analyzing the performance of the algorithm, the simulation adds some objective factors. The results are shown in Table 1; this set of data is used to build a node data prediction model. In the node stage of data prediction, we assume that the node fails. Make effective forecasts using previous forecast models and surrounding node data information. The relative errors of the weighted average method, Bayesian network inference algorithm, and clustering analysis algorithm are 0.3465, 0.2749, and 0.1784, respectively. When the data of the node is in a relatively stable state, the algorithm can always

maintain a low relative error. The prediction algorithm that uses the average value of neighbor nodes fluctuates greatly.

Among them, the clustering analysis algorithm effectively uses the node data rules in the algorithm to compensate for the inaccuracy of adjacent node data information and effectively reduces the fluctuation range and the relative error of data prediction. As the data processing intensity of a node increases, the relative error of the clustering analysis algorithm suddenly increases, degrading the performance of the algorithm. At this time, in this algorithm, neighbor nodes' perception of sudden changes in surrounding environment information is used to reduce the relative prediction error. The average relative error rate of the group data is 0.35–0.41, and the cluster analysis algorithm can effectively integrate the algorithm and the neighbor node method.

4.2. Node Load Performance Test Analysis of the Smart Tourism System Based on Wireless Sensor Network. As shown in Figure 1, any unique record data is inserted into the database every minute. The memory capacity provided by each child node and the length of each record is in bytes.

As shown in Figure 2, compared with the test results of the memory database, we can see that in the case of a single node, although the performance is slightly lower, it is still in a comparable range.

4.3. Data Storage Performance Test Analysis of the Smart Tourism System Based on Wireless Sensor Network. As shown in Figure 3, the main problem in wireless sensor network design is coverage. For the application of wireless sensor networks, the first problem to be solved is the deployment of network nodes. The deployment of wireless sensor network nodes can solve resource constraints, including node energy, computing power, and wireless network communication bandwidth. In order to optimize the resources of the wireless sensor network and improve the quality of services such as perception, perception, monitoring, and communication, it can be achieved through node deployment and routing selection.

As shown in Figure 4, this test shows simultaneous performance testing of queries from 1 child node, 2 child nodes, 3 child nodes, and 4 nodes, respectively, and 10,000 single-point data without indexes.

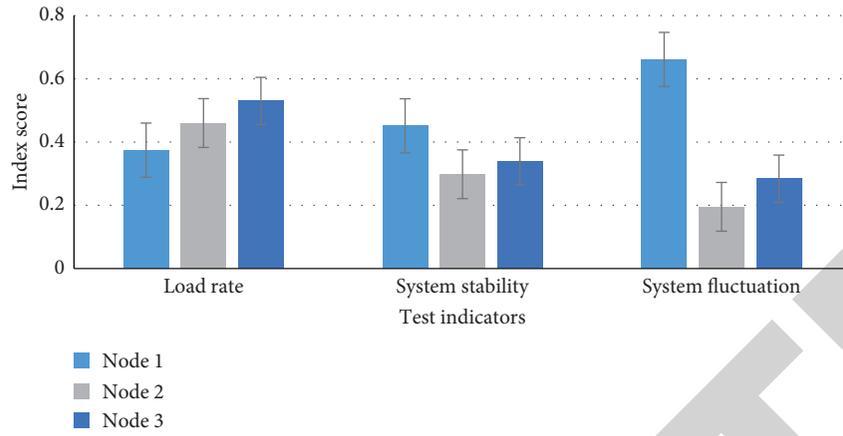


FIGURE 1: Node load score.

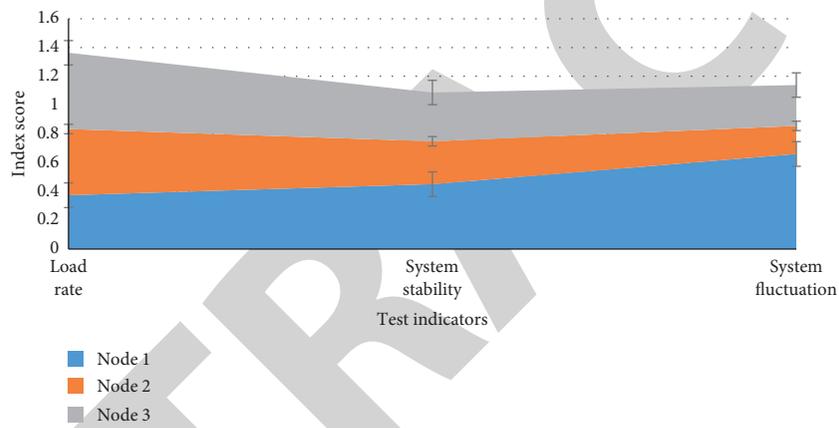


FIGURE 2: Performance chart of node load fluctuation.

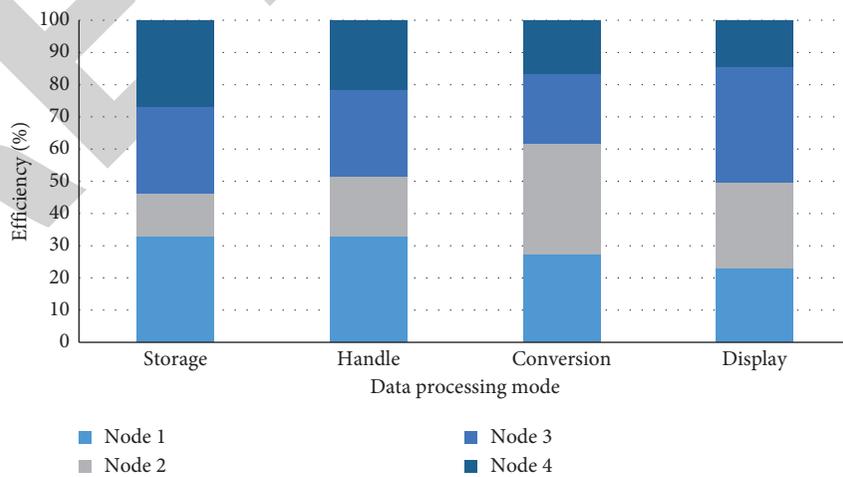


FIGURE 3: System data processing efficiency.

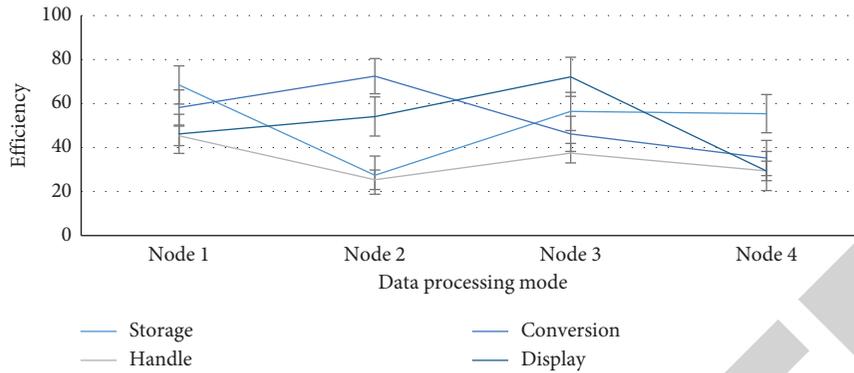


FIGURE 4: System processing efficiency changes.

5. Conclusion

Traditional artificial travel agencies can no longer meet people's needs. In the network information environment, tourists need systematic and large amounts of online travel information to provide support for their decision-making. This paper discusses the research significance and research status of wireless sensor networks at home and abroad and analyzes and optimizes the sensor network algorithms. A tourism management system was designed and developed based on the existing wireless sensor network hardware experimental system. Various user interfaces of the tourism management system were designed, including topology tree structure view, node list, program status and program package view, data management, real-time curve display, and node positioning functions.

The design and implementation of the tourism management system of the wireless sensor network are introduced in detail. First, the function of the wireless sensor system is designed. The hardware system of the test system is based on the cross-node, and the underlying protocol is designed. The basic software is implemented by NESC programming on the TinyOS system. The functions of the test system include: serial port control, data processing, real-time data display, historical data query, node ranging, node link quality evaluation, node energy status monitoring, node positioning, and node topology display. The results show that the tourism management system of the wireless sensor network has achieved the expected results in terms of concurrency, reliability, and scalability.

Finally, in future development, we need to do some work and solve the following problems: the use range of the system has to be expanded so that the test system can be applied to different types of nodes, for example, through additional hardware or components. The function of the system can be expanded to realize the function of the remote control node. By integrating analysis software into a unified software system, data can be directly analyzed and processed, and the required theory or simulation model can be obtained.

Data Availability

No data were used to support this study.

Conflicts of Interest

The author declares no conflicts of interest.

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