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Research Article

Data Image Aggregation Technology of Traffic Wireless Sensor Network

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A wireless traffic sensor network refers to the development of low-power and low-cost traffic sensors on both sides of the vehicle and road. The ability of self-organizing nodes is used to automatically create a network for real-time and accurate monitoring, identification, and monitoring of vehicles, to obtain complete road traffic information of the entire road network for traffic decision-making, and to facilitate the flow of people. This paper aims to study an intelligent traffic detection system based on a wireless sensor network, which collects real-time data information through sensor nodes and uses the wireless network to transmit the data information to the platform for monitoring so that the driver can understand the road in real time from a long distance Information and effective road safety guarantees. This paper firstly summarizes the wireless sensor network and data image aggregation technology, then experimentally explores the data collection planning based on the spatial self-association model, and secondly designs the wireless traffic sensor network design. Through comparative analysis of traffic flow, the experimental results show that the accuracy of using wireless traffic sensors is as high as 97%. It shows that the wireless traffic sensor improves the transmission efficiency and the ability of the network to pass.

1. Introduction

With the rapid development of the national economy and the continuous improvement of people's living standards, travel and people's daily life are becoming more and more dependent on transportation. The continuous growth of urban motor vehicles has caused congestion in many cities. Traffic jams and traffic accidents have naturally become problems that threaten the normal life of mankind. The alleviation of traffic congestion depends to a large extent on the collaboration of colleges and universities in traffic service, control, and management. The comprehensive acquisition and full use of traffic information is the basis and prerequisite for achieving efficient collaboration. Factors such as land use and economic constraints restrict road construction, which requires the use of modern information and communication technologies to improve transportation efficiency and road capacity. Based on the current development trend of road transportation, intelligent transportation systems have become a key development area and a milestone in the era of intelligent road transportation.

With the advantages of low cost, low consumption, small size, and relatively convenient and flexible deployment of wireless network sensor nodes, information management methods are used. Through the information interaction between the vehicle and the road, the road releases real-time traffic information to provide the driver with the most timely and effective traffic reference information, which promotes the smooth and comfortable driving of the vehicle on the road, so that the choice of driving route is no longer at a loss. Through the data image aggregation technology, the step of sending the original data is omitted, and the processed information is directly sent to the end user. This not only saves node energy but also receives more accurate and faster information, which helps to improve data collection efficiency to alleviate road traffic problems.

The innovation of this paper is (1) research on a new algorithm so that the algorithm can optimize the physical topology of the network under the limitation of the maximum cost to improve the reliability of the network. At the same time, on the basis of meeting the reliability requirements, a reasonable data transmission path has been designed, and the minimum transmission delay has been obtained. With the help of two-level programming, the optimal design of network stability and real-time performance under cost constraints is realized. (2) Using data image aggregation technology, in order to reduce unnecessary data transmission to the network and effectively save transmission energy consumption, the collected data is processed and collected, information from different data sources is collected, unnecessary information is deleted, and the amount of data transmitted is reduced. Purpose is improved.

2. Related Work

With the rapid development of low energy consumption and wireless communication technology, wireless sensor networks as a comprehensive information collection and processing technology are gradually infiltrating and changing our lives. Alshinina and Elleithy [1] outlines the latest applications of WSN in agricultural research and classifies and compares various wireless communication protocols, the energy-saving classification, and energy harvesting technologies of WSN that can be used in agricultural monitoring systems, and the comparison between earlier research work, Agricultural WSN. The challenges and limitations of wireless sensor networks in the agricultural field are discussed, as well as several energy-saving and agricultural management technologies for long-term monitoring. However, the energy-saving model he proposed failed to achieve energy-saving in the true sense [1]. Kunz and Tatham [2] briefly introduced the main methods of software-based node location in WSN. Through simulation, using the Curve Component Analysis (CCA-MAP) protocol as a representative protocol in this category, the impact of anchor node placement is demonstrated, and a set of guidelines is proposed to ensure the best results. However, his positioning accuracy is still in error [2]. Havinga et al. [3] proposed that wireless sensor networks (WSNs) usually consist of a large number of small, low-power, and inexpensive sensor nodes distributed in a large area. He focuses on decentralized event detection, with the goal of designing online, distributed, and adaptive event detection to cope with the dynamic characteristics of deployment areas, use cases, and the network itself. However, his design lacks real-time performance [3]. Qiu et al. first proposed a new modeling strategy to generate scale-free network topology and proposed a new scale-free WSN robustness enhancement algorithm ROSE. However, his experimental data are few and lack convincing [4]. Luo et al. [5] focus on minimizing energy consumption and maximizing the network life of data relay in one-dimensional (1-D) queue networks. The Energy Saving by Opportunistic Routing (ENS_OR) algorithm aims to ensure the lowest power cost during data relay and protect nodes with relatively low remaining energy. However, the solution he proposed can not completely improve the performance of the network in terms of energy saving and wireless connection [5]. Zhang et al. [6] considered the secure resource allocation of Orthogonal Frequency Division Multiple Access (OFDMA) two-way relay wireless sensor networks (WSNs). For scenes without CJ, an asymptotically optimal algorithm based on the dual decomposition method and a suboptimal algorithm with lower complexity are proposed. For the CJ scene, the resulting optimization problem is nonconvex. He proposed a heuristic algorithm based on alternate optimization. Finally, the proposed scheme is evaluated through simulation and compared with the existing scheme. However, the accuracy of his algorithm is relatively low [6]. Dong et al. [7] propose a new event data collection method called Reliability and Multipath Encounter Routing (RMER) to meet reliability and energy efficiency requirements. Although RMER can indeed reduce certain energy consumption, it does not extend the life of the network [7]. Han et al. [8] analyzed the characteristics of the latest four energy-saving coverage strategies by carefully selecting four representative connectivity coverage algorithms. Through a detailed comparison of the network life cycle, coverage time, average energy consumption, dead node ratio, etc., the characteristics of the basic design ideas for optimizing IWSN coverage and network connectivity are reflected. According to the coverage attributes, the industrial fields that are most suitable for each algorithm are described. However, his research cannot achieve the expected performance indicators in different industrial applications [8].

3. Combination Method of Wireless Traffic Sensor Network and Data Aggregation Technology

3.1. Two-Level Programming Model for Sensor Networks. In recent years, the rapid development of sensor networks, especially wireless sensor networks (WSNs), has provided technical support for the full-time, networked, and large-scale acquisition of various types of information in the transportation field. The development of sensor networks has provided great convenience for environmental perception and information acquisition. At present, the United States, Canada, the United Kingdom, Germany, and Japan are among the countries with outstanding research results on sensor networks in the world. The wireless sensor network is a self-organizing network system, which mainly includes the deployment of a large number of sensor nodes with radio communication functions in the expected monitoring area [9]. Wireless sensor networks have the potential to develop large-scale nodes, which can be self-assembled and configured, and their use scenarios include real-time tracking, monitoring of the environment, and detection of network equipment. Detecting remote data is its simplest application.

As an important support in the field of information and automation, sensor technology has a long history of development. People can now use basic sensors to obtain accurate and reliable information in the fields of nature and production. With the development of sensing technology, the information extracted by a single sensor can no longer meet people's requirements for information accuracy and comprehensiveness. This promotes the development of multipoint detection technology and multisensor systems, and a sensor network is bound to be formed. Compared with wired networks, wireless networks have a natural trend, so wireless sensor networks have become a recent trend in sensor technology development.

The sensor node is mainly composed of a microprocessor, a wireless communication module, a power supply, and various sensors. The protocol stack of wireless sensor network nodes is shown in Figure 1, including the application layer, transport layer, network layer, data link layer and physical layer, energy management plane, mobility management plane, and task management plane [10].

In the protocol stack of the wireless sensor network node, the energy management plane, the mobility management plane, and the task management plane pass through each level of the protocol stack. Among them, the physical layer controls the setting, transmission, and reception of data, and the data link layer is responsible for the data frame, frame detection, access, and control of errors and network levels should be mainly responsible for the creation and activation of routing and data routing. The main task of the transport layer is to control the data flow when necessary. This layer is particularly important when the system needs to access the Internet or other external networks. The realization layer mainly solves common application problems, including a series of software based on detection work [11].

The core of a sensor network used for traffic perception is a set of communication networks used to connect sensors and data centers. The topology of the sensor network directly affects the overall function of the network. If the structure is not properly designed, it will increase network latency and reduce credibility, which in turn will affect the overall performance of the network.

Since the sensor network adopts two-way transmission, a graph Ti is used to characterize the physical topology of the sensor network, $Kv = [M, L, Q]$. Among them, M represents a node in the network, L represents a link in the network, and Q represents an adjacency matrix that characterizes the relationship between nodes and links in the network Ti. The physical topology optimization of the sensor is a process of finding the optimal solution of Kv kvopt, kvopt ∈ Kv when a certain type of constraint Cv = [cv1, cv2, cv3, . . .] is satisfied. Another graph Kl is used to characterize the logical topology of the sensor network, $K1 = [J, L, Q, L^*, Q^*]$. Among them, M, L, and Q are corresponding elements in the physical topology of the network, L^* is the actual link that the data flow in the network needs to use, and A^* is the lead matrix that characterizes the network data flow. The logical topology optimization process of the sensor network is a process of seeking the optimal solution klopt of Tl and satisfying klopt $\in Kl$ under the premise of satisfying certain constraints $Cl = [cl1,\ cl2,\ cl3, \ldots]$.

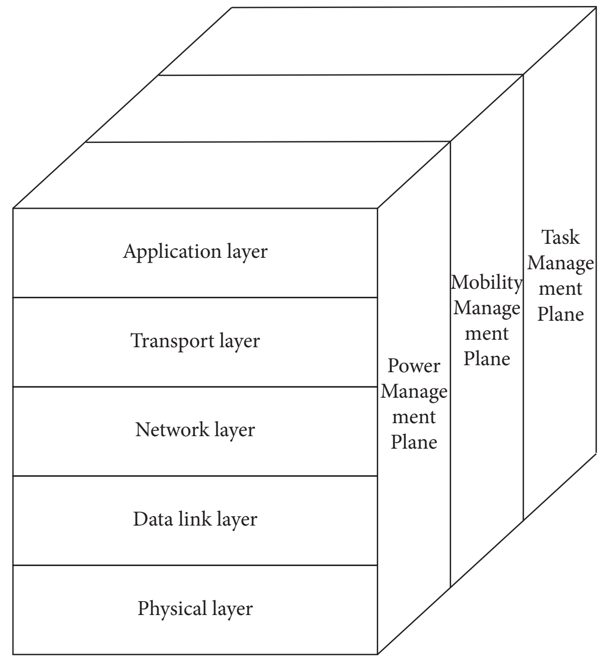

Figure 1: Wireless sensor network protocol composition.

Network designers can plan the physical topology of the network, and according to this physical topology to influence the logical topology of the sensed information flow, so that the data can be transmitted in the network in an optimal way [12]. This mutual game process can be expressed as the following two-level programming model:

$$\begin{aligned} &(I) \max_{u} F(x, u), \\ &\text{s.t.} K(x, u) \le 0, \\ &(L) \min_{u} f(x, u)), \\ &\text{s.t.} k(x, u) \le 0. \end{aligned} \tag{1}$$

The above-given two-level planning model includes two submodels, (I) is the upper-level planning, that is, the physical topology planning problem of the network; (L) is the lower-level planning, that is, the logical topology planning problem of the network. F and u are the objective function and decision vector of the physical topology planning problem; K is the constraint condition of the decision vector of the (I) problem; f and x are the objective function and decision vector of the logical topology programming problem; k is the problem of (L) Decision vector constraints.

Since all information in the sensor network can be transmitted in both directions, an undirected graph is used to describe the sensor network. Suppose $T = (M, L, Q)$ it is a network without a parallel connection, and there is no single point in the network. The network reliability optimization problem subject to cost constraints can be expressed as follows:

$$
\begin{aligned}
(UI)\max W(x) &= \left\{\sum_{\Omega}\left[\prod_{l\in L'} k(l_j)\right]\cdot\left[\prod_{l_j\in (L/L')} 1-K(l_j))\right]\right\}\cdot\left[\prod_{i=l}^{N} K(m_i)\right],\\
\text{s.t.} &\sum_{j=1}^{N} c(l_j)d_j u_j + \sum_{i=1}^{N} c(n_i) \le C(x),\\
K(l_{ij}) &= F[c(l_{ij})],\\
K(m_j) &= G[c(m_j)].
\end{aligned}
\tag{2}
$$

Among them, $W(x)$ is the overall dependency of the network; $K(l_j)$ is the reliability of the link l_j, $K(m_i)$ is the reliability of the node mi; Ω is the set of all available states of the network, as described in this article In the optimization problem, $\Omega = \text{kv}_{\text{opt}}$; $C(x)$ is the maximum useable cost of the entire system; $c(l_j)$ is the cost per unit example of link j; d_j is the length of link j; $c(m_i)$ is the cost of node i Cost; L is the number of links; M is the number of nodes; F is the functional relationship between link reliability and link unit price; K is the functional relationship between node reliability and node cost. At any time period, only part of the links in K can work. At this time, the state of K is a subgraph (M, L') of the graph (M, L, Q), where L' is a set of normal working links. If $l_i \in L'$, then $u_j = 1$, otherwise $u_j = 0$.

After the physical topology is fixed, designers need to optimize the logical topology of data transmission according to different design purposes. The logic topology optimization problem of sensor network can be expressed as follows:

$$
\begin{aligned}
L1\min K(x) &= \sum_{\varphi}\left[\sum_{l\in L'} k(l_j) + \sum_{n\in M'} t(m_i)\right],\\
&\text{s.t.}\beta \in \Omega,\\
V(l_{ij}) &= f[t(l_j)],\\
V(m_i) &= k[c(m_i)].
\end{aligned}
\tag{3}
$$

Among them, $K(x)$ is the total delay of the system; $t(l_j)$ is the delay on the link l_j, $t(m_i)$ is the delay on the node mi; data are transmitted from any node to another node When the transmission path passed is a subset of G, denoted as (M', L''); $\beta = \text{kl}_{\text{opt}}$; f is the functional relationship between the link delay and the link unit price; k is the node delay and The functional relationship between node costs.

3.2. Data Aggregation Technology for Wireless Sensors. In wireless sensor networks, data-centric methods are usually used for backhaul. Under normal circumstances, there will be a large number of nodes in or near the test project, and the data they collected for the same event are the same or similar, so data aggregation (Data Aggregation) can be performed [13, 14]. Multiple data sent from other sensor nodes received or received should be processed on the network to eliminate unnecessary information and then transmit the processed data, as shown in Figure 2.

Sensor nodes classify data collected or obtained from other sensor nodes, delete unnecessary data, and merge data that is more efficient and user-friendly. The result of data aggregation expressed in mathematical expressions is

$$
\text{Date}_{\text{agg}} = f(\text{data}_1, \text{data}_2, \ldots, \text{data}_n). \tag{4}
$$

Among them, Data_{agg} represents an aggregation function, which depends on the representation of Data_{n}, and corresponds to the actual aggregation processing operation; Data_{n} can be a function of time, space, and perception of data content [15].

In a sensor network where data aggregation is preferred, as many data packets as possible are usually transmitted to certain nodes in the network, and then data aggregation is performed at these nodes. In order to facilitate the analysis, suppose there is only one sink node in the network, and the sensor nodes are randomly distributed. The data packets collected from the nodes are of equal size, and they become the intermediate nodes of fixed-length data packets after collection. $G = \langle P, Q\rangle$, P is the sum of all nodes in the wireless sensor network, Q is the connection between all nodes that can communicate directly, s_i $(i = 1, 2, 3, k)$ is the source node, D is For sink node, d_i is the minimum number of hops from source node s_i to sink node, $\min(d_i) = \min\{d_i\}$, $\max(d_i) = \max\{d_i\}$. In a round of data collection, the number of data transmissions for each node in the data aggregation tree is 1. Assuming that the data cut from each source node is transmitted back along the minimum migration path, the minimum number of data transmissions required during the use of data collection is M_D, and the minimum number of data aggregation required when not aggregated is M_A, then $M_A = d_1 + d_2 + \ldots + d_k = \text{sum}(d_i)$. If $\text{SP}(i, j)$ is the minimum number of hops from node i to node j, and S is the combination of source nodes, then the X diameter of the S set is $X = \max_{i,\, j\in S}\text{SP}(i, j)$. Assuming that the diameter of the area where the source node is located is $X \ge 1$, then return the data collected from the data collection,

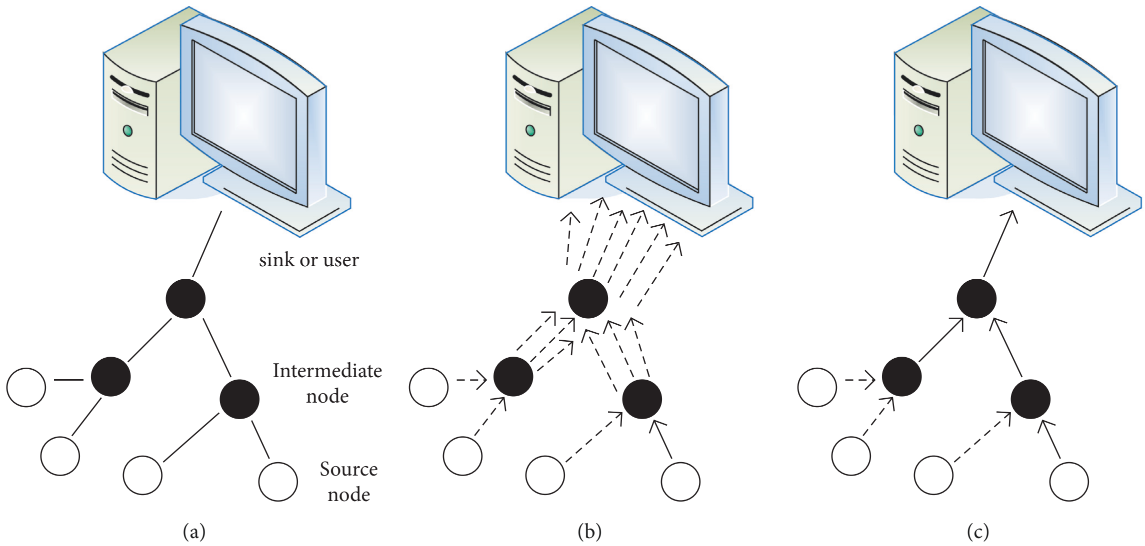

FIGURE 2: Schematic diagram of data aggregation.

and the minimum number of M_D data transmissions meets the following conditions:

$$M_D \leq (k-1)X + \min(d_i),\quad M_D \geq \min(d_i) + (k-1). \tag{5}$$

Proof. If you let other source nodes in the area, first transfer the collected data packet to the nearest source node of the sink, and then send it back to the sink, then the number of edges included in the data aggregation tree.

$$M_D \leq (k-1)X + \min(d_i). \tag{6}$$

When $X = 1$:

$$M_D \geq \min(d_i) + (k-1). \tag{7}$$

When the direct $X < \min(d_i)$ of the area where the source node is located, there is

$$M_D < M_A. \tag{8}$$

Prove:

$$\because M_D \leq (k-1) + \min(d_i) < k\min(d_i),\quad \therefore M_D < \mathrm{sum}(d_i) = M_A. \tag{9}$$

That is, when the source nodes are relatively close to each other and far away from the sink node, data aggregation can definitely save energy. □

3.3. Current Status of Traffic Parameter System. More and gradually formed a brand-new engineering field, namely, Intelligent Transportation System (ITS) for short, and some developed countries in the world have also responded to it. The intelligent transportation system is a revolution in transportation, especially in the field of road transportation. It reuses electronic technology, information technology, and communication technology to make the transportation system intelligent, thereby greatly improving the safety and operation efficiency of transportation. An intelligent transportation system is a large-scale system created by the effective integration and application of advanced information technology. Data communication technology, electronic detection technology, electronic control technology, and computer processing technology run through the entire land transportation management system. It is an efficient, real-time, and accurate integrated traffic management system. Its appearance not only makes the operation of vehicles safer but also greatly improves the efficiency of the traffic management system. It emphasizes the systematic nature of transportation equipment, the interactive nature of information exchange, and a wide range of services. Transform the traditional transportation system and management system to form a new modern transportation system that is informatized, intelligent, and socialized [16, 17].

At present, the inductance coil still dominates in traffic flow detection and signal light control, which depends on its relatively low cost, relatively mature development characteristics, and the requirements of relevant policies and regulations. In addition, nonintrusive sensors mounted in the air, such as video image sensors, multidomain microwave, and infrared sensors, also replace part of the application areas of the inductor coil. The high cost of these sensors can just make up for the cost of inductor coil installation and maintenance.

4. Experimental Design and Result Analysis of Transportation Network Data

4.1. Data Aggregation Design Based on Spatial Autocorrelation Model. Data aggregation is an important technology for data processing in wireless sensor networks. Multiple data collected or received are aggregated through sensor nodes, such as average and maximum values, which can effectively remove redundant data and build data transmitted in the network. To save network energy consumption. Based on the spatial autocorrelation model data aggregation algorithm SMDA (Spatialauto-regression Modle based Data Aggregation), this algorithm on the premise of reducing the amount of network data, to improve data accuracy as the standard, node programming, data prediction, and data aggregation [18]. The simulation results show that this method can effectively reduce unnecessary data on the network while ensuring data accuracy, balancing network energy consumption, and extending network life. Three algorithms are used to verify the performance of the algorithm, namely: Common Data Aggregation algorithm (CDA), Low-energy node Sleeping first Aggregation algorithm, and the aggregation mechanism of randomly selecting sleeping nodes (Randomized Independent Sleeping). Low-energy node Sleeping first Aggregation algorithm (Low-energy node Sleeping first Aggregation algorithm), LSDA algorithm is developed on the basis of CDA, the idea is to let nodes with low remaining energy enter a limited sleep state but does not analyze the missing data of sleeping nodes and estimate. Randomized Independent Sleeping (Randomized Independent Sleeping) is an aggregation mechanism that randomly selects sleeping nodes. The RIS algorithm means that in a period T, ordinary nodes in the cluster will randomly enter the dormant state. The algorithm does not perform correlation analysis and prediction on the data of sleeping nodes. The following five indicators are evaluated under different sleep ratios: network life cycle (number of running rounds), average energy consumption, total network data volume, data transmission efficiency, and total average error. After 16 experiments, to ensure that the data are close and correct, and finally get in the case of different sleep ratios, the life cycle changes of the four algorithm networks are shown in Figure 3. Tables 1 and 2 compare the total network data volume, data transmission efficiency, and sleep ratio of the four algorithms, respectively.

4.2. Data Aggregation Design Results Based on Spatial Autocorrelation Model. It can be seen from Figure 3 that in the CDA algorithm because no node scheduling algorithm is used, data aggregation is only performed at the cluster head node. Therefore, when the sleep ratio changes, the network life cycle does not change. It is the network life of the four algorithms. The LSDA algorithm adds node sleep on the basis of CDA. The cluster head node selects the node with low remaining energy in the cluster to sleep and then aggregates the received data at the cluster head [19]. In this algorithm, as the proportion of sleep increases, the network life cycle increases significantly, and it has the same life cycle as SMDA. However, the data of the node is lost due to the dormancy of the node, which affects the accuracy of the data. In the RIS algorithm, the cluster head node selects the node in the cluster to become a dormant node with a random probability. The nodes with high energy consumption may work continuously, resulting in a significantly lower network life cycle than the SMAD algorithm and the LSDA algorithm. In the SMDA algorithm, due to the combination of node scheduling, data prediction, and data aggregation, the cluster head node selects the node dormancy period with low remaining energy while ensuring the accuracy of the data. In summary, using the data aggregation algorithm SMDA we mentioned based on the spatial autocorrelation model can effectively extend the life of the network.

It can be seen from Tables 1 and 2 that no matter how the sleep ratio r changes, the total network data transmission volume and data transmission efficiency of SMDA and then LSDA algorithms are always the highest. This is because the network life cycle of the SMDA algorithm is relatively high, making the total network data volume of the SMDA algorithm far more than that of the RIS and CDA algorithms. At the same time, with the increase of the sleep ratio r, the total network data volume and data transmission efficiency in the SMDA algorithm show an obvious growth trend, while the RIS and CDA algorithms remain almost unchanged. This is because the node scheduling algorithm is not used in the RIS and CDA algorithms, which causes the nodes with high energy consumption to die early, and the network life cycle is reduced, which reduces the total amount of data in the network. The SMDA algorithm selects nodes with lower remaining energy to sleep, and the saved energy can be used to transmit more data information. Therefore, the data transmission rate is improved.

Through the research on data aggregation algorithms in wireless sensor networks, a data aggregation algorithm SMDA based on the spatial autocorrelation model is proposed for the problems of node energy consumption, processing capacity, and storage capacity in sensor networks. Experiments show that the proposed SMDA algorithm can effectively reduce the transmission of redundant data, balance and borrow the energy of nodes, and at the same time ensure the accuracy of the data.

4.3. Design and Analysis of Wireless Traffic Sensor Network. First, suppose that the minimum communication delay of each node in the sensor network is only related to the shortest path between nodes, and the shortest path has nothing to do with the line length between two nodes. That is, when a piece of information is transmitted in the network, it is only related to the number of nodes it passes through. The link and node delay will be tested separately [20]. The tested node adopts MOXA TN-5580 industrial Ethernet switch, which complies with EN50155 standard, and the tested link adopts AMP Unshielded Twisted Pair 6/100Base-TX. The test process complies with the RFC-2544 standard, and the test equipment uses FLUKE EtherScope ES2. The node delay is shown in Table 3, and the link delay is shown in Table 4.

The time delay in Table 3 refers to the elapsed time from when the first byte of a data frame enters the node to when the last byte leaves the node. During the test, the load of the tested node is 50% of the total traffic. The test result reflects the average delay of nodes in the sensor network at different frame sizes.

The time delay in Table 4 refers to the elapsed time from when the first byte of a data frame enters the link to when the last byte leaves the connection line. The communication rate

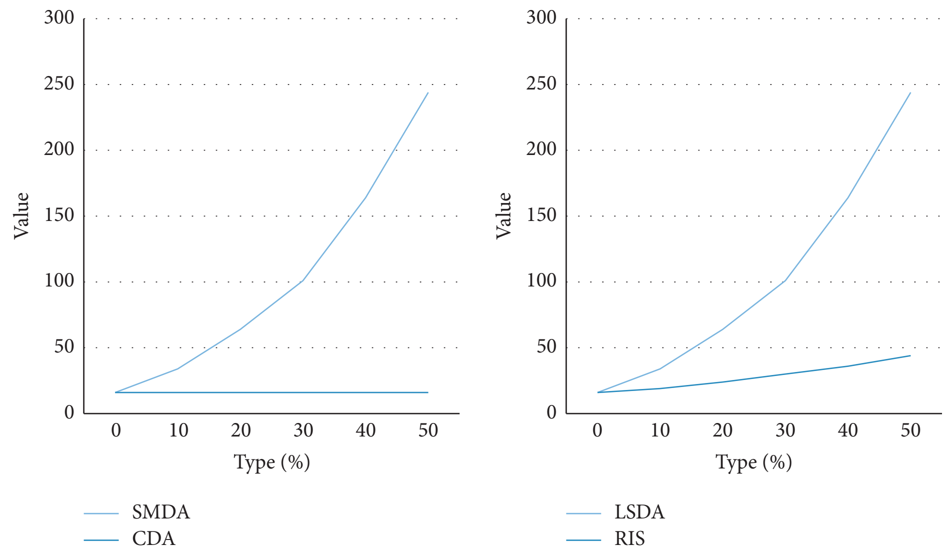

Figure 3: Network life cycle (round).

Table 1: Total data volume in the network life cycle.

Total network datarounds sleep ratio r	0	10%	20%	30%	40%	50%
CDA	16	16	16	16	16	16
LSDA	16	24	42	60	86	100
RIS	16	17	18	19	19	19
SMDA	16	24	42	60	86	100

Table 2: Data transmission efficiency.

Total network datarounds sleep ratio r	0	10%	20%	30%	40%	50%
CDA	0.58	0.58	0.58	0.58	0.58	0.58
LSDA	0.58	0.68	0.8	0.96	1.18	1.3
RIS	0.58	0.56	0.58	0.6	0.6	0.56
SMDA	0.58	0.68	0.8	0.96	1.18	1.3

Table 3: Node delay test results.

Test frame size (bit)	Average delay (μs)
64	82.54
128	88.75
256	99.97
512	123.88
1024	169.84
1280	199.52
1518	210.69

Table 4: Line delay test results.

Line length (m)	Average Delay9 (μs)
10	0.49
30	0.49
60	0.5
90	0.53

of 100 Mpbs was used during the test. The test result reflects the average delay of the sensor network through the line at different lengths.

It can be known from the above actual test results that the time delay caused by the lines between nodes is very small compared with the nodes. Therefore, when considering the real-time performance of the sensor network, the transmission delay can be ignored, and only the number of forwarding passes through the information transmission process, that is, how many nodes have passed through it, is considered.

The experiment selected a microstrip antenna with light weight, small size, low cost, and flat structure. It becomes a unified component with components and circuits, which simplifies the generation and detection of system-wide errors, significantly reduces costs, and improves communication quality [21]. Figures 4 and 5 are the test results of a city's main highway from 6: 30 to 8: 40 in the morning and 16: 30 to 18: 40 in the evening:

Through the observation of Figures 4 and 5, the peak period of morning traffic flow is between 7: 40 and 7: 50, and the peak period of evening traffic flow is between 17: 40 and 17: 50, which is the easiest during this period. Causes traffic congestion and traffic accidents and other problems. The overall test results are consistent with the actual recorded basic results, and the data matching degree is as high as 97%. It can be seen that the wireless traffic sensor in this case is a feasible technology for the intelligent transportation system. Figure 6 is the mark left by the car passing the same node forward and backward. According to the image, we can see that there are not a few vehicles passing by. Based on the repeatability and consistency of the sensor nodes, after many experiments, it is known that the vehicle speed will affect the measurement accuracy of the system. The lower the vehicle speed, the higher the measurement accuracy.

With the increase in the number of intelligent transportation system projects, the demand for communication continues to increase, and the amount of state investment in

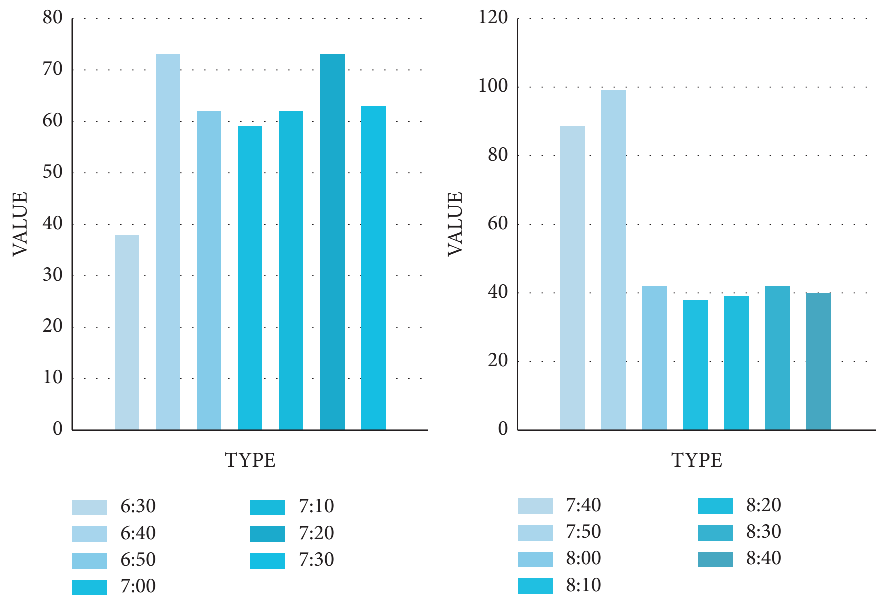

Figure 4: Traffic flow during the morning test.

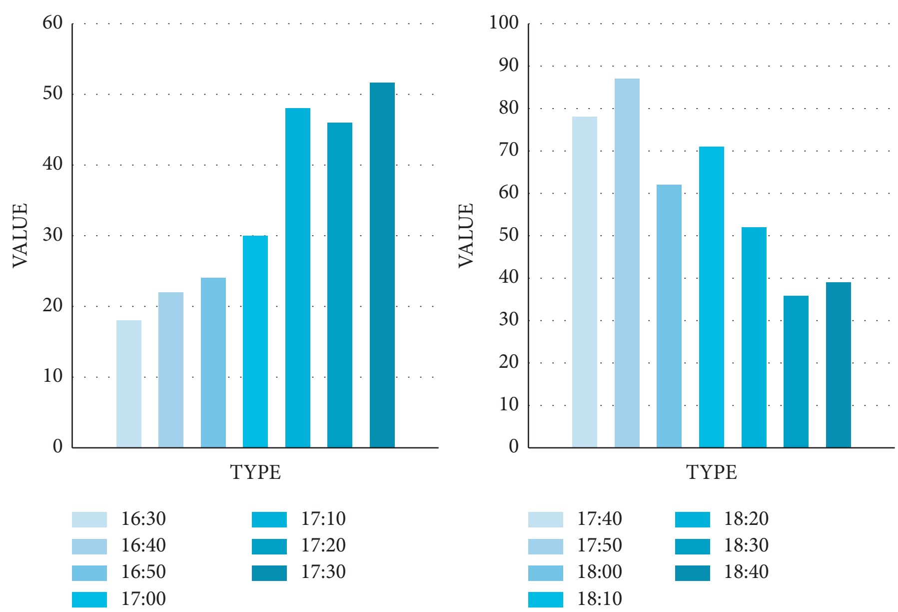

Figure 5: Traffic flow during the evening test.

traffic management is also increasing year by year. Due to the low cost of installing radio traffic sensors, accurate traffic data can be provided, vehicle speed and vehicle speed can be predicted in real time, and road conditions can be saved. The country has certain human, material and economic resources. At present, highways in various provinces and autonomous regions of our country have been opened to traffic one after another, and the highway network is gradually developed, and the design and construction of traffic monitoring projects are implemented or reviewed [22, 23]. In order to fully demonstrate the huge investment in the efficiency of road transportation, the wireless traffic sensor introduced in this article has a specific reference role. In fact, the microstrip antenna extension technology allows the system to send signals to a wider frequency band, which makes it easier to implement wireless traffic sensor networks.

5. Discuss

This article is dedicated to researching wireless sensor networks and data image aggregation technology, and applying them to transportation. It is not only a detailed description of the wireless sensor network but also a new attempt to establish a two-level programming model for the sensor network. Through the analysis of the current situation of the traffic parameter system, pave the way for subsequent

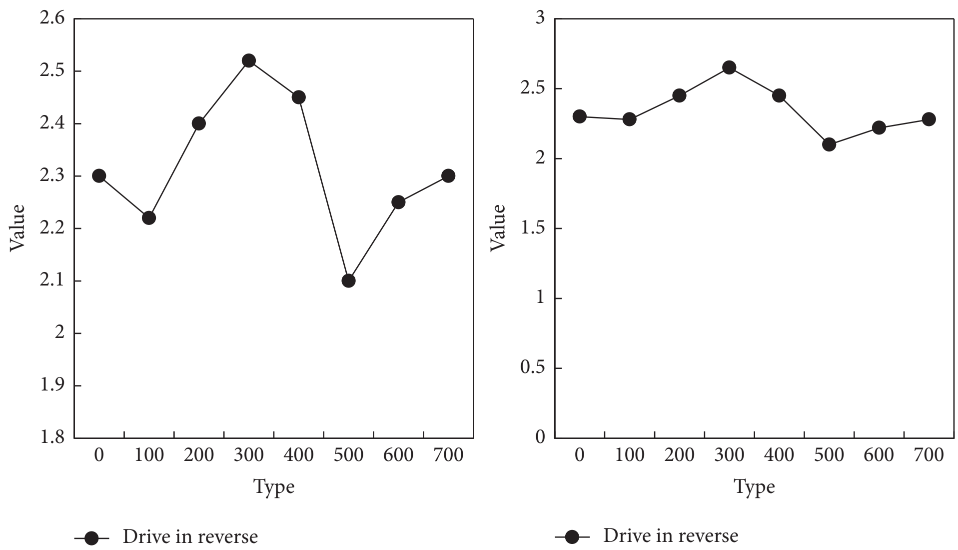

Figure 6: Car round-trip mark.

research. In addition, the data aggregation technology of wireless sensors is researched, and the algorithm is understood. This article analyzes wireless sensor nodes from the very beginning of the network system, combines them with the two-level programming model, and improves them to obtain the best results. Through the adaptation to the road traffic flow, it is verified that the wireless traffic sensor is a feasible technology for the intelligent transportation system.

Through the analysis of this case, we can clearly understand that there are various problems in my country's current transportation. The problem can be alleviated and finally solved through the method of data and image aggregation of the wireless sensor network. You can also try to manage it through other different technical means. This can greatly reduce the occurrence of traffic problems and ensure the smooth driving of traffic roads and people's driving safety problems. In the specific experimental design, you can use different algorithms to compare data, use the network reasonably and flexibly, select the optimal algorithm, and finally achieve the goal of improving the efficiency of the network system.

This article takes traffic wireless sensor network data image aggregation technology as the research object. First, through the understanding and analysis of wireless sensor network, using the combination of wireless sensor network and data image aggregation technology, the flow data analysis of traffic vehicles is an extension of the system. Design applications to provide a data basis. In order to pay full attention to road efficiency, the wireless traffic sensor network introduced in this article has a certain reference role. Wireless network sensors are used in various fields closely related to people's lives, adding more color to people's lives.

6. Conclusions

The traffic perception system requires long-term continuous efforts and multisector cooperation to promote its scientific and sustainable development. The interactive three-dimensional human body radio network in the transportation system, vehicles, and roads based on wireless network sensors are high-tech for the safe and efficient operation of the future transportation system. Based on the existing wireless sensor network, this research proposes its application in the transportation field. Select the data image aggregation technology, study the relevant network life cycle, as well as the total data volume, data transmission efficiency, as well as node delay, and line delay. Through off-site experiments, the test result is up to 97% the same data as the actual record it is verified that the wireless traffic sensor under the microstrip antenna is a feasible technology for the intelligent transportation system. The experimental results show that with the help of a mature wireless network, the traffic management department can provide a basis for real-time traffic control and prediction, which is of great help to alleviating people's life travel traffic problems.

Data Availability

No data were used to support this study.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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References

[1] R. Alshinina and K. Elleithy, "Performance and challenges of service-oriented architecture for wireless sensor networks," *Sensors*, vol. 17, no. 3, pp. 536–575, 2017.

[2] T. Kunz and B. Tatham, "Localization in wireless sensor networks and anchor placement," *Journal of Sensor and Actuator Networks*, vol. 1, no. 1, pp. 36–58, 2012.

[3] P. Havinga, N. Meratnia, and M. Bahrepour, "Artificial intelligence based event detection in wireless sensor networks," *University of Twente*, vol. 85, no. 6, pp. 1553–1562, 2017.

[4] T. Qiu, A. Zhao, F. Xia, W. Si, and D. O. Wu, "ROSE: robustness strategy for scale-free wireless sensor networks," *IEEE/ACM Transactions on Networking*, vol. 25, no. 5, pp. 2944–2959, 2017.

[5] J. Luo, J. Hu, D. Wu, and R. Li, "Opportunistic routing algorithm for relay node selection in wireless sensor networks," *IEEE Transactions on Industrial Informatics*, vol. 11, no. 1, pp. 112–121, 2015.

[6] H. Zhang, H. Xing, J. Cheng, A. Nallanathan, and V. C. M. Leung, "Secure resource allocation for OFDMA two-way relay wireless sensor networks without and with cooperative j," *IEEE Transactions on Industrial Informatics*, vol. 12, no. 5, pp. 1714–1725, 2016.

[7] M. Dong, K. Ota, and A. Liu, "RMER: reliable and energy-efficient data collection for large-scale wireless sensor networks," *IEEE Internet of Things Journal*, vol. 3, no. 4, pp. 511–519, 2016.

[8] G. Han, L. Liu, J. Jiang, L. Shu, and G. Hancke, "Analysis of energy-efficient connected target coverage algorithms for industrial wireless sensor networks," *IEEE Transactions on Industrial Informatics*, vol. 13, no. 1, pp. 135–143, 2017.

[9] G. Han, J. Jiang, C. Zhang, T. Q. Duong, M. Guizani, and G. K. Karagiannidis, "A survey on mobile anchor node assisted localization in wireless sensor networks," *IEEE Communications Surveys&Tutorials*, vol. 18, no. 3, pp. 2220–2243, 2016.

[10] Y. Deng, L. Wang, M. Elkashlan, A. Nallanathan, and R. K. Mallik, "Physical layer security in three-tier wireless sensor networks: a stochastic geometry a," *IEEE Transactions on Information Forensics and Security*, vol. 11, no. 6, pp. 1128–1138, 2016.

[11] Y. Hu, M. Dong, K. Ota, A. Liu, and M. Guo, "Mobile target detection in wireless sensor networks with adjustable sensing frequency," *IEEE Systems Journal*, vol. 10, no. 3, pp. 1160–1171, 2016.

[12] Z. Fei, B. Li, S. Yang, C. Xing, H. Chen, and L. Hanzo, "A survey of multi-objective optimization in wireless sensor networks: metrics, algorithms, and open problems," *IEEE Communications Surveys&Tutorials*, vol. 19, no. 1, pp. 550–586, 2017.

[13] J. Duan, D. Gao, D. Yang, C. H. Foh, and H. H. Chen, "An energy-aware trust derivation scheme with game theoretic approach in wireless sensor networks for IoT applications," *IEEE Internet of Things Journal*, vol. 1, no. 1, pp. 58–69, 2014.

[14] P. Boselin, V. Sakkthi, A. Babu, and T. C. Anand, "Mobility assisted dynamic routing for mobile wireless sensor networks," *Social Science Electronic Publishing*, vol. 3, no. 1, pp. 9–19, 2017.

[15] S. H. Seo, J. Won, S. Sultana, and E. Bertino, "Effective key management in dynamic wireless sensor networks," *IEEE Transactions on Information Forensics and Security*, vol. 10, no. 2, pp. 371–383, 2017.

[16] Y. Gu, F. Ren, Y. Ji, and J. Li, "The evolution of sink mobility management in wireless sensor networks: a s," *IEEE Communications Surveys&Tutorials*, vol. 18, no. 1, pp. 507–524, 2016.

[17] B. N. Adam, A. Abdaoui, T. Elfouly, M. Hossam Ahmed, A. Badawy, and M. S. Shehata, "Structural health monitoring using wireless sensor networks:A comprehensive survey," *IEEE Communications Surveys&Tutorials*, vol. 19, no. 3, pp. 1403–1423, 2017.

[18] H. Yetgin, K. T. K. Cheung, M. El-Hajjar, and L. Hanzo, "A survey of network lifetime maximization techniques in wireless sensor networks," *IEEE Communications Surveys&-Tutorials*, vol. 19, no. 2, pp. 828–854, 2017.

[19] J. Wang, Y. Zhang, J. Wang, Y. Ma, and M. Chen, "PWDGR: pair-wise directional geographical routing based on wireless sensor network," *IEEE Internet of Things Journal*, vol. 2, no. 1, pp. 14–22, 2015.

[20] Z. Sheng, C. Mahapatra, V. C. M. Leung, M. Chen, and P. K. Sahu, "Energy efficient cooperative computing in mobile wireless sensor networks," *IEEE Transactions on Cloud Computing*, vol. 6, no. 1, pp. 114–126, 2018.

[21] M. Hammoudeh, F. Al-Fayez, H. Lloyd et al., "A wireless sensor network border monitoring system:deployment issues and routing protocols," *IEEE Sensors Journal*, vol. 17, no. 8, pp. 2572–2582, 2017.

[22] X. Liu, "A deployment strategy for Multiple types of requirements in wireless sensor networks," *IEEE Transactions on Cybernetics*, vol. 45, no. 10, pp. 2364–2376, 2015.

[23] C. P. Chen, S. C. Mukhopadhyay, C. L. Chuang et al., "A hybrid memetic framework for coverage optimization in wireless sensor networks," *IEEE Transactions on Cybernetics*, vol. 45, no. 10, pp. 2309–2322, 2015.