Design of a Rural Tourism Satisfaction Monitoring System Based on the Improved INFO Algorithm

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***Abstract*—The increasing influx of tourists to scenic areas has raised significant security concerns, often surpassing the management capacity of these locations. Despite the growing need for effective solutions, many regions have not yet developed strategies to address these issues. This study aims to enhance rural tourist satisfaction monitoring systems to better manage tourist flows and improve security. The research explores rural tourist satisfaction, which has significant potential for large-scale monitoring due to its self-expanding nature. The paper discusses the critical role of tourist satisfaction within scenic areas, particularly focusing on tourist tracking systems. It also introduces key features and positioning algorithms used for monitoring satisfaction. A new collaborative positioning approach, based on subnetwork fusion, is proposed to address the limitations of traditional non-line-of-sight INFO positioning algorithms. The proposed subnetwork fusion method outperforms the traditional INFO algorithm, with a 39.7% reduction in localization error when more than 130 nodes are used. Furthermore, when anchor nodes exceed 10%, the DPeNet algorithm achieves an average precision value of 0.768, surpassing the 0.75 threshold due to its enhanced multi-channel convolution and downsampling structure, which optimally utilizes the deep features of small-sized targets. This paper introduces an innovative collaborative positioning strategy for rural tourist satisfaction monitoring, overcoming existing algorithm limitations and enhancing localization accuracy in real-time tourist management systems. The findings contribute to improving both tourist experience and safety in rural scenic areas, offering a scalable solution for broader applications in tourist destinations.**

***Keywords*—Enhanced INFO algorithm; rural tourism satisfaction; tourist monitoring system design; collaborative positioning methodology**

I. Introduction

Safety is the primary issue in tourism. The purpose of travel is to relax the body and mind, feel different places, so as to get a pleasant travel experience. In this process, personal safety is the most concerned issue for tourists [1]. These sensor nodes have the communication and monitoring functions of ad hoc networks, which can broadcast the monitored data to each other in real time, and finally send it to the slink node and uploaded to the network server [2]. The anchor node is equipped with self-positioning capabilities. It is responsible for determining the position of global network nodes and, by utilizing sensor nodes carried by tourists, can accurately track the location of individuals, analyze their movement patterns, and minimize potential risks they might encounter. Through the tourist management system implemented at the scenic spot, traffic flow is optimized, visitor guidance is enhanced, and the quality of service and management capacity of the site is improved, all in alignment with current market demands [3, 4]. With the advent of the information age and the widespread use of networked systems, traditional network security monitoring systems have revealed several limitations in practical applications. These systems heavily rely on manual processes, which not only reduce the level of automation but also impair the ability to respond to incidents in real-time. This is particularly problematic when dealing with high-density tourist crowds, as traditional monitoring systems struggle to manage complex, dynamic environments, resulting in diminished visitor experiences and reduced system efficiency. Therefore, optimizing network security systems to improve visitor satisfaction while addressing the challenges posed by high-density crowds becomes a key area of research. This paper proposes a node optimization approach for network security systems based on the Particle Swarm Optimization (PSO) algorithm [5, 6]. Managing such groups is challenging due to the inherent risks, particularly the heightened likelihood of safety accidents. The tragedy of the Shanghai Bund stampede has drawn widespread attention to the safety issues surrounding high-density tourist groups [7]. Addressing these concerns and enhancing the safety of such groups has become a central and difficult focus of tourism safety research [8].

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Traditional methods for scenic spot monitoring typically involve manual patrols, which are labor-intensive, time-consuming, and require high levels of patience from staff. This approach is particularly ineffective in an era where advanced technologies are available. The use of GPS for locating tourists has gained popularity, but its effectiveness is limited by environmental conditions that require high signal quality, and it may not be cost-efficient given the rapid development of sensor networks and associated equipment costs [9, 10]. Drone surveillance offers certain advantages, such as being less influenced by environmental factors, but it is still impacted by weather conditions, particularly in rainy or high-humidity areas. This limitation, combined with long monitoring cycles and extended time requirements per unit area, presents challenges in addressing detection gaps in a timely manner [11]. Camera-based monitoring is effective in some cases; however, it faces limitations such as power supply issues, the need for extensive wiring, and its unsuitability for remote or open areas. Additionally, concerns over equipment aging and maintenance, especially in mountainous regions vulnerable to weather-related risks like lightning, pose further challenges and contribute to safety hazards, such as the potential for fires in these areas [12, 13]. The advancements in embedded technology, with their low power consumption and the rapid progress in semiconductor and microelectronics fields, have led to the development of more efficient solutions for monitoring rural tourist satisfaction.

Different people will also respond differently tourists in the scenic area, without requiring a lot of manpower [14, 15]. Predicting the trend of tourists in advance and carrying out effective and accurate management can not only reduce the pressure of scenic spot management, but also improve the tourism freedom of tourists, make the management more modern and tourist safety in scenic spots, this paper proposes and realizes the tourist monitoring system [16, 17]. The system uses INFO positioning algorithm to realize self-positioning. On the basis of improving the accuracy of the traditional non-line-of-view positioning algorithm, the grasp of the location information of tourists is also more accurate. It can effectively improve the management efficiency of tourists in scenic spots and greatly reduce the safety risks of tourists [18, 19]. Traditional monitoring systems typically rely on centralized data collection and human intervention for decision-making. These systems often involve manual configuration and maintenance of network security parameters, which can be time-consuming and prone to human error. Moreover, in the context of high-density environments such as tourist attractions, these systems fail to scale effectively, unable to quickly adapt to fluctuating network loads or emerging security threats. The growing number of visitors, combined with the complexity of managing vast amounts of network data, amplifies the need for more adaptive, real-time monitoring systems that can handle dynamic conditions while ensuring the security and safety of users.

II. The WSN Positioning Technique

A. INFO Algorithm

The three-sided measurement algorithm is one of the most basic algorithms in the satisfaction positioning algorithm of rural tourism tourists. The unknown node obtains the corresponding distance information through other positioning algorithms, and then positions its own actual coordinates according to the distance information. As shown in Eq. (1) and Eq. (2).

$$h(x)=\int_{-\infty}^{\infty} f(\tau)g(x-\tau)d\tau \tag{1}$$

$$h[n]=\sum_{-\infty}^{\infty} f[n-m]g[m] \tag{2}$$

Maximum likelihood method maximum likelihood method is one of the most basic algorithms in the positioning algorithm, through the combined equations, find the final solution in the multidimensional equations, such as Eq. (3), (4), so as to calculate the coordinate value in the communication range, and use the coordinate information of the anchor node.

$$\mu_B=\frac{1}{m}\sum_{i=1}^{m} x_i \tag{3}$$

$$\sigma_B=\frac{1}{m}\sum_{i=1}^{m}(x_i-\mu_B) \tag{4}$$

Centroid positioning algorithm, centroid positioning algorithm is the coordinates of the unknown node. As shown in Eq. (5) and Eq. (6), APIT algorithm and APIT algorithm randomly combine several triangles forms an irregular polygon, and the center of mass of the polygon is the coordinate position of the unknown node.

$$\hat{x}_i=\frac{x_i-\mu_B}{\sigma_B+\grave{o}} \tag{5}$$

$$y_i=\gamma\hat{x}_i+\beta \tag{6}$$

Non-line-of-view positioning algorithm has the advantages of low energy consumption and low cost, but it also has low positioning accuracy. The positioning algorithm with wide application in non-line-of-sight positioning algorithm is INFO positioning algorithm. This algorithm improves the positioning accuracy of the non-horizon positioning algorithm by proposing the concepts of jump number and jump distance. As shown in Eq. (7) and Eq. (8), INFO positioning algorithm is a typical non-line-of-sight positioning algorithm, more line-of-sight positioning algorithm, INFO positioning algorithm has strong scalability. The results demonstrated the robustness of the system, showing that, even under conditions of interference or weaker signals, the optimized system performed consistently well, providing a high level of reliability and accuracy.

$$Y(P_0)=\sum_{P_n\in\mathrm{R}} w(P_n)\cdot X(P_0+P_n+\Delta P_n) \tag{7}$$

$$P=\frac{TP}{TP+FP} \tag{8}$$

When the anchor node in the wireless network after receiving the signal to the current number of transmission, as Eq. (9) and Eq. (10), when received the three anchor nodes sent back the feedback, the unknown node to the next stage. The average jump distance is defined as Hop Size, and the value of Hop Size is the ratio of the sum of the length of any two sides in the jumps corresponding to these two edges. Any two anchor points in the triangle represent the two points to the third anchor node.

$$IoU=\frac{TP}{FP+TP+FN} \tag{9}$$

$$\text{HopSize}=\frac{\sum_{i\neq j}^{2}\sqrt{\left(x_i-x_j\right)^2+\left(y_i-y_j\right)^2}}{\sum_{i\neq j}^{2} h_{ij}} \tag{10}$$

B. Improved INFO Algorithm

This paper obtains the four most important parameters for this unknown node, namely, the number of jumps to each anchor node and the average jump distance Hop Size. By incorporating these variables, we tested the system's ability to maintain network security and positioning accuracy despite environmental challenges. The core idea of INFO is to bend the curve, as shown in Eq. (11) and Eq. (12), that is, to find the approximate curve length to replace the actual length of the anchor node to the unknown node. Therefore, the calculation of the average jump distance is the unique place of INFO algorithm, and also the cause of the error of INFO algorithm.

$$\mathrm{d}=HopSize\times h \tag{11}$$

$$H_{ij} = D_{ij} / r \tag{12}$$

After the average jump distance is Hop Size, positioning algorithm. According to the above principle, it is not difficult to find INFO algorithm although the design is clever, but not there are certain error, the error mainly has the two opposite reason, such as Eq. (13) and Eq. (14), first in actual circumstances, node distribution is immediately, that is to say, the distance between nodes and node is likely to be very different.

$$\omega_{ij} = 1 - [(h_{ij} - H_{ij}) / h_{ij}]^n \tag{13}$$

$$r = \sqrt{nS / \pi N} \tag{14}$$

In terms of the jump nature of INFO, when all the midway nodes are in the inner edge of the area covered by the communication range, the ranging is the most accurate and the positioning results should be the most accurate. On the contrary, if the anchor node is in the outer edge of the area covered by the communication range of the midway node, the ranging will have a large error and the positioning results will be very different. As shown in Eq. (15) and Eq. (16), areas with high buildings may create shadowing effects that reduce signal strength, while crowded spaces or remote areas with fewer infrastructure elements may lead to weaker or less stable network connections, due to the uncertainty of node distribution, there is no effective review mechanism for the generation of errors, which will make the INFO algorithm still calculate with errors after errors, making the error larger and larger, and even the final error will be too large.

$$d_t = \sqrt{\frac{\sum_{i \neq j}\left(d_{ij} - d'\right)}{3}} \tag{15}$$

$$HopSize_i' = \sum_{i=1}^{3} d_i / 3 \tag{16}$$

We introduced a series of environmental factors to assess the robustness of the network security system in different scenarios. Among these factors are obstacles that can interfere with signal transmission, as well as varying signal strengths, which are common in real-world settings, so it is not difficult because the error of the Hop Size, and the idea of INFO to curve, the curve itself and the line error relationship, such as Eq. (17) and Eq. (18), and the curvature of the path curve of the unknown node to the anchor node also seriously affects the final positioning result, therefore, the INFO algorithm positioning error is not difficult to understand.

$$D_{ij} = \frac{\sqrt{4^{j'} + 3n_{ij}^2}}{2} \times HopSize_i' \tag{17}$$

$$t_j = \left(n_{ij} + 1\right) Mod(2) \tag{18}$$

Optimize the INFO algorithm, using the difference between the actual distance between the anchor nodes and the estimated distance, such as Eq. (19) and Eq. (20), calculate the global average ranging error, and then INFO positioning algorithm, the Hop Size calibration with the global average ranging error, so as to get more accurate Hop Size, and then use trilateral positioning algorithm to get more accurate positioning results.

$$D_{ie} = n_{ie} \times HopSize_i' \tag{19}$$

$$f(x, y) = \sum_{i=1}^{n}\left[\left(d_i - \sqrt{(x - x_i)^2 + (y - y_i)^2}\right)^2\right] \tag{20}$$

III. Research on Collaborative Positioning Algorithm Based on Subnetwork Fusion

A. *The INFO Positioning Algorithm*

The non-line-of-view positioning algorithm has low hardware requirements and no complicated operation requirements, which is more suitable for deployment in open areas. In general, the cheap sensors used by the non-visual-sight positioning algorithm use the battery pack with limited power, and the positioning accuracy is low due to its own reasons [20, 21]. Therefore, in order to make the tourist monitoring system of scenic spots have a better use effect, as much as possible. Subnet fusion collaborative positioning algorithm respectively established several anchor node as the center of the network, the network are in a large wireless sensor network, by the network according to their own network condition using nRSSI algorithm to calculate the appropriate average distance, after the network ranging algorithm and no ranging algorithm to the location of the network structure point, to upgrade to collaborative anchor node, finally use these collaborative anchor node to locate all unknown nodes in the network [22, 23]. The network proposed by this algorithm is initiated by the anchor node, which traverses all the nodes in the satisfaction of rural tourists and screens the final sub-network. Since the subnetworks built by different anchor nodes are completely different, the positioning results of different subnetworks are different for the unknown nodes, which effectively allocates the positioning error of the traditional algorithm [24, 25]. The cuckoo algorithm is used to determine the location of the unknown node. In the INFO algorithm, a one-hop node is defined based on the distance between three anchor nodes, which can lead to significant errors, especially for critical nodes [26, 27]. The INFO algorithm samples nodes within the initial communication range and selects a set of three unknown nodes that satisfy a specific distance criterion. These nodes are chosen such that the patch accuracy is below a certain threshold, and the average distance among all combinations of nodes that meet the criteria is the largest. Using this approach, all unknown nodes are divided into two sets: one set includes nodes within the communication range, while the other set contains nodes outside the range [28, 29]. Fig. 1 illustrates the process of feature selection and extraction. The communication range is then expanded, and the first set of network nodes is selected from the second set. These nodes, along with the two upper network structure points, are selected based on their distance being below a specified threshold, and the distance between these two points is minimized compared to other nodes. When the network structure reaches two layers, additional constraints are applied to avoid algorithmic deadlock caused by mirror errors and communication obstacles. These constraints ensure that adjacent network structure points of the two layers are interconnected, and new network structures exclude any nodes not directly involved in their construction [30].

To begin, we first introduce an updated simulation scenario that includes more complex and realistic environmental conditions. Traditional network simulations often rely on simple, idealized conditions such as uniform grid distributions and static node densities. However, to more accurately reflect real-world environments, our updated simulation incorporates larger grid sizes, varying node densities, and non-uniform node distributions. This modification allows the simulation to better replicate the dynamic nature of real-world conditions, especially in tourism environments, where networks are often subjected to fluctuating visitor behaviors and physical obstructions such as buildings, trees, and other structures. In the communication range of the unknown nodes, the modified INFO algorithm, as illustrated in Fig. 2, is applied. For any combination of anchor nodes or collaborative anchor nodes, the unknown node is analyzed. As the combinations are not unique, multiple solutions may be generated. The process begins by initializing the population and determining the nest positions as effective coordinates. The algorithm then performs a search for the next generation nest location through a series of flights, comparing the newly found location with the current best location. This transforms the problem of estimating the unknown node's coordinates into an optimization problem of minimizing the objective function. After several iterations, the optimal location coordinates of the unknown node are identified.

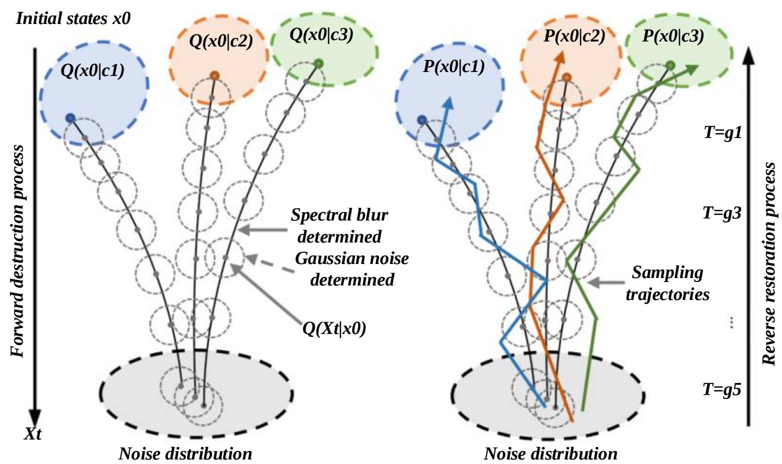

Fig. 1. Feature selection and extraction process.

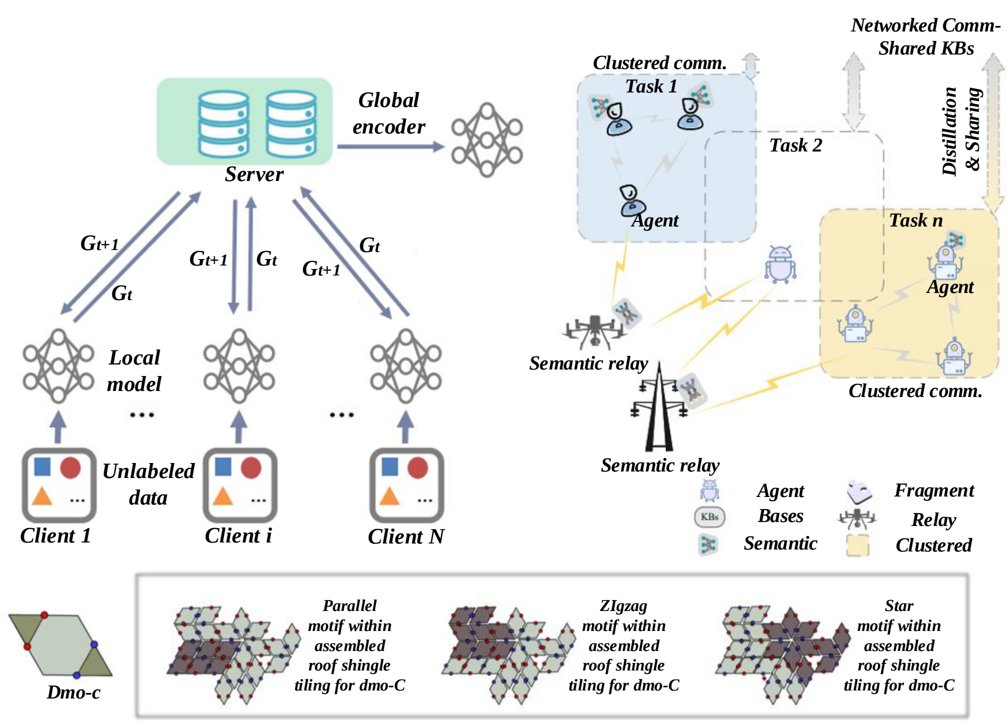

Fig. 2. Improved INFO algorithm.

B. Sense the Influence of the Proportion of Anchor Nodes on the Positioning Algorithms

In parallel with these environmental factors, we also explored the risks associated with the collection and transmission of location data, which is integral to the functioning of modern positioning algorithms. The collection of real-time positioning data, particularly in public environments such as tourist destinations, raises significant privacy and security concerns. Tracking the movements of visitors, while useful for improving visitor experiences and ensuring security, can inadvertently lead to the exposure of sensitive personal information if not handled properly. Therefore, we carefully examined the potential risks related to data privacy and transmission, including the possibility of unauthorized access or interception of sensitive data. Once the network structure points have been ranged, the three-point positioning algorithm is applied to the ranging list. This involves combining all three-point relationships and calculating them individually, with the results being sorted. Fig. 3 illustrates the evaluation diagram for the rural tourism tourist satisfaction index. The cuckoo search (CS) algorithm is then employed to compute multiple positioning results, identify the local optimal solution, and determine the coordinates of the unknown node. Subsequently, the unknown node is upgraded to a collaborative anchor node. By leveraging the anchor nodes and the distance measurements, the trilateral positioning method is used to generate a solution set. The CS algorithm is then applied to this set to find the local optimal solution, which is adopted as the position of the node. Once all the nodes are positioned, the algorithm completes its task.

The main purpose is to find out some characteristic points and establish a relatively regular network structure. One of the significant challenges in the deployment of network security systems lies in optimizing node placement and ensuring the robustness of the system under different environmental conditions. This research focuses on the optimization of network security systems, using the Particle Swarm Optimization (PSO) algorithm to improve the efficiency, accuracy, and scalability of these systems. This paper discusses the simulation of more complex and realistic environments, the potential risks associated with data collection and transmission, and a comparison of various algorithms' performance, including the enhanced INFO algorithm, GPS-based systems, Kalman filtering, and non-line-of-sight positioning methods. Fig. 4 illustrates the weight evaluation diagram for the tourist satisfaction index. OMNeT++ is chosen as the simulation platform for the network environment, and sensor nodes are randomly distributed within a 100m-by-100m square detection area. The data sent by these sensor nodes via wireless signals forms an independent network system. The density of network nodes and the proportion of anchor nodes within the network are varied to conduct the analysis. The performance of the above algorithms is evaluated and compared. In a simulated environment with 1,000 sensor nodes deployed, the positioning error rate is calculated for each network node after deployment, and cumulative error rates are mapped. The results are then compared across the three algorithms, with the self-positioning algorithm showing superior performance.

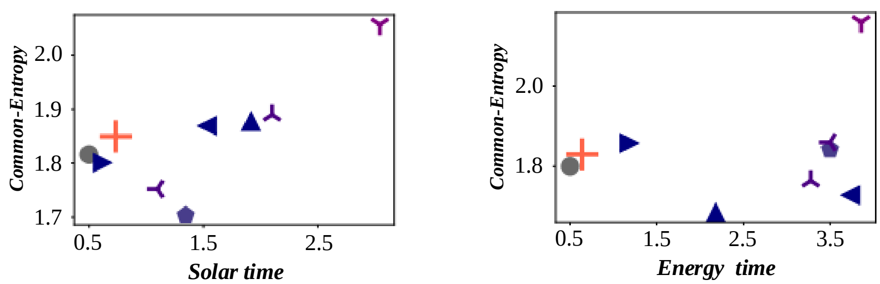

Fig. 3. Evaluation chart of rural tourists.

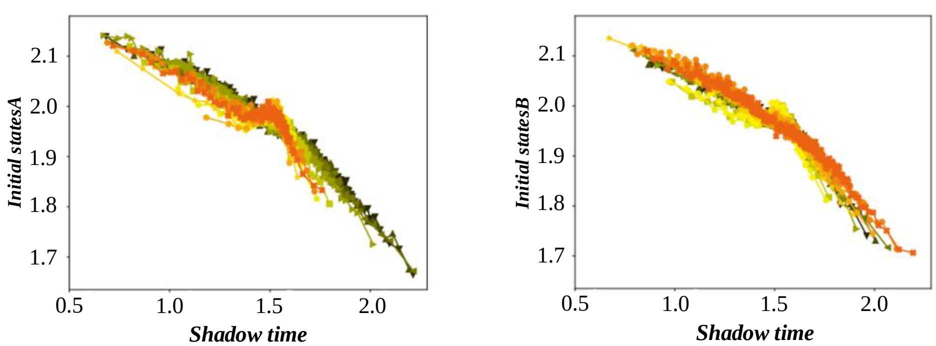

Fig. 4. Weight evaluation diagram of tourist satisfaction evaluation index.

IV. Research on the Design of Rural Tourism - Tourist Satisfaction Monitoring System based on the Improved INFO Algorithm

Tourist satisfaction can be influenced by various factors such as convenience, accessibility, and safety, all of which are closely related to the effectiveness of the monitoring system. To enhance visitor satisfaction, one promising area of research is the integration of visitor satisfaction monitoring and tracking algorithms, which involve real-time data collection and analysis. Sensor networks, such as GPS, RFID, and Wi-Fi-based tracking systems, can be used to monitor the movement patterns of tourists and provide insights into crowd density, visitor preferences, and behavior. Fig. 5 illustrates the visitor satisfaction evaluation across different age groups. Due to differences in peripheral units such as the timer and serial port compared to other 8051 cores, code that utilizes peripheral unit special function registers (SFR) may not function correctly. The 8 KB RAM retains data across various power supply modes and can be paired with buffer modules of varying capacities as per system requirements. When used with the ZigBee protocol stack, the CC2530 provides a powerful communication solution, and when integrated with the RemoTI platform, it offers a complete RF4CE remote control scheme.

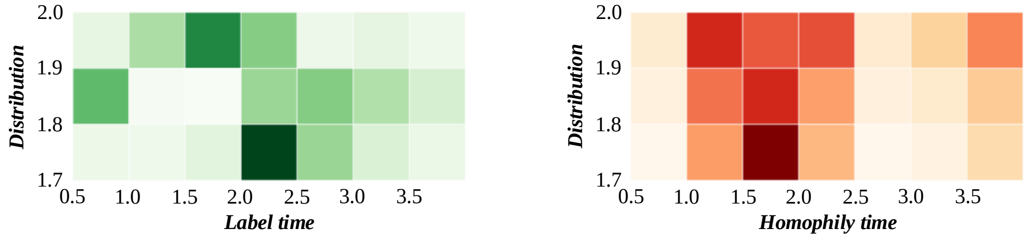

Fig. 5. Satisfaction assessment chart of tourists of different ages.

Recent studies have proposed various algorithms for positioning and tracking within crowded environments, particularly in the context of smart cities and tourism. These algorithms are designed to improve the accuracy and efficiency of tracking, enabling better real-time decision-making. For instance, the application of localization algorithms using sensor networks has shown promising results in detecting high-density areas, guiding visitors, and optimizing traffic flows within tourist attractions. These technologies not only support the operational management of tourist destinations but also contribute to enhancing the overall experience of the visitors. On the one hand, the sensor nodes generally use the battery pack to provide energy. Table I is the data table of sensor nodes. For some sensor nodes that are out of power, they need to take abandoned means and then release new sensor nodes, or reach the position of the sensor nodes and replace the battery and then put them into the scenic spot. Either way will make the position of the sensor node recorded before invalid. At this time, in order to keep the data in the database not occupied by the dead data, the data should be managed and the accuracy of the data in the database should be restored in time.

TABLE I DATA SHEETS OF THE SENSOR NODES

Order Number	Field Name	Field Type	Restrain	Explain
1	Id	Int	Non-Empty	Automatic Number
2	Node_id	Int	Primary Key, Non-Empty	Node Number
3	Axis_X	Double	Non-Empty	Node x Coordinates
4	Axis_Y	Double	Non-Empty	Node y Coordinates
5	Energy	Double	Non-Empty	Node Energy
6	Time	Int	Non-Empty	Clock

To mitigate these risks, we proposed several protective measures, chief among them being the use of anonymous data collection methods. By anonymizing location data, we can ensure that individual visitors cannot be identified based on their movement patterns or behaviors. This method not only protects the privacy of the visitors but also ensures that the data cannot be traced back to any specific individual, thus reducing the likelihood of misuse or exploitation of personal information. In addition to anonymization, we also implemented secure transmission protocols to encrypt data as it is sent from sensors to the central monitoring system. This step ensures that any intercepted data would be rendered unreadable to unauthorized parties, further safeguarding the system against potential security breaches. If a tourist enters a hazardous area, the system can calculate the shortest route for rescue based on the tourist's current location and coordinates. Table II displays the electricity identification information. Additionally, the system can predict the movement patterns of tourists, allowing for the formulation of timely and efficient rescue plans. The sensor nodes located within the monitoring area of the scenic spot utilize their internal positioning algorithms to determine their exact locations. Tourist nodes, equipped with numerous distributed sensors, calculate their location coordinates and transmit this information via nearby sink nodes or base stations to the network server. The data is then dynamically displayed on the terminal interface, providing real-time updates for the management of the scenic area. The node location data is scaled according to the actual size of the scenic spot, ensuring accurate representation on the map.

TABLE II DESCRIPTION OF THE POWER QUANTITY IDENTIFICATION

Identify The Color	Node Energy	State Description
Blue	75%~100%	Power Is Sufficient
Green	50%~74%	Available
Yellow	25%~49%	Available
Red	0%~24%	Need To Replace

However, to fully address the challenges posed by high-density tourist crowds, the existing positioning and tracking algorithms need to be further optimized. Current solutions often face limitations when it comes to handling complex, large-scale environments with rapidly changing conditions. For example, GPS-based algorithms can struggle with accuracy in dense, indoor spaces, and Wi-Fi-based positioning systems may suffer from signal interference. To improve the effectiveness of these systems, it is essential to develop advanced algorithms that integrate real-time data from multiple sensors and environmental factors. By employing techniques such as machine learning and data fusion, these algorithms can be optimized to provide more accurate, real-time tracking information, which is crucial for enhancing both security and visitor satisfaction. For effective management of scenic spots, ensuring an even distribution of tourists is critical for their safety. If tourists are not evenly distributed, it can lead to congestion along routes and overcrowding in specific areas of the scenic spot. Such issues not only disrupt the management of the location but also negatively impact the visitors' experience, potentially even leading to dangerous situations such as stampedes, which pose a significant safety risk. Leveraging the tourist management system, data on the number of visitors at different spots is collected and relayed to both users and administrators in real-time. This allows tourists to adjust their routes based on the current distribution of people in the area, while managers can implement macro-level strategies to ensure smooth crowd flow, thereby minimizing safety risks. The algorithm, written in code, is loaded onto the CC2530 chip via a simulator. The sensor is positioned at a certain distance to transmit signals, and the receiving node continuously monitors and measures the RSSI (Received Signal Strength Indicator) signal strength. The data is then transmitted to the computer through a USB serial interface, allowing for the evaluation of communication distance and quality. The experiment is conducted in both open and natural environments, with the RSSI signal's effective range reaching approximately 25 meters in an open environment. Fig. 6 presents the satisfaction evaluation chart for peak seasonal tourism periods. In the natural environment, factors such as air temperature, humidity, and obstacles between nodes slightly reduce the communication range, but it still reaches approximately 15 to 25 meters. When the red light on the sensor is illuminated, it signifies that the power supply has been successfully established, and a flashing blue light confirms that data transmission and reception are functioning correctly, indicating the successful setup of the network and the start of communication.

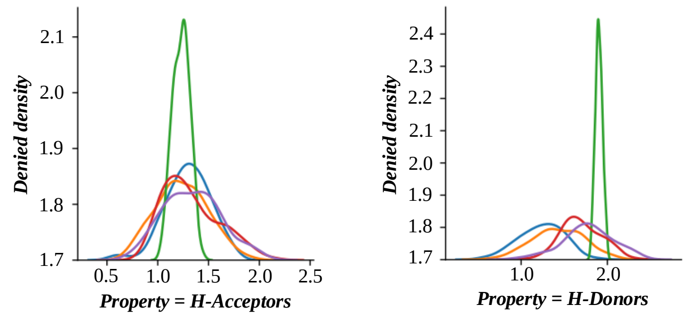

Fig. 6. Satisfaction assessment chart of seasonal tourism peak period.

V. Experimental Analysis

The positioning algorithm uses the idea of substituting the curve to convert the curve segment represented by the single hop distance into a straight segment. This paper explains the shortcomings of the algorithm and the root causes of the high error, and puts forward a new algorithm viewpoint. Fig. 7 shows the evaluation diagram of correlation between satisfaction and tourism revenue. A new collaborative node selection method, focusing on each anchor node topology, introduces several independent subnetworks; using optimized distance calculation method; using cuckoo algorithm to obtain a local optimal solution. With the local optimal solution as the final position coordinates of the located unknown node, the final selected position coordinates are closer to the actual position coordinates, which improves the positioning accuracy. Finally, the whole process of subnetwork fusion collaborative location algorithm is summarized.

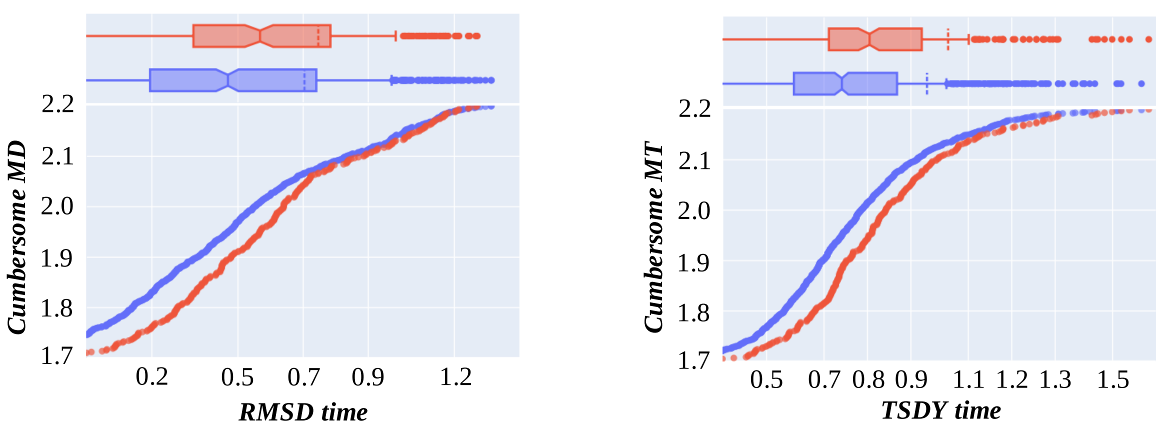

Fig. 7. Evaluation diagram of the correlation between satisfaction and tourism income.

Under identical network conditions, the proposed INFO algorithm demonstrates superior positioning accuracy and lower positioning errors when compared to both the standard INFO algorithm and the improved version of the INFO algorithm. Fig. 8 illustrates the satisfaction evaluation of service facilities. The system uses a random deployment method to place sensor nodes throughout the scenic area. Given the vast size of the area, the distribution of these sensor nodes is uneven, influenced by various factors during the random placement process. In regions with a high density of nodes, the data redundancy generated by the sensors tends to be significant. To minimize unnecessary energy consumption, some nodes are programmed to enter a dormant state and operate in an alternating fashion based on their remaining power, thereby extending the overall lifetime of the network.

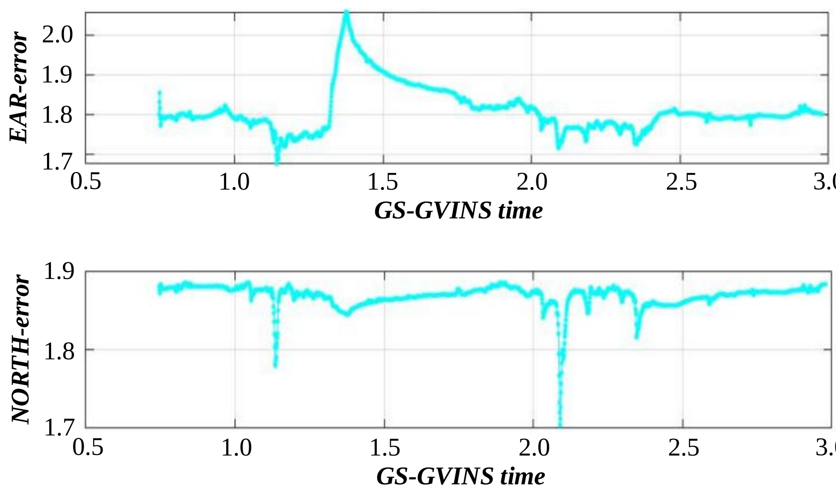

Fig. 8. Assessment chart of satisfaction with service facilities.

The positioning of each node is completed based on the positioning algorithm stored in the component memory. Fig. 9 presents the evaluation of social media sentiment analysis. When a sensor node enters a dormant state, it is activated when a visitor enters the detection area. One of the key advancements in optimizing network security and visitor satisfaction is the integration of real-time data analysis. Real-time data, when processed effectively, can provide valuable insights into both the security status of the network and the current satisfaction levels of visitors. For example, analyzing crowd density and behavior in real-time can help predict potential security threats or disruptions before they escalate. This can be achieved through the use of machine learning models that predict visitor behavior based on historical data and real-time sensor inputs. Similarly, real-time analysis of network traffic can help identify potential security vulnerabilities and enable proactive responses to mitigate risks.

The base station that receives the data further sends the information to the network server via satellite or wireless networks for processing and storage. If the client needs to call the data, the network server sends the information in the database to the client interface. Fig. 10 for satisfaction promotion strategy implementation effect evaluation diagram, the client interface receives related parameters, and after the analysis of the current tourist status, the location or the tourists of the area security and the status of the entourage, etc., and give the danger level prompt and timely remind the scenic spot personnel and prevention and treatment measures.

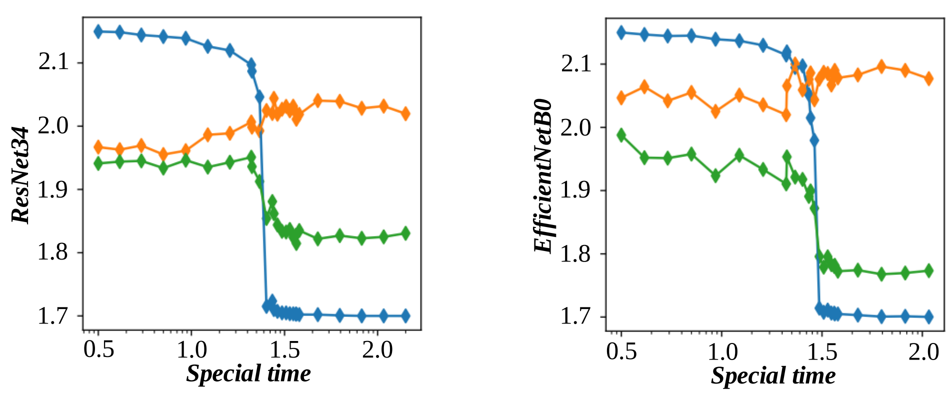

Fig. 9. Assessment chart of sentiment analysis in social media.

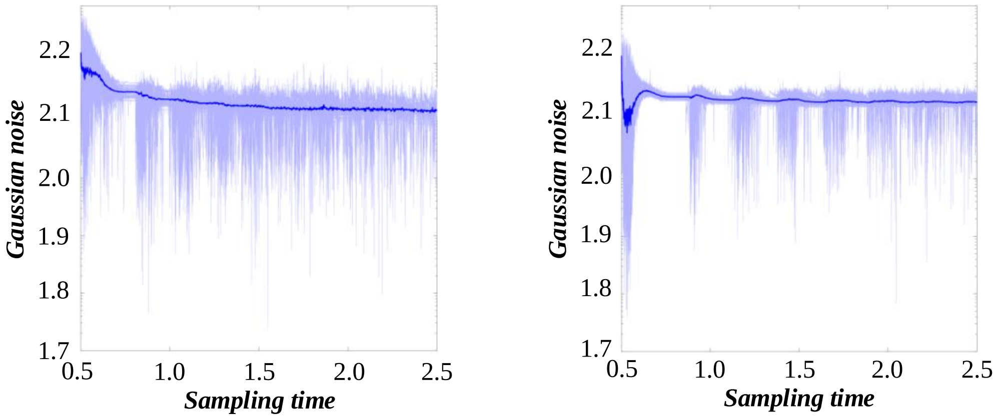

Fig. 10. Evaluation chart of the implementation effect of the satisfaction improvement strategy.

VI. CONCLUSION

At present, most regional scenic spots still adopt the original human management mechanism. This inefficient management mode simply cannot cope with the increasing number of tourists. Although some areas will use monitoring to make up for the lack of manpower, the uncontrolled human activities are often not easy to be captured by monitoring. Or some scenic spots manage tourists at the cost of reducing the scope of tourist activities, but the satisfaction of tourists is greatly reduced, and few places can be visited in the so large scenic spots. The advancement of rural tourism satisfaction technology is expected to pave the way for more efficient tourist management in scenic spots, significantly reducing the need for manual oversight while enhancing overall management effectiveness. This shift will modernize tourist management systems and make them more information-driven. The core of Wireless Sensor Network (WSN) technology lies in the self-localization of nodes, and the fundamental measure of the network's practicality is the accuracy of node positioning. After 30 rounds of training with low-resolution images, the model was trained on the entire dataset. During this phase, the initial learning rate was set to 0.01, which was halved if the Average Precision (AP) indicator on the validation set did not improve after five consecutive iterations. A batch size of 2 was used, due to the inclusion of high-resolution images and GPU memory limitations. This stage involved validating the model for a total of 200 training rounds, with Loss Function values recorded every 72 iterations over 14,400 total iterations, and tracking the AP indicator on the validation set.

Another aspect of this research involves applying the optimized system to other tourism environments, including both rural and urban settings. While much of the current research has focused on urban tourism environments, there is a growing need to explore how such systems can be adapted to rural or less densely populated areas. Rural tourism destinations often lack the infrastructure and resources found in urban areas, making them more vulnerable to security threats and less able to support large-scale monitoring systems. However, by employing optimized positioning algorithms and sensor networks, these systems could be tailored to provide scalable solutions for rural areas, enhancing security and improving the overall visitor experience. Through the simulation experiment, the performance of other correlation algorithms and this algorithm in different environments and different parameters is compared, and the final experimental results show that this algorithm is better than other algorithms, and the positioning accuracy is improved.

In conclusion, the optimization of network security systems in the context of tourism requires a comprehensive approach that combines advanced positioning algorithms, real-time data analysis, and the application of intelligent optimization techniques such as the PSO algorithm. By leveraging the power of these technologies, it is possible to create a more secure, efficient, and visitor-friendly environment. The integration of PSO-based optimization can help address the challenges posed by high-density crowds, improve security monitoring, and ultimately enhance the overall tourist experience. Additionally, the scalability of these solutions allows them to be applied not only in urban settings but also in rural or less developed tourist destinations, contributing to the advancement of tourism infrastructure worldwide.

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