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Research Article

Fixed Assets Positioning Management Based on Nonlinear Difference Algorithm

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Fixed assets are an enterprise's core means of production and a vital asset for the enterprise's sustainability. Good fixed asset management not only helps to enhance asset utilization but also helps to prevent idleness and asset loss, both of which are vital in the success of the enterprise. To improve fixed asset management, it needs not only a good asset management system but also advanced asset monitoring and management technology. As a result, to address the issues of difficult positioning, tracking, and low management efficiency in enterprise's asset management, this paper optimizes the commonly used the LANDMARC positioning algorithm and implements an improved algorithm based on Lagrange nonlinear interpolation. It is also used in fixed asset positioning management to overcome the problem of increasing the density of auxiliary tags to enhance positioning accuracy, which leads to higher costs and greater radio frequency interference. Simultaneously, a set of RFID-based fixed asset management systems was built and implemented, starting with the application requirements of enterprises and combining the optimization algorithm with FRID technology. Finally, a simulation experiment on the application of the Lagrange nonlinear interpolation algorithm in fixed asset positioning management is carried out and a comparison with other algorithms is performed. According to the simulation findings, the new algorithm has enhanced the positioning accuracy. The system can perform all-around dynamic tracking and positioning management of diverse assets, optimize the use efficiency and management level of assets, and improve the intelligent level of enterprise asset management.

1. Introduction

The amount and types of fixed assets possessed by enterprises are constantly expanding, and changes are becoming more frequent as a result of their rapid expansion and growth. Fixed assets, as a significant portion of an enterprise's total assets, provide the material foundation for other activity to occur normally. Their standardized management aids in improving the economic benefits of enterprises and are a necessary condition for their long-term success [1, 2]. However, the administration of fixed assets in some enterprises has not kept up with the information age and is still in the traditional mode. Sticking a paper code strip or an RFID tag to the device for routine statistics and inventory is the typical method of information management for fixed assets [3]. However, as the level of informatization has improved, traditional technologies have become more vulnerable to issues such as low intelligence, time-consuming and labor-intensive inventory, late information updates, and the inability to grasp asset status in real time.

As the IoT technology becomes more mature and reliable, asset tracking and inventory technology based on wireless location technology has steadily been introduced into the asset management system, offering new potential to fixed asset management [4]. WiFi, being the most widely utilized wireless local area network communication technology, has significantly assisted public communication freedom. Wireless access points (APs) and positioning tags can be used to implement location services. Fixed assets are associated with positioning tags, and their location can be detected in real time [5]. The IEEE802.15.4 protocol is used by ZigBee, a new IoT communication technology. This approach estimates the location of the positioning point by combining received signal strength indication (RSSI) information [6]. In addition to WiFi and ZigBee, there are other technologies for asset positioning and dynamic tracking, such as ultra-wideband (UWB) [7], long range (LoRa) [8], and Bluetooth [9]. In particular, as a hotspot in the field of the information industry at home and abroad, radio frequency identification (RFID) has increasingly been acknowledged as the new "gold mine" for enterprises. It can be said that the popularity of RFID technology provides a new technical solution for the spatial positioning and tracking method of fixed assets [10].

However, the existing fixed asset positioning technology can only determine the position of the fixed asset by measuring the distance or judging the current position status of the fixed asset by monitoring the entry and exit of the fixed asset. None of these techniques can provide comprehensive real-time location sharing or detect the exact location of fixed assets. As a result, the location information of moveable fixed assets cannot be grasped in real time, making automatic asset information collection, monitoring, and discovery difficult. The linear interpolation algorithm has been extensively explored at home and abroad to overcome the aforementioned challenges, and a number of interpolation algorithms have been suggested in recent years. Literature [11] and literature [12] developed three linear interpolation techniques for radio frequency signals, all of which can perform two-dimensional radio frequency signal interpolation. However, the existing interpolation algorithms ignore the effect of the nonlinear variation of the radio frequency signal on the interpolation accuracy, resulting in low interpolation accuracy. To this end, many scholars have proposed a variety of sensor nonlinear compensation methods [13, 14]. Then, the signal feature quantity does not conform to the linear distribution due to a complex environment or a large distance between acquisition points; the nonlinear interpolation algorithm can be used to accurately calculate the signal feature statistics between the points according to the nonlinear distribution law, allowing the location of the anchor point to be determined.

For the reasons stated above, this work improves and optimizes the current problems in the LADNMARC asset positioning method based on RSSI and implements the nonlinear interpolation based on the Lagrange algorithm in order to enable multitarget monitoring of a large number of fixed assets. The improved method is used to manage the fixed asset location. This paper's important contributions are as follows: first, the common RFID indoor positioning methods are studied and the RFID technology and its application in fixed asset management are introduced. Secondly, the LANDMARC positioning algorithm and its existing problems are analyzed. The paper optimizes the LANDMARC algorithm and introduces an optimized algorithm on the basis of the Lagrange nonlinear interpolation technique to enhance the positioning accuracy of the fixed asset management system, in light of the high cost and more serious radio frequency interference caused by increasing the density of auxiliary tags to improve positioning accuracy. Finally, a fixed asset management system based on the Lagrange nonlinear interpolation approach is created and implemented by merging the improved algorithm with the RFID positioning technique. The new algorithm has enhanced the positioning accuracy, according to the simulation findings. The performance test also shows that the system can improve the monitoring and management capabilities of fixed assets and effectively prevent the loss of fixed assets, making the management of fixed assets more standardized, convenient, safe, and effective.

2. Related Research

2.1. Indoor Positioning Method. According to the different ranging methods, common RFID indoor positioning methods are divided into four types: RSSI [15], TOA [16], TDOA [17], and AOA [18].

2.1.1. RSSI. According to the electromagnetic wave transmission theory, the signal strength of the electromagnetic wave will gradually weaken as the distance increases during the transmission process. The distance between the tag and the reader can be determined using the Friis electromagnetic wave free space propagation model formula, which takes into account the tag transmit power, the gain of the tag and the reader antenna, and other factors. A target tag is surrounded by three readers with known position coordinates. The distances between the tag and the three readers can be computed as d_1, d_2, and d_3, respectively, based on the electromagnetic wave power of the signal transmitted by the tag and other known factors. According to the geometric relationship, the tag is located at the intersection of the circles with the three readers as the center and d_1, d_2, and d_3 as the radii.

The two methods of signal strength positioning are signal propagation model positioning and empirical positioning. The location of a signal propagation model requires the first construction of a signal propagation model. The model can be designed for the specific application environment or chosen from existing models such as Rician and Rayleigh [19, 20]. The signal strength is calculated using this propagation model as a reference position. The positioning of a signal propagation model does not require a lot of measurement work, and the work efficiency is high, but its positioning accuracy is not very ideal. Data acquisition and data processing are the two processes of the empirical positioning approach for locating objects. A reference tag should be placed near the unknown tag during the data collection step. Three readers, each with a distinct position coordinate, read the signal generated by the reference tag and transmit the received signal strength as well as the reference tag's position information to the data processing center for processing. The position of the object is calculated in the data processing stage by processing the collected data. The empirical positioning method has a higher cost and requires a huge amount of data measurement and processing than the signal propagation model positioning method, but its positioning accuracy is high. Currently, the empirical positioning method is used for indoor positioning based on the signal strength.

2.1.2. TOA. To compute the distance between the tag and the reader, TOA utilizes the propagation time of electromagnetic waves and the propagation speed of electromagnetic waves in the environment. To locate a tag, use three readers, and the distances from the tag to the readers are ct_1, ct_2, and ct_3 (where c denotes the speed of electromagnetic wave propagation) when the measured time of the tag signal reaching the reader is t_1, t_2, and t_3. The tag is at the intersection of the circles with the three readers as the center and ct_1, ct_2, and ct_3 as the radius. Let the tag coordinates be (x_0, y_0) and the reader coordinates be (x_i, y_i) (where $i = 1,2,$ and3), then the relationship between them is as follows:

$$\begin{cases} (x_1 - x_0)^2 + (y_1 - y_0)^2 = (ct_1)^2, \\ (x_2 - x_0)^2 + (y_2 - y_0)^2 = (ct_2)^2, \\ (x_3 - x_0)^2 + (y_3 - y_0)^2 = (ct_3)^2. \end{cases} \tag{1}$$

The position coordinates of the tag to be positioned can be calculated by formula (1).

2.1.3. TDOA. The timing difference between a certain tag signal reaching different readers is used in TDOA to find the tag's coordinates. If the time difference between a tag signal received by the reader is t_{12}, t_{13}, and t_{23}, then the distance difference between the associated tag and the reader is ct_{12}, ct_{13}, and ct_{23}. In accordance with the geometric principle, the tag is placed on a hyperbola, with the position of every two readers as the focus and the corresponding distance difference as the standard deviation. The tag position is determined by the intersection of the two hyperbolas. Assuming that the tag coordinates are (x_0, y_0), and the reader coordinates are (x_i, y_i) (where $i = 1$, 2, and 3), the tag coordinates can be calculated from the following relationship:

$$\begin{cases} \sqrt{(x_0 - x_1)^2 - (y_0 - y_1)^2} - \sqrt{(x_0 - x_2)^2 - (y_0 - y_2)^2} = ct_{12}, \\ \sqrt{(x_0 - x_1)^2 - (y_0 - y_1)^2} - \sqrt{(x_0 - x_3)^2 - (y_0 - y_3)^2} = ct_{13}. \end{cases} \tag{2}$$

2.1.4. AOA. AOA measures the angle of the electromagnetic wave signal emitted by the tag and received by each reader via the reader's antenna array and calculates the tag's precise position based on the angle of the same tag signal received by different readers. It is assumed that the measured angles at which a certain tag signal reaches reader 1 and reader 2 are α_1 and α_2, respectively. The tag is then located at the intersection of a line passing through reader 1 with a slope of $\tan(\alpha_1)$ and a line passing through reader 2 with a slope of $\tan(\alpha_2)$. The position coordinates of the tag can be calculated from the known coordinates of the two readers and the receiving angles α_1 and α_2 , respectively.

2.2. FRID Technology and Its Application in Fixed Asset Positioning Management. RFID stands for radio frequency identification, and it was first used in the 1990s. It works by sending and receiving radio frequency signals and then using those signals to send data. It can recognize specific targets and read and write data about them without making contact with them [21]. RFID technology has the ability to recognize items from a long distance, has a high penetration, is antipollution, is wear resistant, and has a long life. In the field of automatic identification, RFID technology now offers a wide range of applications [22].

The electronic tag, reader, and information processing application system make up for a full-RFID locating system. Electronic tags are the foundation for the application of RFID technology, which are usually attached to the surface of items to mark corresponding items. The RFID reader is a crucial component of the RFID system, which is responsible for tracking and communicating electronic tags. The interaction between the RFID tag and the RFID reader is mainly based on signal propagation, and the strength of the interaction signal depends on the operating frequency of the RFID tag antenna. The operating frequency of an RFID antenna is proportional to the distance of the signal travels. That is, if the frequency of the antenna is higher, the farther the signal travels. Therefore, according to the size of the office area, the appropriate RFID antenna frequency is selected to ensure the accuracy of asset positioning.

In fixed asset management, RFID technology focuses on asset positioning. RFID tags are typically attached to an asset device and RFID readers are installed in various office buildings across the unit. Calculating the distance of signal transmission between the RFID reader and the tag allows the position of the fixed asset to be determined. Figure 1 depicts the design of the system's physical structure.

As shown in Figure 1, the information from each RFID tag is collected by an RFID reader to assure the development of fixed asset information collection. The collected data are then communicated to the system server and the database server via the serial server and the switch, where it is stored and processed. As a result, asset positioning and management may be efficiently realized through the use of modern RFID technology and asset positioning algorithms, which not only ensures standardized asset management but also improves asset security.

3. Fixed Asset Management Based on the Lagrange Nonlinear Interpolation Method

3.1. Overall Design of the System. The two major functions implemented by the fixed asset management system are asset information management and asset inventory functions. The information management of fixed assets primarily achieves

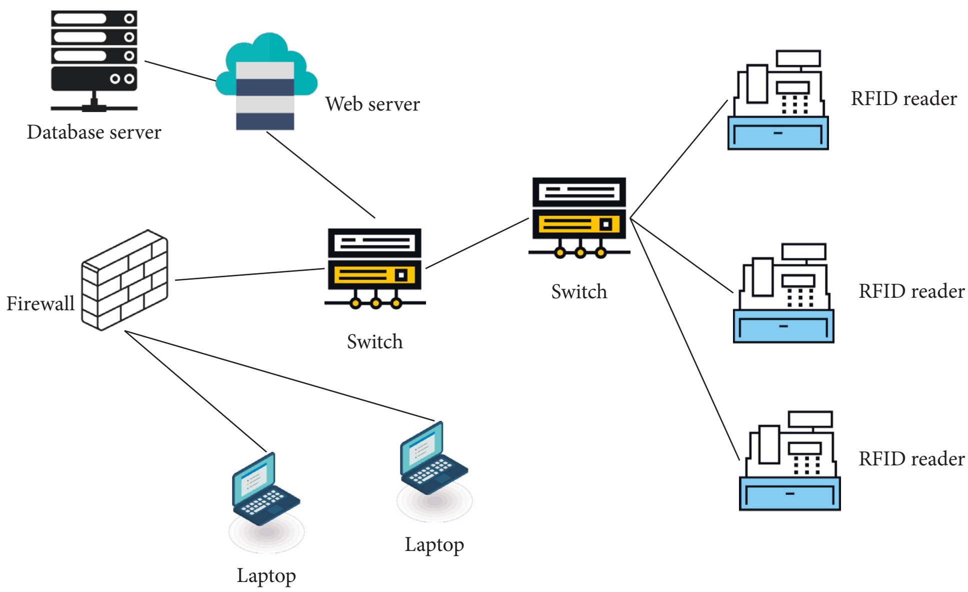

Figure 1: The physical architecture topology of the system.

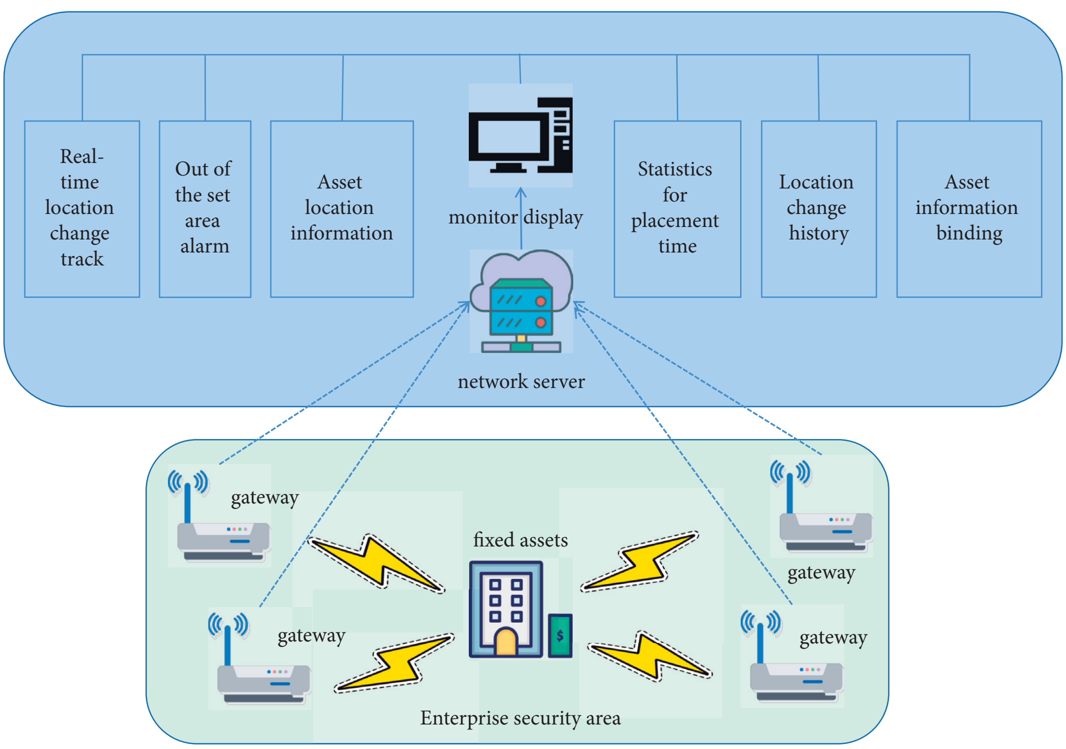

Figure 2: The schematic diagram of the structure of the fixed asset positioning system.

the verification of the information of the located assets, as well as the ability to edit and scrap the information based on the current state of the assets, in order to achieve asset maintenance and update. The purpose of the asset inventory is to verify the assets on the existing asset inventory list. If the asset information is incorrect, the Lagrange nonlinear interpolation approach is used to find the fixed asset in real time. We compare the location information in the located asset table to the location information in the existing asset table to see if the asset has been moved or transferred illegally. The schematic diagram of the structure of the fixed asset positioning system is shown in Figure 2.

The B/S layered architecture is used for logical architecture design in order to ensure that users can easily use the system. Figure 3 depicts the system's logical structure, which is organized into five layers: device layer, data acquisition layer, communication layer, data layer, and application layer.

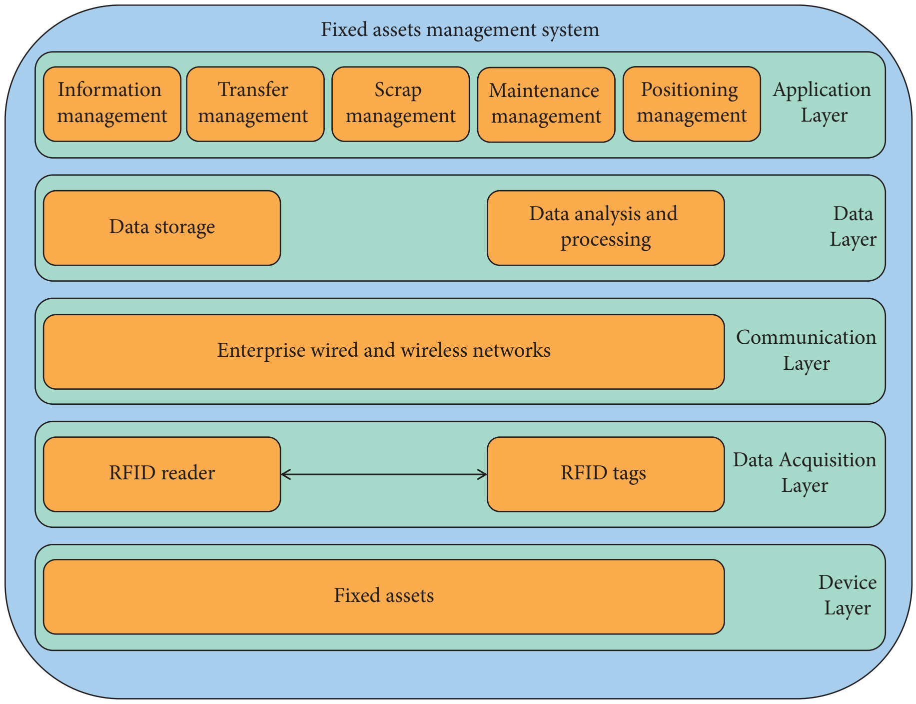

Figure 3: Overall architecture of the system.

As shown in Figure 3, the application layer provides the main functions implemented by the system, and the user can achieve the desired functions by accessing various functional modules of the application layer. The data layer mainly realizes data storage and data processing and provides data support for the realization of various functions of the application layer. The communication layer mainly realizes the transmission of the collected data. The data acquisition layer is the main realization layer of the RFID technology and the asset positioning algorithm. The information of the RFID tag through the RFID reader is read, and at the same time, the location information of the asset through the positioning algorithm of the fixed asset is detected; then, it is compared with the original location information of the asset in the database to determine whether the asset has been transferred. The device layer mainly refers to the managed fixed assets. Each fixed asset has a unique RFID tag, and the basic information of the fixed asset is recorded in the tag.

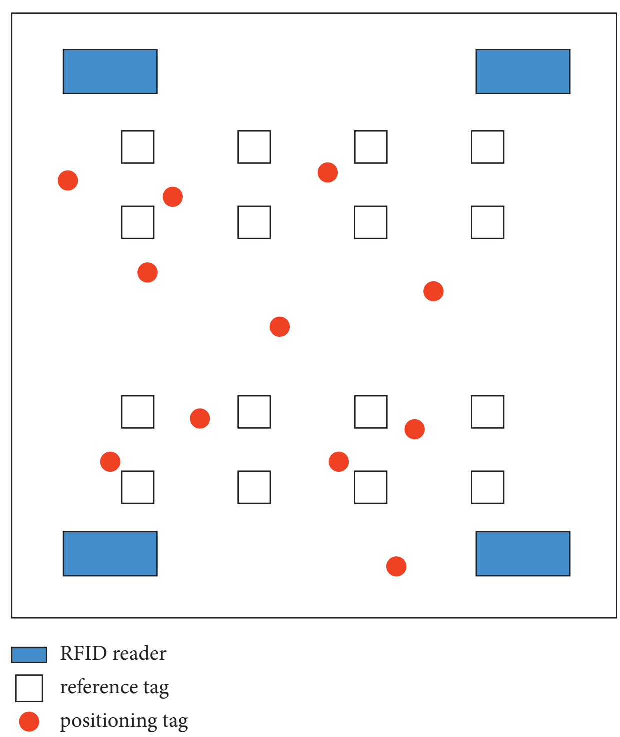

Figure 4: The classic layout of the LANDMARC system.

3.2. LANDMARC Localization Algorithm. LANDMARC is a positioning technology based on RSSI that uses auxiliary tags to calculate the distance between RFID tags and RFID readers to perform asset location [23]. The classic layout of the LANDMARC system tag is shown in Figure 4.

As shown in Figure 4, the LANDMARC positioning algorithm calculates the position of the tag to be positioned according to the position information of the RFID auxiliary tag and the signal strength fed back to the RFID reader by the tag to be positioned. Since the location of the auxiliary tag and its signal strength to the reader are generally known. Because the signal strengths of tags with similar distances received by the reader are generally similar, some auxiliary tags that are closest to the tag to be located can be determined using the principle of the similar signal strength and similar position. The position coordinates of the tags to be located can be calculated using the position coordinates of these auxiliary tags and the relevant empirical weight formula.

Assuming that there are N readers, M auxiliary tags, and L tags to be located in the area, then the signal strength of the ith tag to be located on the jth (where $j\in(1, N)$) reader is represented by R_{ij}. The signal strength of the ith auxiliary tag to be located on the jth (where $j\in(1, N)$) reader is denoted by S_{ij}. Then, the Euclidean distance can be calculated as follows:

$$E_{ij} = \sqrt{\sum_{k=1}^{N} \left(S_{ik} - R_{jk}\right)^2}, \tag{3}$$

where $E_{ij}(i = 1,2, \ldots, L.j = 1,2, \ldots, M)$ represents the Euclidean distance between the ith tag to be located and the jth auxiliary tag. The size of E_{ij} directly indicates the distance between the tag to be positioned and the auxiliary tag. The kth auxiliary tag closest to a tag P to be located is selected (that is, select according to the value of the E_{pj}). Through the positions of these auxiliary tags and the empirical weight formula, the position coordinates of the tag to be located can be calculated as follows:

$$(x, y) = \sum_{i=1}^{k} w_i \left(x_i, y_i\right), \tag{4}$$

where (x_i, y_i) is the position coordinate of the ith auxiliary tag and w_i represents the weight of the ith auxiliary tag. The size of the weight is related to the distance, and the farther the distance is, the smaller the weight is. The value of the weight w is calculated as follows:

$$w_j = \frac{1/E_{pj}^2}{\sum_{i=1}^{k} 1/E_{pi}^2}, \tag{5}$$

where w_j $(j = 1,2, \ldots, k)$ represents the weight and E_{pj} is the Euclidean distance between the tag p to be located and the auxiliary tag j.

Suppose the actual coordinates of the tag to be positioned are (x_0, y_0); then, the positioning error e is as follows:

$$e = \sqrt{\left(x_0 - x\right)^2 + \left(y_0 - y\right)^2}. \tag{6}$$

As can be seen from the above analysis, the addition of RFID auxiliary tags improves the accuracy of the LANDMARC positioning algorithm while reducing the reliance on RFID readers. At the same time, it improves the positioning system's adaptability to the enterprise's complicated environment to some level. Furthermore, because the LANDMARC method is based on the RSSI value, it requires less hardware for readers and tags than algorithms based on TOA and AOA. However, these benefits can only be highlighted in ideal circumstances. Because of the enterprise's complicated internal structure and strong closedness, the algorithm's multipath effect will be more severe, resulting in positioning accuracy that falls short of expectations. As a result, a number of scholars have proposed improved algorithms [24]. The VIRE algorithm was proposed in the literature [25]. The linear interpolation approach is used in the algorithm, and the usage of virtual tags minimizes the number of auxiliary tags needed and enhances positioning accuracy. However, because the indoor propagation attenuation characteristic of radio frequency signals is a nonlinear function, the VIRE algorithm's use of linear interpolation to locate still has drawbacks.

3.3. A Nonlinear Interpolation Algorithm Based on Lagrange. In order to achieve the desired positioning effect, this study improves and optimizes the current difficulties in the LADNMARC positioning technique and provides an improved algorithm based on the Lagrange nonlinear interpolation algorithm. By using virtual auxiliary tags instead of additional auxiliary tags, the improved positioning algorithm generates a to-be-located tag that is closer to the actual location, enhancing asset positioning accuracy.

The office is divided into different areas where asset positioning is required. Simultaneously, multiple virtual RFID auxiliary tags are set based on the number of RFID auxiliary tags set by the LANDMARC positioning algorithm. Let the distance between each virtual RFID auxiliary tag and the RFID reader be d. The set RFID auxiliary tags are sorted according to the descending order of the value of d. Taking d as the independent variable and the signal strength RSSI received by the RFID reader as the dependent variable, Lagrange nonlinear interpolation is performed.

The distance from M virtual RFID auxiliary tags to the reader is set $d_0, d_1, \ldots, d_i$, where the value of i is $0 < i < M$. The signal strength RSSI received by the RFID reader is set $S_0, S_1, \ldots, S_i$. After arranging the values of the vector (d_i, S_i) from small to large, Lagrange nonlinear difference is performed.

According to the derivation of the Lagrange interpolation method, the coefficients of the Lagrangian polynomial can be obtained as

$$I_k(d) = \prod_{h=0}^{M} \prod_{h\neq k} \frac{\left(d - d_h\right)}{\left(d_k - d_h\right)}. \tag{7}$$

Synthesizing parameters d and S, the final Lagrange polynomial can be obtained as follows:

$$S = \sum_{k=0}^{M} S_k I_k(d). \tag{8}$$

According to formula (8), the signal strength value S of the virtual RFID auxiliary tag set in the early stage can be calculated. Assume that a virtual auxiliary tag i has a signal strength of S. The to-be-located point's signal strength value is compared to the S, and if they are close, it indicates that the to-be-located point is in the corresponding area of the virtual RFID auxiliary tag. Given that each virtual RFID auxiliary tag has a corresponding area, the intersection area of each virtual RFID auxiliary tag's corresponding area can be used to evaluate the position of the to-be- located asset.

As can be observed from the previous analysis, the positioning of fixed assets and the determination of relevant factors are primarily concerned with the following two aspects: the density of virtual auxiliary tags in the asset location area is one example. The difference in the signal strength between the virtual auxiliary tags and the tags to be located is the other. The weights of the two aspects are calculated as formulas (9) and (10) when calculating the pending asset location:

$$w_{1i} = \sum_{j=1}^{N} \left| \frac{S_{p(j)} - S_{i(j)}}{MS_{p(j)}} \right|, \quad (9)$$

$$w_{2i} = \frac{n_i}{\sum_{i=1}^{n} n_i}, \quad (10)$$

where N is the number of RFID readers, $S_{p(j)}$ is the signal strength of the virtual auxiliary tag p received by the RFID reader j, and $S_{i(j)}$ is the signal strength of the virtual auxiliary tag i received by the RFID reader j. M is the number of virtual auxiliary tags. n_i is the number of to-be-located areas for connection establishment. n is the number of all possible areas in the to-be-located area. Through the calculation of the weight of the above two factors, the empirical weight factor can be expressed as

$$w_i = w_{1i} \times w_{2i}. \quad (11)$$

Using the auxiliary tags, virtual auxiliary tags, and weight factors, the position coordinates of the tag to be located are calculated using formula (4).

4. Experimental Verification

This study compares the Lagrange nonlinear interpolation algorithm for asset positioning to the LANDMARC and VIRE algorithms using the MATLAB platform in order to test the algorithm's accuracy.

4.1. Test Environment. RFID readers are situated on the four corners of a square space with an 8 m length and width, and 10 pending RFID tags are randomly distributed in the square area. At the same time, 16 RFID auxiliary (reference) tags are evenly distributed in the square area as illustrated in Figure 5.

4.2. Simulation Results and Analysis. According to the VIRE and the Lagrange nonlinear interpolation algorithm, the virtual tag is inserted, and the simulation result is compared with the LANDMARC algorithm. The positioning error is calculated using formula (6). The average error and the cumulative error distribution function are utilized to assess the positioning effect of the three positioning algorithms in the experiment. Table 1 shows the average positioning error of the LANMARC, VIRE, and Lagrange algorithms.

As shown in Table 1, it indicates that the average positioning error of the VIRE algorithm is significantly lower than that of the LANDMARC algorithm. Meanwhile, the Lagrange nonlinear interpolation technique outperforms the VIRE technique in terms of positioning accuracy. The cumulative error distribution curve of each algorithm is shown in Figure 6.

From the CDF curve in Figure 6, it can be seen that if the positioning error is within 0.5 m, the LANDMARC algorithm accounts for less than 70%, while the VIRE algorithm

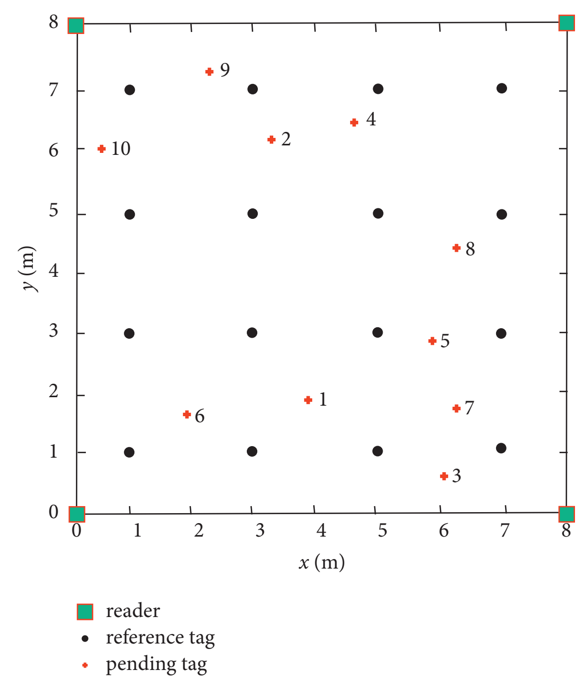

Figure 5: Test environment distribution.

Table 1: Average positioning error of each positioning algorithm.

Positioning algorithm	LANDMARC	VIRE	Lagrange
Average positioning error(m)	0.57	0.38	0.28

and the Lagrangian nonlinear interpolation algorithm account for about 100%. This shows that within this error range the difference between the CDF curves of the Lagrange nonlinear interpolation algorithm and the VIRE algorithm is not obvious. However, in the range of positioning error of 0.2~0.5, the Lagrange nonlinear interpolation algorithm has obvious advantages over the VIRE algorithm.

4.3. Practical Application Effect. The following two example tests are carried out to further confirm the proposed algorithm's localization performance in a real-world setting.

Example 1. Taking the fourth floor of a teaching building in a university as an indoor experimental environment, the points in the corridor were collected at equal intervals. The interval was set to 10 m in order, and the database was constructed to enable the position to be repeated. Then, the interval was set to 30 m, and the database was constructed to allow the position to be repeated. Tables 2 and 3 illustrate the error probability statistics for each positioning algorithm in the two cases, respectively.

The positioning accuracy of the algorithm in this paper is quite high, as shown by the data in Tables 2 and 3, and it is more than 20% higher than that of the VIRE algorithm with a greater effect. In addition, for the LANDMARC algorithm, when the interval between collection points is 10 meters, due to the large interval distance, solving the coordinate mean of K collection points will cause a large positioning error.

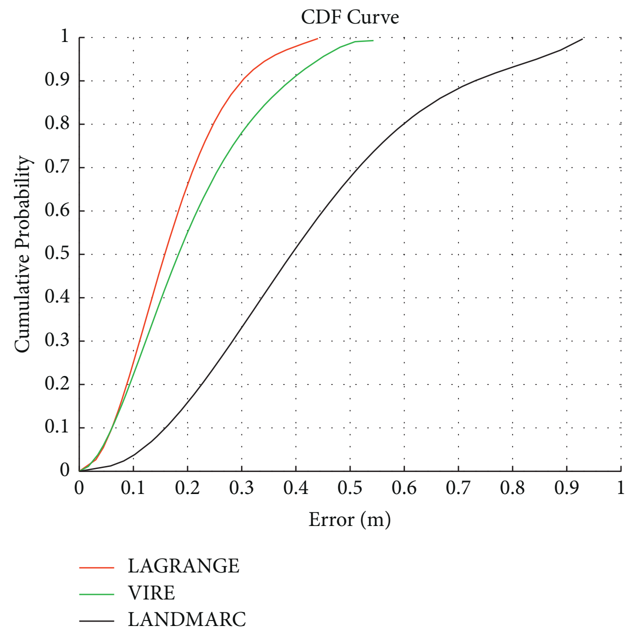

FIGURE 6: The cumulative error distribution curve of each algorithm.

TABLE 2: Comparison of 5 m positioning accuracy of each positioning method when the collection distance is 10 m.

Positioning algorithm	LANDMARC	VIRE	Lagrange
Positioning accuracy	56%	50%	78%

TABLE 3: Comparison of 10m positioning accuracy of each positioning method when the collection distance is 30 m.

Positioning algorithm	LANDMARC	VIRE	Lagrange
Positioning accuracy	53%	45%	75%

When the separation distance is further increased to 30 m, the positioning error becomes larger. For example, when the distance between the collection points is 30 m, the LANMARC algorithm has only a 45% probability of being located within 10 m. For the positioning algorithm in this paper, when the distance between the collection points is increased to 30 meters, there is still a 75% probability of positioning within 10 meters. That is, the positioning accuracy of this algorithm can still meet certain requirements when the distance between the collection points is increased. Therefore, the use of this algorithm can reduce the collection amount to a certain extent and is more suitable for the positioning of fixed assets in a widely distributed area.

Example 2. In addition, to test the actual application effect of the Lagrange nonlinear interpolation technique in real life, the RFID asset management system was used as a solution for a hospital's fixed asset management for trial operation. RFID tags are used on valuable medical devices and other important items in the hospital, and RFID readers are used to automatically collect data for links where barcodes are not competent. Through the intelligent decision-making of the background application software, the efficient and accurate management of assets is realized. The detailed configuration of the system in operation is shown in Table 4.

TABLE 4: Detailed configuration of the system in operation.

Component name	Number	Location
RFID reader	12	Two of them are installed at the front door and the back door of the hospital as inbound and outbound readers. The remaining 10 units are installed as positioning readers in 10 places where medical devices are concentrated
Passive electronic tags	1000+	On valuable medical devices and other important items
Asset tracking management machine (PC machine)	2	They are placed at the front and rear gates of the hospital
Asset positioning management machine (PC machine)	3	Placed in three buildings
Web server	1	Doubles as a database server and runs web applications on it
PC machine	Several	Each department

As shown in Table 4, all PC machines are interconnected through the local area network in the hospital and all fixed readers are connected to the local area network through the serial device network server. In addition, the hospital is equipped with two self-developed handheld RFID readers, which are used as mobile inventory machines for checking assets. After the trial operation, the operating data of the system are shown in Figure 7.

The operating data in Figure 7 show that this RFID technology-based fixed asset management solution directly

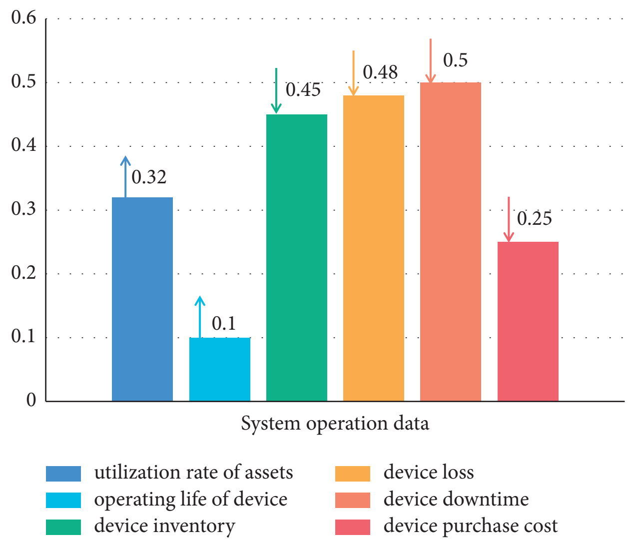

Figure 7: System operation data.

reduces the hospital's repeated procurement costs by about 25%, device inventory by about 45%, device loss by 48%, and device downtime by 50%. At the same time, the utilization rate of assets has been increased by 32%, and the operating life of the device has been extended by 10%.

To summarize, it can be observed that constructing a fixed asset management system using modern RFID technology and a nonlinear interpolation algorithm based on the Lagrange algorithm can successfully achieve asset positioning and management. It not only enhances the unit's asset management informatization and ensures standardized asset management, but it also improves the security and stability of the enterprise's fixed assets.

5. Conclusion

Fixed assets are a significant component of an enterprise's resources. Under the constraints of limited resources, the systematic construction and scientific management of fixed assets are critical to promoting the sustainable and circular development of enterprises. Asset tracking and inventory technology based on wireless location technology has steadily been introduced into the asset management system. In this work, a positioning algorithm based on the Lagrange nonlinear interpolation approach is applied in conjunction with the actual situation to find fixed assets in real time and increase the accuracy of fixed asset positioning. On this basis, combined with RFID technology, a fixed asset management system based on precise positioning was designed and developed. Finally, it is confirmed that the modified algorithm has enhanced positioning accuracy using MATLAB simulation experiments, demonstrating its effectiveness in fixed asset management. However, the research and development of the enterprise's fixed asset management system based on RFID technology involves various theories, methods, and technologies. The system needs to be improved in the future. For example, the existing interpolation algorithm ignores the effect of the radio frequency signal's nonlinear variation on interpolation accuracy, resulting in low interpolation accuracy. It is possible to increase the positioning accuracy of the algorithm by using a range of sensor nonlinear compensation methods to improve the method presented in this paper.

Data Availability

The labeled dataset used to support the findings of this study is available from the corresponding author upon request.

Conflicts of Interest

The author declares that there are no conflicts of interest.

Acknowledgments

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