Research Article

Key Technologies of Real-Time Location Service in Satellite Navigation and Positioning Network Based on Internet of Things

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In this day and age, the necessities for route and situating exactness are getting ever more elevated. The global positioning and navigation system (GPS) can give high-accuracy and long haul route and situating data. But it largely depends on the external environment and is susceptible to environmental disturbances. As a result, the number of visible stars is insufficient, and even placement fails. The research on node positioning technology is of great significance to the research of wireless sensor networks, and node positioning technology is one of the important technologies in wireless sensor networks. Therefore, this paper will introduce the relevant algorithms and technologies of positioning in detail. The purpose of this text is to research how to analyze and research based on Internet of things (IoT) satellite navigation and positioning technology. And the wireless sensor network is described. The two simulation results have showed that, with the positioning technology proposed in this paper, the average positioning error of the anchor node can be kept a small constant regardless of the conditions of different packet sending intervals, changing moving rates, or increasing the transmission power and changing distance. The average positioning error provided in this paper has been kept at about 0.80 m, and the positioning accuracy is high, which is naturally newer and better than the Ssu positioning technology.

1. Introduction

In the long evolutionary process of human beings, the ancient humans began to use navigation technology such as compass very early. Compasses and large arks for direction finding were among the earliest applications of navigation. With the fast improvement of science and innovation, people’s understanding and use of navigation are becoming more and more different, and the military and political departments have higher and higher requirements for precise navigation. People are not limited to using one navigation method, but often use two or more navigation methods to combine them for precise navigation. Many other applications in wireless sensor networks need to be created based on node localization techniques, such as node monitoring, node programming, etc. Most nodes are randomly distributed, so their location information is unknown. First, the location of the node itself can be determined, and then the exact location of the tracked object event can be accurately reflected. As of late, with the quick turn of events and the development of new advances like remote correspondence, coordinated circuits, sensors, and micro-electronic frameworks (MEMS). A few accomplishments have likewise been made in the examination on the siting calculation and the comparing siting framework for remote sensor organizations. In view of the above examination, the exploration of the mix of IoT situating innovation and satellite route is of extraordinary importance and worth.

With the consistent advancement of science and innovation, the research on positioning technology is also becoming more and more in-depth. Han et al. audited the utilization of X-beam situating, ECG, ultrasound, ECG Doppler ultrasound direction, and electromagnetic route framework in PICC tip situating innovation [1]. The framework proposed by Ma et al. gives the specialist a flight and worldwide situating view without depending on customary outside global positioning frameworks for careful
direction [2]. A wireless positioning algorithm for cranes based on the principle of ultra-wideband positioning is proposed for the problem that cranes cannot be accurately and dynamically positioned. Li et al. researched and designed the wireless positioning algorithm model, hardware architecture, and control system, and carried out simulation analysis and whole machine testing. The test results show that the wireless positioning system meets the set performance parameter requirements [3]. Jiang et al. aimed to study a robot-assisted puncture procedure based on optical position-ting technology. This robot can be used for point marking in puncture operations [4]. Zhang et al. proposed an exploration on restriction innovation in light of recurrence regulation band computerized sound telecom (FM-CDR) [5]. But the complexity of reality is not taken into account.

At the same time, the development of the IoT has brought about the wide application of many technologies. Hahm et al. dissect exhaustively the particular prerequisites that a working framework ought to meet to run on low-end IoT gadgets and researches material working frameworks [6]. The Perera et al. overview meant to give direction and a reasonable system for future examination on the IoT and to move further improvement interminably [7]. To diminish how much information gathered by the IoT, Xue et al. proposed a compacted detecting inspecting strategy [8]. Wen et al. outlined the core issues, challenges and future research directions of IoT service atomization orchestration. Early experiences with orchestration scenarios were also presented, demonstrating the feasibility and preliminary results of using distributed genetic algorithms in such situations [9]. Mostafa et al. assessed wearable clinical gadgets in logical papers and business occasions. It was shown through a characterized engineering configuration, including equipment and programming for handling wearables, sensors, cell phones, clinical applications, and a clinical station analyzer for additional diagnostics and information stockpiling [10]. These algorithms improve the accuracy to a certain extent, but ignore the timeliness.

In the process of in-depth data analysis and classification comparison, through the feasibility analysis and research of GPS adaptation structure or system and three-dimensional positioning algorithm, the corresponding anchor nodes can be moved and the wireless communication environment can be used. Based on different calculation results and similar algorithms, this work selectively proposed relevant strategies to improve the localization accuracy and make the technique applicable to any geographic environment. The innovation of this thesis lies in the combination of IoT and positioning technology. It introduced the theory and related methods of IoT in detail, which mainly introduced the location calculation method and the node positioning algorithm of wireless sensor network.

2. Positioning Method of Wireless Sensor Network

2.1. IoT and Satellite Navigation. The purpose of the IoT is to realize information interaction between things (the “things” here refer to people and things with the conditions listed above) [11]. It should have the following three functions: comprehensive perception, reliable transmission, and intelligent processing [12], as shown in Table 1.

The essence of the IoT is the unification of physical infrastructure and IT infrastructure to achieve the unification and use of information acquisition, transmission, storage, and between things and people [13, 14]. The IoT is characterized by a perfect combination of perception recognition, communication transmission, and intelligent control.

As an aggregated complex system, the IoT mainly consists of three parts: the perception control layer, which uses RFID, two-dimensional codes, sensors and other objects to perceive and identify objects [15]; the network transport layer transmits data information from the perception and recognition layer to the application service layer through the core network; and the application service layer uses cloud computing, data mining, and other intelligent computing technologies to complete the intelligent control and management of objects and apply them to specific industry fields [16–18]. The information interaction between the three parts, the transmission of instructions, and the architecture of the entire IoT are shown in Figure 1:

The significance and process of the development of the IoT show that the IoT is a highly integrated network composed of various technologies. Various technical principles are complex and involve many fields, and a unified technical standard system in the world has not yet been formed. This section will introduce various key technologies of the IoT in detail. The key technologies of each layer of the IoT are shown in Table 2.

Sensor technology is one of the key technologies at the perception level of the IoT and is one of the “five senses” of the IoT, used to sense external information. Sensor technology includes two parts: automatic detection technology and automatic processing conversion technology. Sensors can detect specific signals, convert the detected signals into useable signals (generally electrical signals) and output them, thereby realizing processing, information storage, and transmission. A sensor usually consists of two main parts: a sensing element and a conversion element. When the signal is detected, the nonelectrical dimensions (displacement, stress, etc.) are easily converted to the material’s electrical-physical dimensions. It is first converted by the sensitive element and then converted to the electrical physical size by the conversion element [19, 20]. Its basic composition is shown in Figure 2.

The satellite navigation and positioning system is a large and complex system. It installs a certain number of satellites in a specific space orbit, which can provide a global service with continuous navigation from the ground. This space is close to Earth and extends into space, unaffected by meteorological conditions, day and night, and soil properties, as shown in Figure 3.

2.2. Position Calculation Method. The location of WSN nodes is based on the location information of specific nodes, and the location of undefined nodes is perceived
through a specific calculation method, as shown in Figure 4. Based on whether the node’s location information is determined, nodes can be divided into designated beacon nodes (reference nodes) and undefined unknown nodes. Beacon nodes are usually via GPS or during network deployment. It is placed at a specific location to determine its own location information. However, the cost of GPS equipment is high, and manual deployment of the specified location also requires a lot of manpower and material resources. Therefore, beacon nodes usually represent only a few nodes. Beacon nodes are in the node and play an extremely important role in the placement process. Using the coordinate information of the beacon node, the coordinates of the unknown node can be obtained through a specific calculation method.

In the case of determining the position of the beacon node, the position of the unknown node, the calculation of the position coordinates and the correction of the position coordinates can be realized by the steps of determining the position relationship between the nodes.
During the time spent finding the obscure hub, in the wake of deciding the positional connection between the obscure hub and the reference hub, the directions of the obscure hub are still up in the air by the accompanying computation technique.

2.2.1. Trilateration Method. The coordinates of the known reference nodes are $P(x_i, y_i)$, $Q(x_j, y_j)$, and $W(x_l, y_l)$, respectively, and the coordinates $O(x, y)$ of the unknown node is considered. As shown in Figure 5(a).

Then it can be obtained as follows:

\[
\begin{align*}
(x, x_i)^2 + (y, y_i)^2 &= k_i, \\
(x, x_j)^2 + (y, y_j)^2 &= k_j, \\
(x, x_l)^2 + (y, y_l)^2 &= k_l.
\end{align*}
\]  

(Figure 2) Basic process diagram of the sensor.

(Figure 3) Schematic diagram of satellite navigation and positioning.

\[
\begin{bmatrix}
\frac{1}{2}(x_i - x_l)^2 + \frac{1}{2}(y_i - y_l)^2 - \frac{1}{2}k_i^2 + \frac{1}{2}k_l^2 \\
\frac{1}{2}(x_j - x_l)^2 + \frac{1}{2}(y_j - y_l)^2 - \frac{1}{2}k_j^2 + \frac{1}{2}k_l^2 \\
\end{bmatrix}
\]  

The coordinates can be found by solving the above system of formulas as follows:
2.2.2. Triangulation Method. The known reference node coordinates are \( P(x_0, y_0), Q(x_1, y_1), \) and \( W(x_m, y_m) \), respectively, and the unknown node coordinates are assumed. The angles of \( O \) relative to \( P, Q, \) and \( W \) are \( \angle POQ, \angle QOW, \angle WOP \), as shown in Figure 5(b).

For nodes \( P, Q \) and the \( \angle POQ \) formed by them, if the arc \( PQ \) is in \( \Delta PQW \), then a unique circle \( O_1(x_{o1}, y_{o1}) \) can be obtained, and its radius is \( r_1 \), then \( \angle POQ = (2\pi - 2\angle POQ) \), and the following relationship exists:

\[
(x_{o1}, x_1)^2 + (y_{o1}, y_1)^2 = r_1^2, \tag{3}
\]

\[
(x_{o1}, x_j)^2 + (y_{o1}, y_j)^2 = k_i, \tag{4}
\]

\[
(x_j, x_i)^2 + (y_j, y_i)^2 = r_1^2 + r_i^2 - 2r_1r_i \cos \angle POQ. \tag{5}
\]

From formulas (3)–(5), the coordinate \( O_1 \) of the center \((x_{o1}, y_{o1})\) and its radius \( r_1 \) can be obtained. Similarly, for the \( Q, W, \) and \( \angle POQ \) nodes they form, the corresponding circle \( O_2(x_{o2}, y_{o2}), \) circle \( O_3(x_{o3}, y_{o3}) \), and their radii \( r_2 \) and \( r_3 \) can be obtained, respectively.

2.2.3. Maximum Likelihood Estimation Method. The coordinates corresponding to the known reference nodes 1, 2, 3, and \( m \) are \((x_1, y_1), (x_2, y_2), (x_3, y_3), \) and \((x_m, y_m)\), respectively. Let the unknown node coordinate \( O(x, y) \), as shown in Figure 5(c).

Then it can be obtained as follows:

\[
\begin{align*}
(x, x_1)^2 + (y, y_1)^2 &= k_1^2, \\
&\vdots \\
(x, x_m)^2 + (y, y_m)^2 &= k_m^2.
\end{align*}
\]  \( \tag{6} \)

In formula (6), delete \( m \) formulas from the previous \( m-1 \) formula, it can be obtained as follows:

\[
2(x_1, x_m)x + 2(y_1, y_m)y = x_1^2 - x_m^2 + y_1^2 - y_m^2 + k_1^2 - k_m^2, \\
\vdots \\
2(x_{m-1}, x_m)x + 2(y_{m-1}, y_m)y = x_{m-1}^2 - x_m^2 + y_{m-1}^2 - y_m^2 + k_{m-1}^2 - k_m^2. \tag{7}
\]

Express the above formula as a linear formula as follows:

\[
P = \begin{bmatrix}
2(x_1 - x_m)x_1 - 2y_1y_m \\
\vdots \\
2(x_{m-1} - x_m)x_m - 2y_{m-1}y_m
\end{bmatrix},
\]

\[
X = \begin{bmatrix}
x \\
y
\end{bmatrix},
\]

\[
j = \begin{bmatrix}
x_1 - x_m \\
\vdots \\
x_{m-1} - x_m \end{bmatrix}
\begin{bmatrix}
y_1 - y_m \\
\vdots \\
y_{m-1} - y_m \end{bmatrix} + \begin{bmatrix}
k_1 \\
\vdots \\
k_{m-1}
\end{bmatrix}.
\]  \( \tag{8} \)

Based on the principle of least mean square error, the coordinates of unknown nodes can be obtained by using generalized inverse table theory \( O(x, y) \).

2.3. Node Location Algorithm of WSN

2.3.1. Ranging-Based Positioning Algorithm. This limitation calculation should quantify the point or distance between the predetermined reference hub and the unclear obscure hub during the confinement interaction.

(1) TOA-Based Positioning Algorithm. The positioning method of the TOA algorithm is relatively simple. Knowing the propagation speed and arrival time of the signal, the distance between two points can be calculated as follows:

\[
d = w \times t. \tag{9}
\]

The signal can be RF or ultrasonic. Since the speed of RF is the speed of light, it is difficult to measure, so ultrasonic is usually used as a detection signal. TOA algorithm can achieve high positioning accuracy, but this algorithm requires high hardware platform, high cost, and accurate timing, so it is difficult to be widely used in WSN.

(2) TDOA-Based Positioning Algorithm. The basic principle of TDOA algorithm is shown in Figure 6(a), the unknown node transmits two signals at the same time. When the reference node receives these two different signals, it records the time corresponding to their arrival, then records the difference between the two moments and the speed of the two signals.

The measured distance between the two nodes can be solved as follows:

\[
c = (E_2 - E_1)W_{W-US} - W_{W-US}. \tag{10}
\]
When we know the measured distances from multiple reference nodes to an unknown node, the location coordinates of the unknown node can be obtained by the method of thirds or maximum likelihood estimation.

Although the TDOA algorithm has high positioning accuracy and the requirements for time synchronization are not as strict as TOA, TDOA also has high requirements for hardware devices. Losing the simplicity of WSN, large-scale TDOA algorithm nodes will become a very serious problem.

(3) AOA-Based Positioning Algorithm. The principle of the AOA algorithm is shown in Figure 6(b). The detection node detects the azimuth angle corresponding to the detection signal sent by the adjacent node through the antenna device, and then, by calculating the triangulation, the position coordinates of the unknown node can be solved. In the whole positioning system, the ultrasonic transmitting device should be used together with the detection antenna device to obtain accurate angular direction information. Network cost and energy consumption are increasing rapidly.

2.3.2. Positioning Algorithm without Ranging. Distance-based algorithms can indeed achieve high-accuracy in the localization process. But this algorithm usually requires high hardware node equipment, high cost, and poor
network scalability. In the case of synthesizing various factors, experts and scholars have proposed many positioning algorithms with no value range. These algorithms are based on the characteristics of the WSN network and WSN node platform. They do not require high hardware equipment. The total network power consumption is low, and the cost is low. However, the absence of range comes at the expense of localization accuracy. Most algorithms are still in the theoretical research stage, and the implementation of the amplitude-free layout algorithm requires large-scale and high-density nodes as support, which is difficult to implement. Common no-ranging positioning includes centroid, DV-Hop, Amorphous, APIT, etc.

The principle of the centroid location algorithm is very simple. The top of the polygon should be the coordinates of the reference node, and the geometric center of the polygon is the location of the unknown node, see Figure 6(c).

In the process of node positioning, the reference node sends its own node coordinate signals through transmission. The unknown node continues to collect these transmitted signals. Assuming that the coordinate position corresponding to the collected multiple reference nodes is \((m_a, n_a)\), where \(a\) represents the reference node, \(a = 1, 2, 3, \ldots, x\), the coordinates of the unknown node can be obtained as follows:

\[
(m, n) = \left( \frac{\sum_{a=1}^{x} m_a \sum_{a=1}^{x} n_a}{x \times x} \right).
\]  

The centroid algorithm is based on network connectivity for detection. The calculation method is simple and does not require additional hardware equipment. However, this algorithm requires a large number of dense reference nodes as support. If nodes are required to be evenly distributed within the localization area, unknown nodes will be detected and the coordinates will be very scattered.

3. Simulation Experiment and 3d Positioning

3.1. Simulation Environment. 200 sensor hubs are haphazardly organized in a WSN with a size of \(500 \times 500\) as a reproduction site, which is alluded to as “climate A” for short. In the exploratory cycle, the free space model is used.
This paper chose exploratory information in light of the RFM TR3000 transmitter, and specifies that the length of every parcel is 300 pieces, the bandwidth is 60kHz, the transmission rate is 20kbit/s, the carrier frequency is 430MHz, and the FSK modulation method is used. Other parameters are shown in Table 3.

Definition of positioning error: in the simulation experiment, this paper uses two criteria to measure the performance of the positioning algorithm.

Average Position Error (ALE): Its formula is as follows:

\[
\text{ALE} = \frac{\sum_{a=1}^{M} \sqrt{(x_{ea} - x_a)^2 + (y_{ea} - y_a)^2}}{M}
\]  

(12)

Where \(M\) represents the number of sensor nodes, the estimated position coordinate \((x_{ea}, y_{ea})\) of the node and the actual position of the node \((x_a, y_a)\). Average execution time (AET) can be defined as follows:

\[
\text{AET} = \frac{\sum_{a=1}^{M} \text{Exec}_{a}}{M}
\]  

(13)

Where \(\text{Exec}_a\) represents the time required for node \(a\) to complete self-positioning, and \(M\) represents the number of sensor nodes.

In the positioning algorithm simulation, we randomly arrange 200 sensor nodes in the WSN with a size of 500 * 500, so as to complete the three-dimensional fast positioning of each node in the WSN. Now the simulation results of the positioning technology in this paper and the Ssu positioning technology are compared and analyzed.

The subsequent step is to haphazardly orchestrate 100 sensor hubs in a WSN with a size of 250 * 250 as a reenactment site. Just the recreation boundaries are appropriately changed, and the rest stays unaltered, which is alluded to as climate B, as displayed in Table 4.

### 4. Results

The average positioning errors of the proposed nonranging 3D positioning algorithm and the Ssu algorithm are compared under different packet sending intervals, as is shown in Figure 7.

It may be seen from the examination in Figure 7(a) that with the decrease of the parcel sending span, the typical situating blunder of the two calculations diminishes as needs be. At the point when the parcel sending span is 0.1 s, the typical situating mistake acquired by the nonrunning 3D situating calculation is under 1 m, while the situating blunder of the Ssu calculation is as yet more noteworthy than 5 m. Obviously, in the remote channel environment, the estimation proposed in this paper can work outstandingly in any distant uproar environment, while the presentation of the Ssu calculation will be enormously decreased. It tends to be seen from the examination in Figure 7(b) that when the parcel sending span is 0.2 s, the typical situating blunder got by the nonrunning 3D situating calculation is near 1 m, while the situating mistake of the Ssu calculation is as yet more noteworthy than 5 m.

In the Ssu situating framework, it is accepted that the result of the moving rate and the bundle sending span ought to be steady. For correlation in this paper, during the reproduction, let the portable anchor hub send a parcel at a similar distance stretch, for example, ibeacon/m. In this way, while expanding the moving pace of the anchor hub, the parcel sending time period of the anchor hub should be diminished, with the goal that the first situating mistake can be kept up with under various moving rates, as is displayed in Table 5.

It very well might be seen from Table 5 that as long as the aftereffect of the speed of moving the anchor center and the pack sending length stays unaltered, the situating mistakes of the two calculations will likewise stay at 0.79 m and 5.36 m, separately. It may be seen that the normal execution season of the two calculations will diminish from 127 sec to 50 sec with the increment of the moving pace of the anchor hub. This is on the grounds that as the pace of the anchor hub increments, more sensor hubs will get the data sent by the versatile anchor hub in a decent time, which will definitely diminish the typical execution season of the whole organization hub. In any case, it is actually quite significant that, since the two computations perhaps play out the aide point assurance estimation when the single perseverance time of the versatile anchor center is drained, there is no differentiation in the ordinary execution time of the two computations.

In this paper, the typical situating blunders of the two calculations are looked at under the transmission force of five distinct portable anchor hubs, as displayed in Figure 8.

It tends to be seen from Figure 8(a) that with the increment of communicating power, the presentation of the Ssu calculation will be extraordinarily decreased, while the typical situating blunder gave in this paper will continuously stay around 0.80 m. This is on the grounds that in the remote channel climate, the two kinds of guide focuses got in the Ssu calculation will not be on a similar circle, and simultaneously, as the communicating power expands, the span distinction between the two circles will expand and get bigger. In this paper, the position of the mobile anchor node corresponding to the maximum RSSI value obtained from...
the sensor node should be used as the beacon point. The beacon point can be obtained correctly as long as the distance between the node to be located and the motion trajectory of the mobile anchor node remains unchanged. Consequently, the typical situating blunder of the situating calculation in this paper is kept at a consistent level under various transmission abilities, while the typical situating mistake in the Ssu calculation will increment with the increase of the transmission power. It may be seen from Figure 8(b) that with the increment of sending power, the typical situating blunder gave in this paper is very nearly a consistent, staying at around 1.1 m. In any case, with the

![Graph](image1.png)

**Figure 7:** Comparison of average positioning errors for different packet transmission intervals. (a) Environment A. (b) Environment B.

| Maximum movement rate (m/sec) | 10  | 20  | 30  | 40  | 50  |
|-------------------------------|-----|-----|-----|-----|-----|
| Packet sending interval (sec) | 0.100 | 0.04 | 0.030 | 0.023 | 0.019 |
| Average positioning error (m) | The algorithm of this paper | 0.81 | 0.80 | 0.80 | 0.79 | 0.79 |
|                               | Ssu algorithm | 5.36 | 5.37 | 5.35 | 5.36 | 5.35 |
| Average execution time (sec)  | The algorithm of this paper | 127.21 | 74.75 | 64.42 | 56.36 | 49.75 |
|                               | Ssu algorithm | 126.94 | 73.97 | 65.28 | 56.23 | 49.88 |

**Table 5:** Comparison of localization performance at different rates.

![Graph](image2.png)

**Figure 8:** Average positioning error statistics under different transmit powers. (a) Average positioning error statistics of environment A. (b) Average positioning error statistics for environment B.
increment of send power, the exhibition of Ssu calculation will be enormously decreased, and the range distinction between the two circles will expand and get bigger.

In the experiment, this paper compares the average localization error performance of the two algorithms under the condition of five different distance thresholds, as shown in Figure 9.

As should be visible from Figure 9(a), as the distance edge diminishes, the presentation of the two restriction calculations will move along. At the point when the distance is under 145 m, the normal situating mistake of the non-running 3D situating calculation is under 0.9 m, while the typical situating blunder in the Ssu calculation will continuously keep a moderately enormous worth. Although both localization algorithms are affected by the distance threshold, when the average distance between the sensor node and the movement trajectory of the mobile anchor node is less than the critical value (when the movement trajectory is the tangent of the receiving range, the resulting value is the critical value). The algorithm in this paper can

Figure 9: Analysis of average positioning errors under different distance thresholds. (a) Analysis of average positioning error of environment A. (b) Analysis of the average positioning error in environment B.

Figure 10: Average execution time comparison. (a) Comparison of the average execution time under different transmit powers in environment A. (b) Comparison of average execution time under different distance thresholds in environment A.
still obtain a small average positioning error. It tends to be seen from Figure 9(b) that when the distance limit is under 155 m, the normal situating blunder of the nongoing 3D situating calculation is near 1.1 m, while the typical situating mistake in the Ssu calculation will continuously keep a generally enormous worth.

This paper compares the average execution time of the two algorithms under different transmit power and different distance thresholds, as shown in Figure 10.

It may be finished up from Figure 10(a) that with the increment of the send force of the portable anchor hub, the typical execution season of the two situating calculations will diminish. This is since, in such a case that the communicating force of the portable anchor hub increments, more sensor center points will get the groups sent by the flexible anchor center point in a comparable time.

It tends to be seen from Figure 10(b) that as the distance edge diminishes, the typical execution season of the two calculations will increase, but the magnitude is relatively small. The reason is that, in order to satisfy the smaller distance threshold, the algorithm will spend more time obtaining the beacon point. Therefore, according to Figures 9(a) and 10(b), it will in general be seen that under a comparative ordinary execution time, the display of the nonrunning 3D arranging estimation is better.

5. Conclusions

With the development of navigation technology, people’s requirements for navigation accuracy are getting higher and higher. A single navigation system can no longer meet the individual needs of people. This paper focuses on how to improve the accuracy of navigation systems. This paper mainly studied the basic technology of wireless sensor network and satellite fusion navigation through simulation methods, completed the generation of WSN and satellite navigation system data, and realized the fusion positioning of the combined system through the loose combination algorithm, which improved the accuracy and stability of positioning. Due to the limitations of time and some equipment, the research on the algorithm has not been able to in-depth but only stays on the theory and simulation software. In the real environment, everything becomes more complicated and there are more variable factors. Therefore, the applicability of the positioning technology of the algorithm needs to be further verified.

Data Availability

No data were used to support this study.

Conflicts of Interest

The authors declare that there are no conflicts of interest.

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