

Retraction

Retracted: Filtering Algorithm for Positioning Accuracy of the Logistics Tracking System Based on the 3D Virtual Warehousing Logistics Demonstration System

Journal of Electrical and Computer Engineering

Received 15 August 2023; Accepted 15 August 2023; Published 16 August 2023

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1].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

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

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

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

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

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

References

- [1] G. Sun and F. Qiao, "Filtering Algorithm for Positioning Accuracy of the Logistics Tracking System Based on the 3D Virtual Warehousing Logistics Demonstration System," *Journal of Electrical and Computer Engineering*, vol. 2022, Article ID 5963140, 9 pages, 2022.

Research Article

Filtering Algorithm for Positioning Accuracy of the Logistics Tracking System Based on the 3D Virtual Warehousing Logistics Demonstration System

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Received 22 October 2021; Accepted 4 January 2022; Published 31 January 2022

Academic Editor: Muhammad Rashad

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Under the background of the global integrated supply chain, the work of logistics is more and more complicated. Warehouse management is now an important part of logistics. The optimization of the logistics tracking system in the building material market proves that the tracking result of the system is highly reliable. The system has the advantages of small size, low cost, accurate positioning, real-time convergence, and high performance.

1. Introduction

The continuous development of China's economy is inseparable from the development and support of logistics enterprises. At the same time, as a reasonable comprehensive service form in industrialization, it occupies an important position in the current economic development [1, 2]. The packaging, storage, transportation, inspection, processing, and even the packaging and distribution of goods before and after constitute the current logistics system [3, 4]. Now, the requirements of logistics informatization require logistics enterprises to solve the one-stop service system, provide strong support for the one-stop supply chain, and make the whole supply chain obtain the highest economic benefits, which is the overall goal of logistics enterprises [5, 6]. Warehousing management plays an important role in logistics management. A good warehousing system can speed up the flow of materials, reduce costs, ensure the normal operation of services, and realize the effective management and utilization of resources [7, 8].

This paper studies the way of the three-dimensional virtual warehouse logistics demonstration system and logistics tracking system. Using this demonstration system can

timely and accurately find the location of goods, and then the GPS data, through the system positioning accuracy filtering strong tracking, can realize the real-time and effective monitoring and tracking of goods. It can get the positioning data and the data of the monitoring center in time.

2. Structure and Hardware Design of the Logistics Tracking System

2.1. Structure of the Logistics Tracking System. In the research process of the traditional logistics tracking system positioning accuracy filtering algorithm, usually, a two-dimensional map is mainly used to describe the movement environment of the logistics tracking system. However, because the two-dimensional map can only describe relatively high environmental plane information, it cannot provide relative information. Therefore, it has a great influence on the completion of the positioning accuracy filtering algorithm of the logistics tracking system. Mostly, the construction of a three-dimensional environment is very important for the positioning accuracy filtering algorithm of the logistics tracking system, and the signing and forwarding of business documents are carried out at the same time. The

main work of the logistics team and the control manager is to construct the information management system of the transportation fleet and the transportation vehicle and to set the deployment method of the specific cargo to the logistics transportation task [9]. This time, the train passes through the route and the central station and has formulated a systematic and target product element control plan, transportation application vehicle schedule, product element-product vehicle allocation combination, and logistics transportation invoice information collection and input management.

2.2. Hardware Design of the Logistics Tracking System.

The hardware circuit diagram of the logistics tracking system is shown in Figure 1. The CPU used in this system is MSP430f147 macroprocessor developed by Texas Instruments (TI). The power supply voltage of this series of macroprocessors is low.

Users can use the function modules of the system to call the corresponding system functions for data operation [10, 11]. Therefore, from the perspective of application, it can be seen that controlling users' access to system functions can realize the access control of user information and can effectively improve the performance of the tracking system. The technical fault reporting measures of the logistics tracking and positioning information system at the use level can use software to complete the access control of the user side in the information system, and the corresponding theoretical essence is the authorization of the system function authority; that is, the completion of each function of the system can only be used after the authorized user [12, 13].

Following the existing relational database management system as an example, the authorization is configured. The permissions of the SQL server can be divided into four types of users: system administrator, database holder, acceptor of the database object, and other users of the database, as shown in Figure 2.

3. Filtering Algorithm for Positioning Accuracy of the Logistics Tracking System

3.1. Design of the Storage Environment Based on the 3D Virtual Logistics Demonstration System. Before planning the global path of the warehouse logistics tracking system, it is necessary to complete the modeling of the warehouse storage environment and improve the warehouse storage status of the warehouse storage logistics tracking system. The warehouse storage environment modeling in this section selects the 3D virtual warehouse logistics demonstration system. The 3D reconstruction technology of computer multimedia is also called cell decomposition method. It divides the environment of the warehouse logistics tracking system into area and volume [14], divides it into two-dimensional or three-dimensional grids with consistent shape, and describes other components in the warehouse environment in small lattice as units for abstract explanation. Build a warehouse environment that is easy to understand in the logistics tracking system.

The length of the warehouse system is described as M , and the width is described as N . Taking a corner of the warehouse as the origin, the grid coordinates of the upper left corner are set as $(0, 0)$ to build a rectangular coordinate system. Assuming that the cargo boundary is a , when the size block of 3D reconstruction technology a is regarded as a cell grid and the grid of the warehouse environment is changed to several small grids, the number of each grid can be described as follows: the grid number of ceil (n/a) different columns is described by the cell (M/a) , in which ceil represents upward arrangement [15].

Two-dimensional and one-dimensional space structures are used in the storage environment after gridding.

In the process of positioning accuracy filtering algorithm, it is transformed and used according to the requirements of planning algorithm. The detailed mapping relationship is as follows:

$$\text{bianhao} = (x - 1) \times \text{ceil}\left(\frac{m}{a}\right) + y. \quad (1)$$

3.2. Construction of the Mathematical Model of Location Accuracy Filtering Algorithm in the Logistics Tracking System.

Regardless of the point and the correct path of the point, the path planning problem is divided into two parts according to whether the initial point of the warehouse logistics tracking system has exports. One of them is that the initial point of the warehouse logistics tracking system is at the time of export. It can be considered as a typical TSP problem. Another is that if the initial point is not at the exit, then the end point of the initial point can be considered as a constant TSP problem, namely, ST-PSP problem. The mathematical model of the typical TSP problem can be expressed by formula (2), and the best path $P = \{u_1, u_2, \dots, u_k\}$ can be calculated.

$$\min Z(P_\alpha) = \sum_{i=1}^{k-1} d(u_{\alpha_i}, u_{\alpha_{i+1}}) + d(u_{\alpha_k}, u_k). \quad (2)$$

In the formula, P_α is used to describe the reorganization set $d(u_{\alpha_i}, u_{\alpha_{i+1}})$ of the K path point sequence of the Manhattan distance α_i between two points.

If the potential field ant colony algorithm is used to solve the typical TSP problem, all the path points can be regarded as group individuals and can be adaptive function selection formula (2). For TSP and ST-PSP problems, potential field ant colony algorithm can only obtain the best access order of global path points, not the path, which cannot meet the requirements of the mobile wheeled logistics tracking system. It is necessary to obtain an accurate global planning path through 3D reconstruction technology.

3.3. Positioning Accuracy Filtering Algorithm Based on the Three-Dimensional Reconstruction Technology.

In the grid environment, in the process of planning the global path of the logistics tracking system through 3D reconstruction technology, the OPEN table and CLOSE table are set, and the

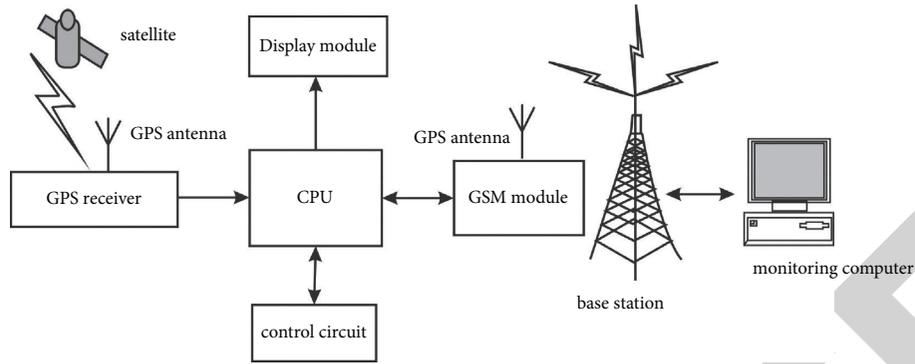


FIGURE 1: Structure of the logistics tracking system.

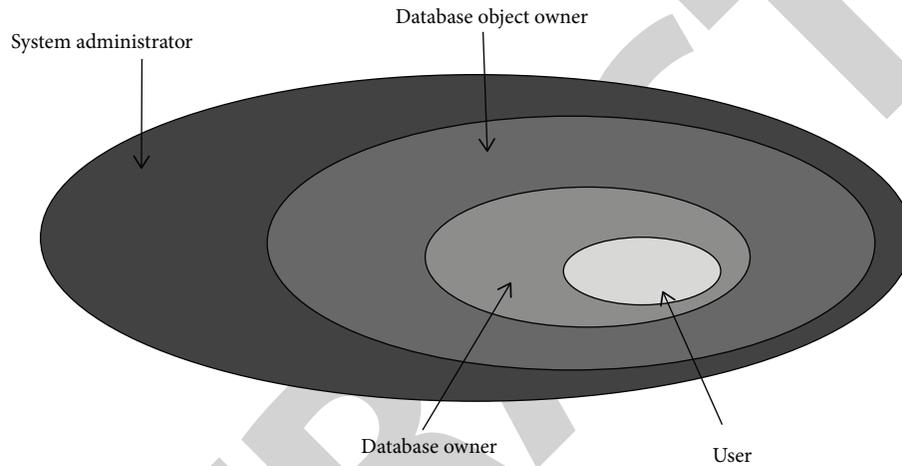


FIGURE 2: : Permission level of the SQL server.

initial point is added to the OPEN table during initialization. The current CLOSE table is empty. The initial point is

$$f(s) = h(s), \quad (3)$$

where $f(s)$ is the initial point evaluation function. $h(s)$ is used to describe the estimated interval between the initial node and the end point.

The OPEN table is empty. If there is no target location, the retrieval will be stopped, and there is no valid path. On the contrary, when the OPEN table is empty, repeat the following steps before obtaining the target node:

- (1) Select a node with a small f value in the OPEN table, add it to the CLOSE table, and delete the corresponding value in the OPEN table. Assuming that the node with the smallest f value of the adjacent node of the initial point is q , the initial point is considered as the parent node.
- (2) All the adjacent nodes of the current point P are calculated, assuming that the adjacent nodes are u_i . Then, $f(u_i)$, $h(u_i)$, and $g(u_i)$ are obtained. Here, $g(u_i)$ explains the interval between the selection point and the object node, the following determination is made:

① If the terminal is u_i , then jump out of the three-dimensional reconstruction technology algorithm, take the end point as the starting point, trace back from the parent node to the initial point, obtain the batch of the warehouse logistics tracking system, and select the shortest route.

② If u_i is an unreachable point, skip the point.

③ If u_i is in the CLOSE table, skip the point.

④ If u_i is not in either of the OPEN table or the CLOSE table, it is added to the OPEN table and is the parent node of u_i .

⑤ If u_i is in the OPEN table, find the g value of the new path and judge whether it is the smallest. If yes, p is the parent node of u_i , and update f , h , and g at the same time; on the contrary, no change is made.

- (3) Save the search track and use the parent node to trace back to the initial point.

Positioning accuracy filtering model of the non-differential phase precision dynamic single-point positioning system:

$$\begin{cases} X_k = F_{k/k-1}X_{k-1} + T_{k-1}U_{k-1}, \\ Y_k = H_kX_k + N_k. \end{cases} \quad (4)$$

The statistical characteristics are $E(U_k) = 0$, $E(N_k) = 0$, dynamic noise vector U_k , and observation noise vector W_k ; all of the dynamic noise vectors and the observation vectors are white noise vectors with an expected value of 0, $\text{cov}(U_k, U_j) = Q_k \delta_{kj}$, $\text{cov}(N_k, N_j) = R_k \delta_{kj}$, and $\text{cov}(U_k, N_j) = 0$ where X_k and Y_k are the state vector and observation vector at k time, respectively; $F_{k/k-1}$ is the state transition matrix; U_k is the dynamic noise at k time; $T_{k/k-1}$ is the system control matrix; H_k is the k -time observation matrix; N_k is the observation noise at k time; Q_k and R_k are, respectively, the variance matrix of the system dynamic noise and observation noise. δ_{kj} is the Kronecker function:

$$\delta_{kj} = \begin{cases} 1 & (k = j), \\ 0 & (k \neq j). \end{cases} \quad (5)$$

For simplicity, firstly, the matrix vector with constant surrounding ambiguity is considered, and the constant speed model is adopted for the dynamic model.

Pre-estimated value:

$$X_{k/k-1} = F_{k/k-1} X_{k-1/k-1}. \quad (6)$$

Variance matrix:

$$P_{k/k-1} = F_{k/k-1} P_{k-1/k-1} F_{k/k-1}^T + T_{k-1} Q_{k-1} T_{k-1}^T. \quad (7)$$

Calculate the Kalman gain matrix:

$$K_k = P_{k/k-1} H_k^T (H_k P_{k/k-1} H_k^T + R_k)^{-1}. \quad (8)$$

Calculate the filtering value $X_{k/k}$ of the positioning accuracy of the system and its variance matrix $P_{k/k}$:

$$\begin{aligned} X_{k/k} &= X_{k/k-1} + K_k (Y_k - H_k X_{k/k-1}), \\ P_{k/k} &= (I - K_k H_k) P_{k/k-1} (I - K_k H_k)^T + K_k R_k K_k^T. \end{aligned} \quad (9)$$

The recursive initial value is $X_{0/0} = E(X_0)$ and $P_{0/0} = \text{var}(X_0)$.

The filter maintains this capability when it reaches a stable state and has relatively low sensitivity to initial values and noise statistical properties [6].

$$\begin{aligned} P_{k+1/k} &= \lambda_{k+1} F_{k+1/k} P_{k/k} F_{k+1/k}^T + Q_{k+1}, \\ \lambda_{k+1} &= \text{diag}(\lambda_{(k+1)}, \lambda_{2(k+1)}, \lambda_{3(k+1)}, \dots, \lambda_{n(k+1)}), \\ \lambda_{i(k+1)} &= \begin{cases} \alpha_i C_{k+1} & (\alpha_i C_{k+1} > 1), \\ 1 & (\alpha_i C_{k+1} \leq 1). \end{cases} \\ C_{k+1} &= \frac{\text{Tr}[v_{0(k+1)} - R_{k+1} - H_{k+1} Q_k H_{k+1}^T]}{\sum_{i=1}^n \alpha_i (F_{k+1/k} P_{k/k} F_{k+1/k}^T + H_{k+1}^T H_{k+1})} \end{aligned} \quad (10)$$

$$v_{0(k+1)} = \begin{cases} \tilde{Y} \tilde{Y}_1^T & (k = 0), \\ \frac{\rho v_{0(k)} + \tilde{Y}_{(k+1)} \tilde{Y}_{(k+1)}^T}{1 + \rho} & (k \geq 1, 0 \leq \rho \leq 1). \end{cases}$$

The value of a in equations (9) and (10) is determined by a priori knowledge. It can be seen that when the state changes suddenly, the increase of estimation error $\tilde{Y}_{(k+1)} \tilde{Y}_{(k+1)}^T$ will increase the error variance matrix $v_{0(k+1)}$; accordingly, the weighting coefficient $\lambda_{i(k+1)}$ increases, the tracking ability of the filter is enhanced, and the reliability is improved. During the simulation, the system and observation noise change suddenly. The adaptability of the two algorithms to noise change is compared.

Simulation initial value is $x_0 = [1000 \ 50]^T$, $P_0 = \begin{bmatrix} 100 & 0 \\ 0 & 10000 \end{bmatrix}$, $\alpha = 1.2$, and $\rho = 0.6$. The simulation results are shown in Figures 3 and 4.

Figures 3 and 4 show that the ability of the previous system positioning accuracy filtering algorithm to deal with noise mutation is relatively weak; especially, when the difference between the noise model and the fixed model in the simulation is large, the divergence phenomenon occurs in the filtering. The system positioning accuracy filtering algorithm can adapt to the noise change in the filtering process, but the filtering accuracy is reduced.

4. Design and Implementation of Positioning Accuracy Filtering Algorithm for the Logistics Tracking System

4.1. Getting Initialization Information.

- (1) The management of basic information includes adding, modifying the use of identity, and does not delete the basic information.
- (2) When the basic information with the master-slave relationship is recorded in the main table, the usage flag is set to 0 (no longer used) to judge whether the usage flag of all the subrecords in the table is 0. If not all 0, the usage ID of the main table cannot be changed. First, notice that the user sets the usage flag for all child records to 0.
- (3) The record display area of the add basic information page displays all the records in the table and finally displays the record marked as 0.
- (4) All codes of the basic information table are automatically generated by the system. The number increases from 1, and 0 is added before the length is 0.
- (5) There is a master-slave relationship table. The first few digits of the table code are the main table code.
- (6) For the basic information related to the correspondence of Co., Ltd., no separate menu item is set, and the corresponding link is added in the record display area of the addition page to pop up the correspondence correction screen of the corresponding Co., Ltd.
- (7) For the basic information related to the corresponding relationship of a joint stock company, when the usage flag is changed to 0, the system will delete the corresponding relationship with all the joint stock companies. After the user agrees, all the

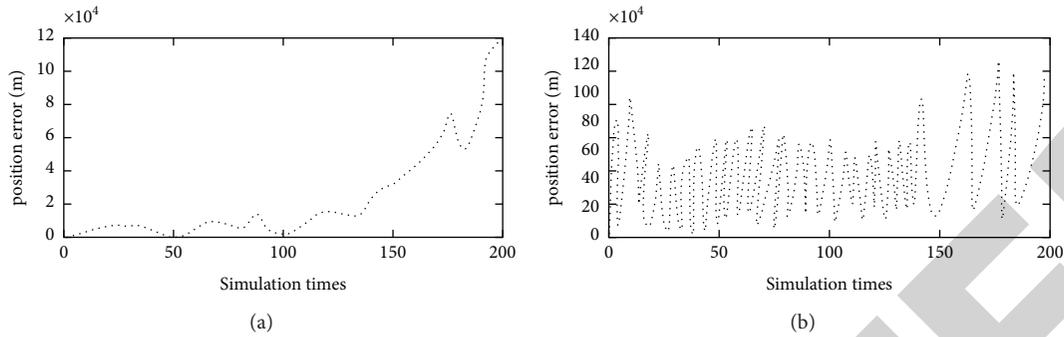


FIGURE 3: Position error simulation results of two algorithms. (a) Conventional Kalman filter. (b) Strong tracking Kalman filter.

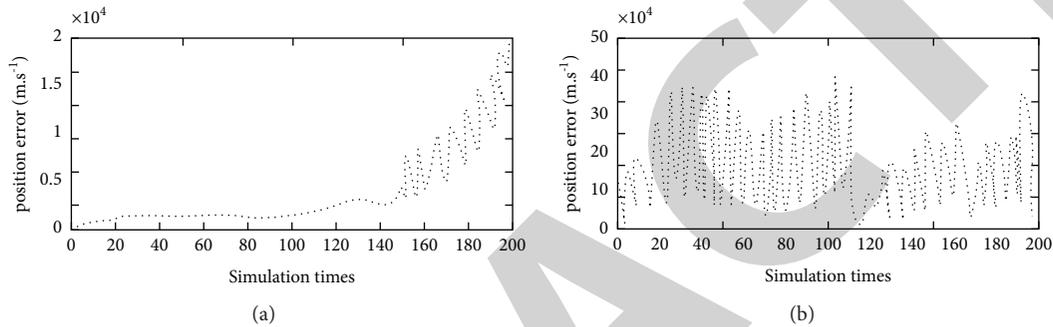


FIGURE 4: Speed error simulation results of two algorithms. (a) Conventional Kalman filter. (b) Strong tracking Kalman filter.

records corresponding to the joint stock company will be deleted automatically.

- (8) There are many information records of factory cars and stock limited companies, which are inconvenient to retrieve and maintain. The sorting function is added to the record display area table of the factory cars and stock information addition page. Click the corresponding column name to sort the records (ASC or DESC) in the order of click.
- (9) The primary key or code of the basic information cannot be modified.

4.2. Acquisition of Change Information and Exchange Information of Transportation Logistics. The change information of railway transportation logistics within the enterprise, the logistics change information of railway transportation within the enterprise, and the logistics exchange information inside and outside the enterprise have the characteristics of information change. The change of information can be represented by the change of specific data, and the change process of data can be represented by data flowchart in Figure 7. In order to facilitate the program, it can be transformed into a more direct program flowchart.

4.2.1. Internal Railway Transportation Logistics Change Information. Taking the loading process as an example, the flowchart is shown in Figure 5.

The loading of vehicles is divided into two parts: the loading of station vehicles and the loading of factory

vehicles. The loading registration interface of station vehicles and the loading registration interface of factory vehicles are set. The loading investigation and maintenance interface of station vehicles is set. The loading time is registered as the sign of vehicle completion in the process of vehicle registration.

4.2.2. Internal and External Logistics Exchange Information. Take the train number delivery business process as an example; the process is shown in Figure 6.

During the delivery of goods, the train will be sent from the locomotive to the handover line at the time of delivery. This handover line is mainly a virtual tracking system, but the vehicle needs to be identified according to the vehicle number. The system will judge whether the number distinguishes the vehicle according to color. After confirming the delivery, if other data items need to be determined, the data will be extracted according to the relevant information form. After the completion of the operation, the train number can be removed from the existing table, and the corresponding train number table and train number detail table can be filled in at the same time. The logistics tracking information management system can display the tracking logistics information and carry out statistical management at the same time.

- (1) Tracking operation processing subsystem: the tracking operation processing subsystem plays a core role in the overall positioning accuracy filtering algorithm of the railway transportation logistics

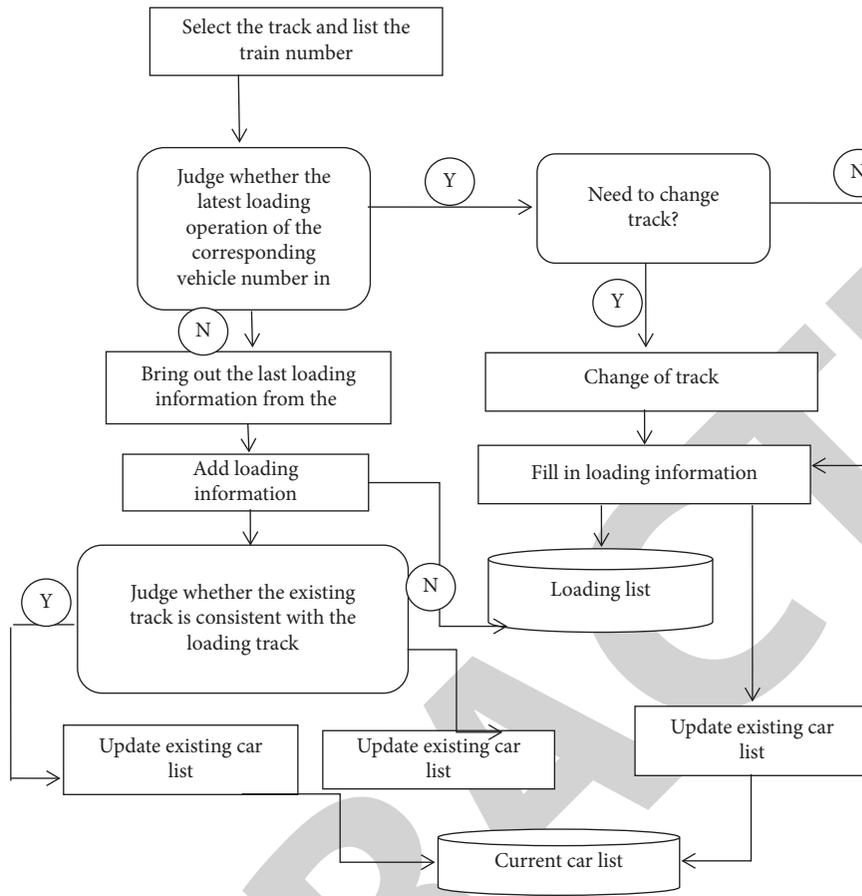


FIGURE 5: Loading process flowchart.

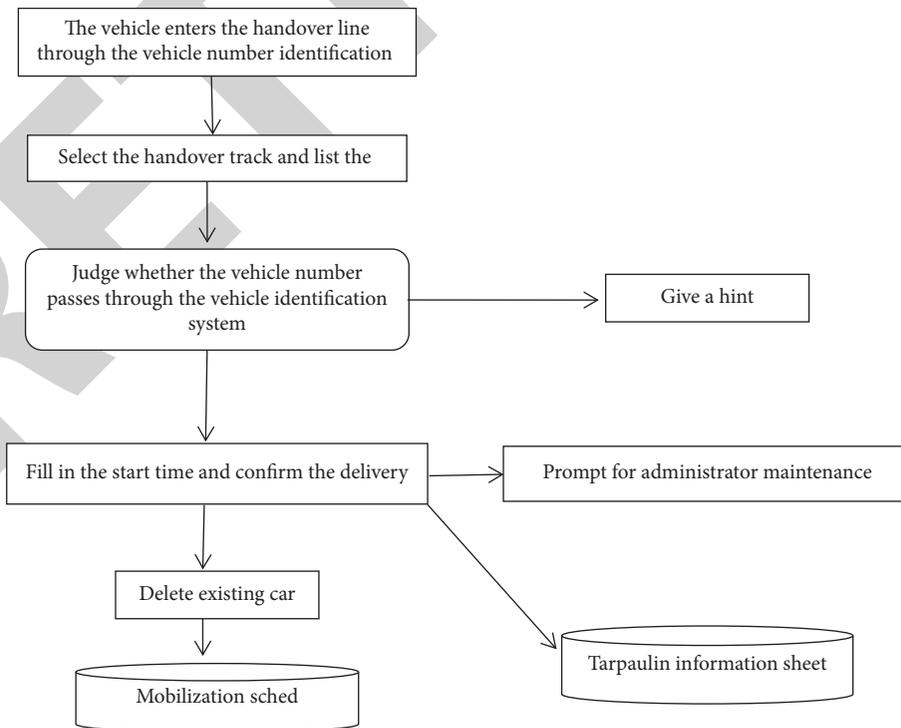


FIGURE 6: Flowchart of train number delivery business.

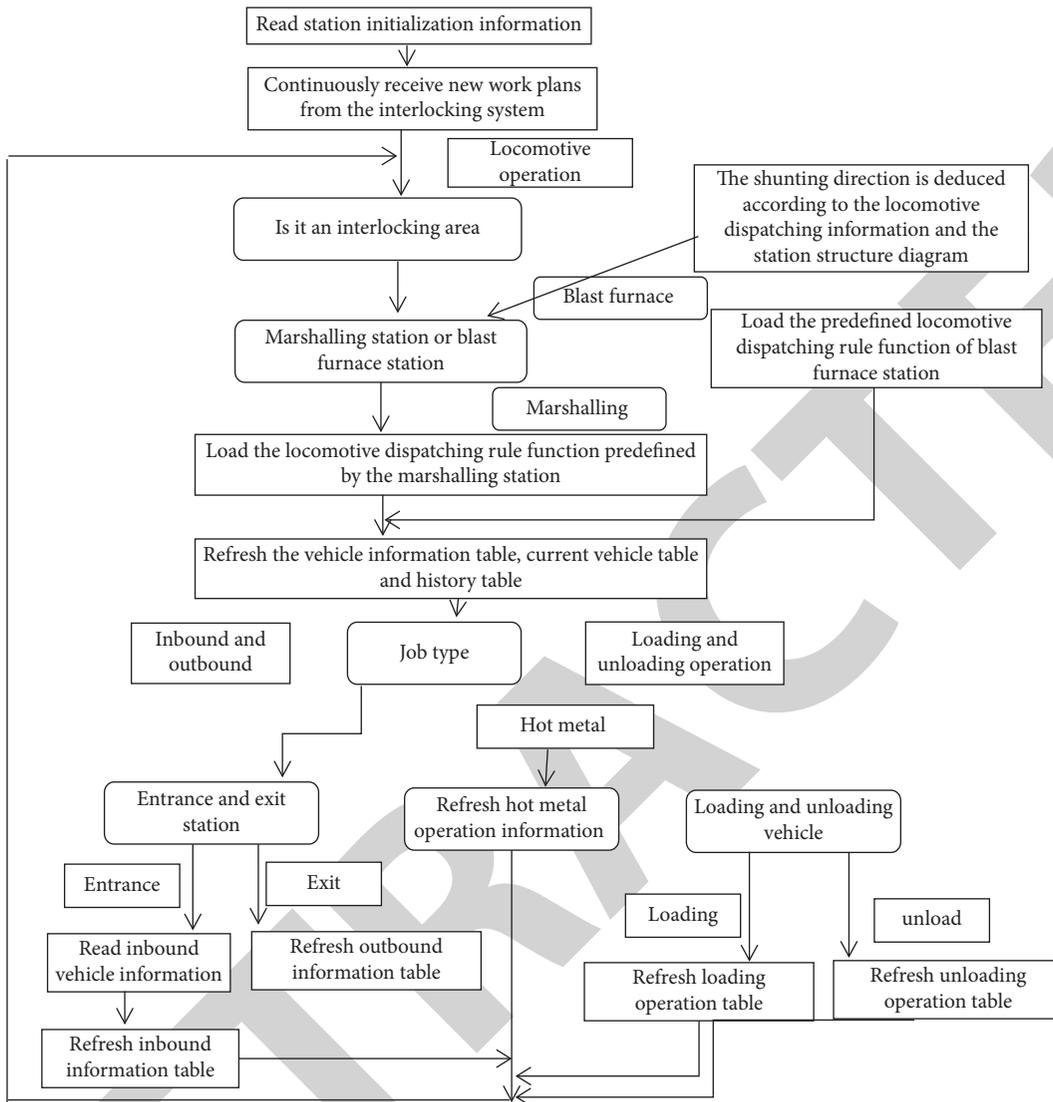


FIGURE 7: Schematic flowchart of the tracking calculation subsystem.

tracking system. The simple flow of the tracking operator system is shown in Figure 7.

- (2) As shown in Figure 8, the logistics tracking information management subsystem structure is mainly composed of browser/web server + web application server and database server. In this type of architecture, the web application server can process the business logic function of the intermediate service, so as to ensure that the electronic client on the user side can send HTTP request to the web server and send the request to the web application server in time.

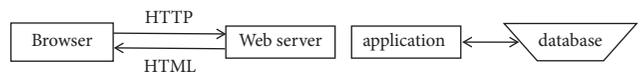


FIGURE 8: Four-tier architecture of B/S.

Finally, according to the obtained data request information, the web application server sends it to the system database server synchronously. The database server sends the obtained data to the web application server and uses the web server to send the data to the customer.

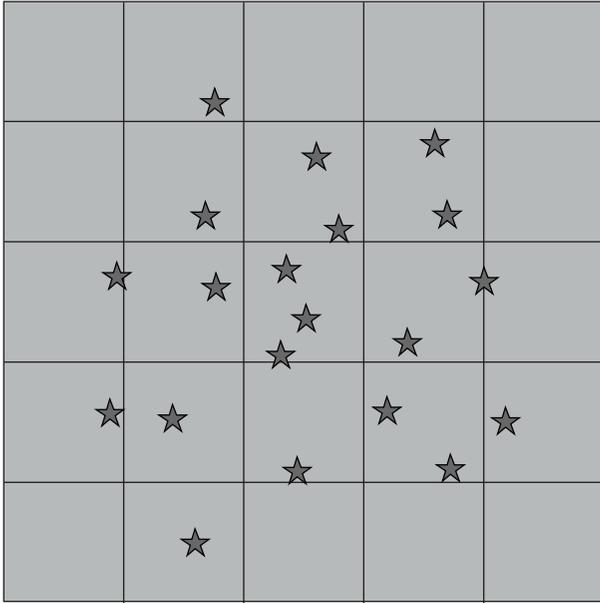


FIGURE 9: Test results of the unused filter.

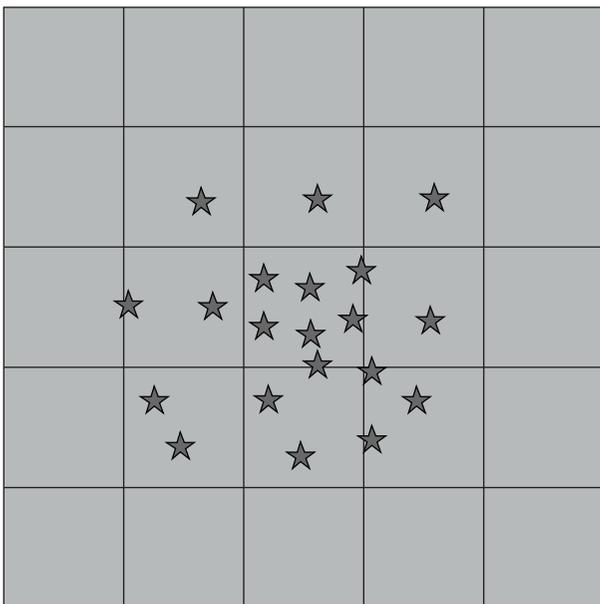


FIGURE 10: Test results of positioning accuracy filtering using the strong tracking system.

The implementation of the logistics tracking information management subsystem adopts Java Server Pages Technology (JSP) and realizes the connection of the database through JDBC.

5. Test Result

In order to verify the role of the powerful system positioning accuracy filtering algorithm in GPS positioning, the powerful tracking system positioning accuracy filtering and GPS positioning without using the filter algorithm are compared at fixed points. It is obvious from Figures 9 and 10 that using

the strong tracking system positioning accuracy filtering algorithm can effectively suppress the satellite position drift and improve the satellite positioning accuracy.

6. Conclusions

The three-dimensional virtual warehouse logistics demonstration system has the advantages of small volume, low cost, good convergence, and high precision. The strong tracking method of system positioning accuracy filtering is used to locate and track the logistics system data, which can accurately and efficiently determine the detailed location of items according to the received data, effectively improve the accuracy and level of monitoring and management technology, and solve the problem of complex and changeable environment in the tracking process. After many experiments, GPS has high positioning accuracy and good performance in the background of obstacles and can receive and process information in real time and accurately. With the continuous updating of industry technology, improving the positioning accuracy in different environments is still an important research direction in the future.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare no conflicts of interest.

Acknowledgments

The name of this research project is Research on the Application of “Internet Course Sizheng” in the Professional Courses of Logistics Management in Higher Vocational Colleges—taking “Procurement and Supply Practice” as an example. The project number is CJJY201901. The authors thank the project for supporting this article.

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