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Design and Development of Intelligent Logistics Tracking System Based on Computer Algorithm

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Abstract

The logistics industry has experienced significant growth alongside the progress of the social economy. In this research article, the aim is to create a sophisticated tracking system for the logistics sector by utilizing computer technology. The primary focus is on developing an intelligent inventory decision support system. The article introduces two key algorithms: one that detects the integrity of goods packaging and another that identifies the behavior and posture of goods using a three-dimensional acceleration sensor. Furthermore, the article describes the workflow of the system and provides a thorough design for implementation in a real cabin environment. To validate the effectiveness of the system, experiments are conducted, and its performance is evaluated. The continuous advancement of the logistics industry, driven by the growth of the social economy, has prompted the need for innovative solutions. This scholarly article aims to address this demand by proposing the development of an intelligent logistics tracking system empowered by computer technology. The primary objective is to create an intelligent inventory decision support system capable of optimizing inventory management processes. To achieve this, the article presents two crucial detection algorithms. The first algorithm focuses on assessing the integrity of goods packaging, ensuring that goods remain intact throughout the logistics journey. The second algorithm leverages a three-dimensional acceleration sensor to analyze the behavior and posture of goods during transportation. The article also provides a comprehensive overview of the system's workflow, detailing the various steps involved. Furthermore, to validate the practical applicability and efficiency of the system, a detailed design is executed in a real cabin environment. Through rigorous experimentation and performance evaluation, the article aims to ascertain the effectiveness of the proposed system in enhancing logistics operations.

Keywords: Intelligent Logistics, Computer Algorithm, Decision Support System

1. Introduction

The logistics industry continues to thrive and advance alongside the progress of the social economy [1]–[3]. Logistics, which involves the physical movement of goods from suppliers to recipients, encompasses a range of economic activities that generate temporal and spatial value. These activities include transportation, storage, distribution, packaging, loading and unloading, circulation processing, and logistics information processing, with each function contributing to the overall logistics process [4], [5].

Traditional monitoring systems for cold storage environments typically rely on wired networking technology, presenting challenges such as complex wiring, high costs, potential data errors caused by line transmission loss, and susceptibility to aging and damage, leading to increased maintenance expenses in the long run [6]–[8]. Similarly, conventional refrigerated trucks often rely on manual methods for regularly collecting monitoring data, resulting in time-consuming efforts and compromising real-time performance, thereby posing safety risks to the transported goods [1], [8], [9].

This article aims to explore the design and development of an intelligent logistics tracking system utilizing computer algorithms. The goal is to provide logistics enterprises with an efficient platform for managing their logistics operations and offer customers value-added services. By harnessing computer algorithms, this study seeks to delve into the creation and advancement of an intelligent logistics tracking system. The objective is to furnish logistics companies with a robust platform that streamlines their management processes, while simultaneously enhancing the value delivered to customers.

The implementation of an intelligent logistics tracking system, reliant on computer algorithms, is being investigated in this article. The primary purpose is to equip logistics enterprises with a highly efficient platform for managing their logistics activities, enabling them to provide enhanced services and support to their customers. This article is focused on examining the design and development of an intelligent logistics tracking system that leverages computer algorithms. The aim is to empower logistics companies with a comprehensive platform for managing their operations effectively, while also offering value-added services to customers.

The main objective of this article is to explore the conceptualization and creation of an intelligent logistics tracking system using computer algorithms. The intended outcome is to establish a cutting-edge platform that facilitates efficient logistics management for businesses in this industry, ultimately enabling them to provide customers with additional value. Through the utilization of computer algorithms, this article delves into the design and development of an intelligent logistics tracking system. The purpose is to provide logistics enterprises with a highly effective management platform, enabling them to optimize their operations and deliver enhanced services to customers.

The focus of this article is to investigate the design and development of an intelligent logistics tracking system, which is based on computer algorithms. The primary objective is to equip logistics enterprises with a robust platform for managing their operations efficiently, thereby empowering them to offer customers value-added services. By employing computer algorithms, this article explores the design and implementation of an intelligent logistics tracking system. The aim is to provide logistics companies with a comprehensive platform that enhances their management capabilities and allows them to deliver value-added services to customers. In an effort to enhance logistics operations, this article explores the design and development of an intelligent logistics tracking system, utilizing computer algorithms. The objective is to offer logistics enterprises an efficient management platform that facilitates streamlined operations and enables the provision of value-added services to customers.

2. Literature Review

2.1. System goals

Modern logistics sets itself apart from traditional logistics by offering value-added services that are not available in the traditional approach. Among these services, the ability to track and control the entire logistics process stands out as one of the most crucial aspects of modern logistics, and it has emerged as a core technology driving its development [10]. Consequently, the objective of the intelligent logistics real-time tracking service system is to extensively utilize advanced computer technology, communication technology, artificial intelligence, and other related fields to enhance the logistics system. This system aims to address the real-time information collection of logistics operations through the utilization of technologies such as GPS and barcodes [11], [12]. Additionally, it intelligently analyzes and processes the gathered information, supplying decision-making support for logistics managers and delivering customers with comprehensive information and value-added logistics services in the context of electronic commerce (EC).

To elaborate further, the introduction of modern logistics has revolutionized the industry by offering a range of services that traditional logistics could not provide. One of the key differentiators is the implementation of whole-process tracking and control mechanisms, which enable businesses to have a real-time overview of their logistics operations [10], [13]. By employing advanced technologies like GPS and barcodes, modern logistics is capable of collecting precise real-time information on the movement and status of goods throughout the supply chain.

The integration of computer technology, communication technology, and artificial intelligence within the intelligent logistics real-time tracking service system plays a vital role in optimizing logistical operations. This comprehensive system facilitates the seamless gathering of data from various sources, including GPS and barcode technologies, enabling accurate and timely tracking of goods [14], [15]. Furthermore, it leverages artificial intelligence algorithms to intelligently analyze and process the collected data. This analysis yields valuable insights and decision support for logistics managers, empowering them to make informed choices and efficiently manage their operations.

In addition to supporting logistics managers, the intelligent logistics real-time tracking service system benefits customers by providing them with detailed information and value-added services. Customers can access comprehensive and up-to-date information regarding the status and location of their shipments, empowering them to plan and coordinate their activities more effectively. Moreover, the system goes beyond mere data provision and offers value-added services, such as personalized notifications, route optimization recommendations, and proactive issue resolution. This heightened level of customer service enhances the overall logistics experience and fosters customer satisfaction and loyalty.

The operating environment of electronic commerce (EC) plays a significant role in shaping modern logistics practices. The intelligent logistics real-time tracking service system operates within this context to cater to the specific demands and challenges of e-commerce logistics. By seamlessly integrating with e-commerce platforms and systems, the system enables businesses to align their logistics operations with their online sales activities. This integration allows for smoother order processing, accurate shipment tracking, and efficient last-mile delivery, all of which are crucial for the success of e-commerce businesses.

In conclusion, modern logistics distinguishes itself from traditional logistics by offering value-added services, with whole-process tracking and control being a prominent feature. The intelligent logistics real-time tracking service system harnesses advanced technologies to enable real-time information collection, intelligent analysis, and decision support for logistics managers. Simultaneously, it provides customers with detailed information and value-added services, enhancing their experience. Furthermore, by operating within the EC environment, the system aligns logistics operations with online sales activities, improving efficiency and customer satisfaction.

2.2. System structure design

The "Intelligent Logistics Tracking Service System" is composed of four subsystems: logistics platform management subsystem, warehouse management subsystem, transportation scheduling and monitoring subsystem, and e-commerce platform subsystem [16], [17], as shown in Figure 1.

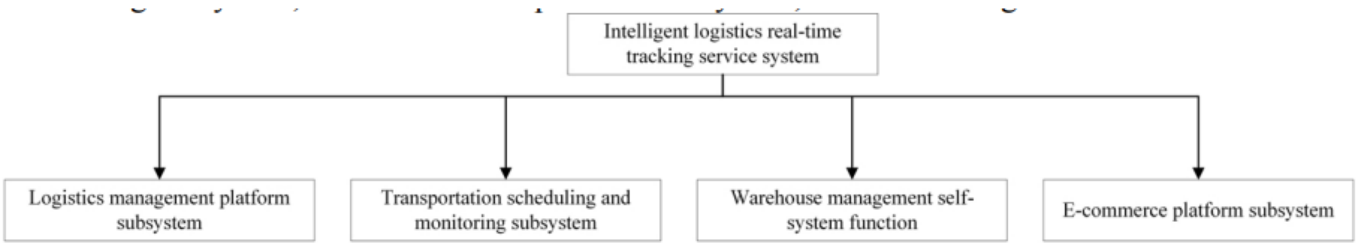

Figure. 1. System logical structure diagram

The intelligent logistics tracking system consists of 4 parts: a wireless sensor monitoring network, a data transmission network, a monitoring center (remote monitoring terminal) and a secondary monitoring center (transportation staff). The base station is responsible for the long-distance transmission of data, and can also provide communication for the monitoring terminal and the sink node [18], [19]. The monitoring terminal is responsible for further analysis of the data, monitoring and tracking the status and integrity of the cargo behavior.

The wireless sensor monitoring network is the core of the entire monitoring system. Responsible for the collection of cargo status data and preliminary detection of abnormal behavior [20], [21]. When the cargo behavior is abnormal, the detection results are transmitted to the secondary monitoring center in real time, and the status data under the abnormal behavior is transmitted to the primary monitoring center. Each cargo in the carriage of the primary monitoring center has a detection node. The entire monitoring network consists of multiple The detection node is composed of a sink node (gateway).

The detection node is deployed inside the cargo, close to the surface opening position. The hardware structure is composed of a local storage module, a processor module, an energy supply module, a magnetic sensor module, a three-dimensional acceleration sensor module, and a wireless communication module. When the goods are packaged, the door magnetic sensor module and the permanent magnet are close together to passively sense the opening and closing information of the goods package. If the goods package is opened during transportation, the detection node will use the wireless communication module to transmit the current monitoring to the convergence node data. The three-dimensional acceleration sensor module samples the acceleration of the cargo in 3 dimensions (X, Y, Z) at a certain sampling frequency. The processor analyzes the collected data and judges the current behavior of the cargo. When the cargo behavior is abnormal, the wireless communication module is used to report The sink node transmits the current behavior and monitoring data of the goods.

The GPS node is deployed on the top of the carriage of logistics transportation, and the hardware structure is composed of a local storage module, a processor module, an energy supply module, a prePuddle module, and a 5G module. The GPS receiving module regularly measures its current position. In order to receive satellite signals normally, its GPS antenna needs to be led out and installed outside the vehicle. The Zigbee communication module conforming to the 1EEE802.15.4 standard provides geographic location information and time information to the wireless sensor monitoring network in the carriage.

The gateway is deployed on the top of the carriage of logistics transportation, and the hardware structure is composed of a local storage module, a processor module, an energy supply module, an advance module and a 5G module. The wireless communication module is used to receive the data sent by each detection node. The pre-Puddle module provides real-time notifications of abnormal cargo behavior to the transportation personnel. The 5G module transmits the received monitoring data of the abnormal behavior of the cargo to the remote monitoring terminal for supply. further analysis. In order to receive 5G signals normally, its GPS antenna needs to be drawn out and installed outside the vehicle

The data transmission network is composed of GSM network and adopts 5G wireless communication mode. 5G is a 5G packet-switched data network based on China Mobile's GSM network. It has good signal coverage. In most areas of the country, it can automatically attach to the 5G network as long as it is turned on, and establish a communication link with the data center to provide stable data. transmission. At the same time, 5G charges fees according to the number of data packets received and sent, and no fees are charged when there is no data flow. Therefore, the use of 5G communication can ensure the reliability, real-time, stability and economy of monitoring data transmission.

3. Methodology

Since the two logistics links of inventory and transportation involve a large number of decisionmaking optimization problems, these problems cannot be solved by simply relying on the experience of the logistics manager. Therefore, the system is required not only to provide information for the logistics manager, but also to assist the manager in providing decision-making. Support us to establish their own intelligent decision support systems in the transportation scheduling and monitoring system and the warehouse management subsystem to assist the decision-making of the shopkeeper and the warehouse manager. Take inventory as an example here to design an intelligent decision support system, as shown in Figure 2.

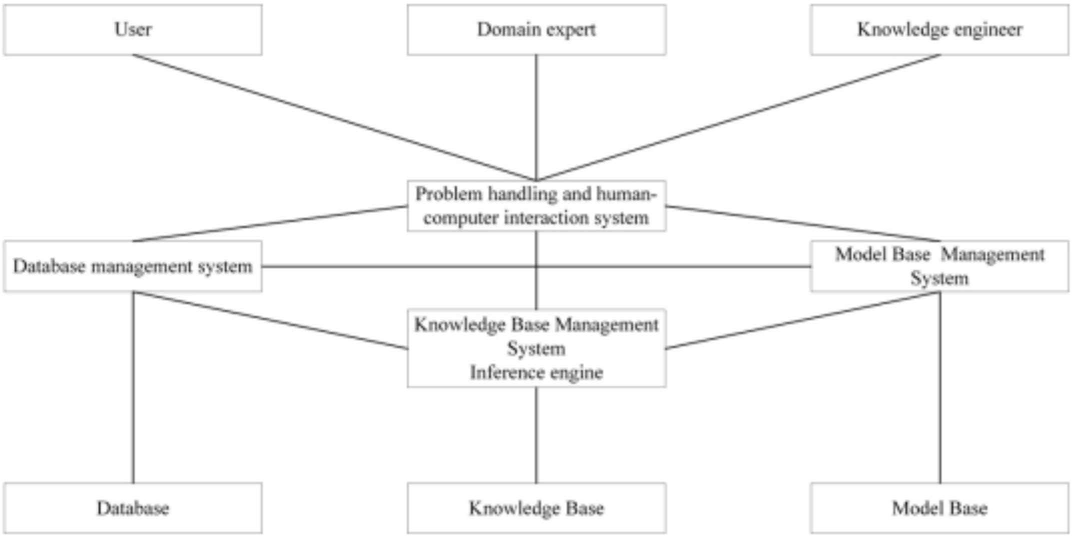

Figure. 2. Overall structure of inventory IDSS system

The intelligent inventory decision support system operates through the following steps:

1) The user interacts with the system through a dialogue interface and provides the inventory information in a table format.
2) The system searches the knowledge base's case library. If there are existing cases, it utilizes the inventory model from a relevant case to optimize and generate the desired optimization results. If no relevant case is found, it proceeds to the next step.
3) An inference engine is employed to locate matching rules within the knowledge base. The system then outputs the discovered inventory model and applies it along with relevant methods to address the inventory situation.
4) The system evaluates and compares each inventory model that has been selected. The comparison results are then presented to the user.
5) The system selects the best inventory model based on the evaluations and stores the case in the knowledge base for future reference.
6) Finally, the system outputs the ultimate decision result, reflecting the optimized inventory management approach.

To achieve the aforementioned functions, the system has been designed with detailed considerations for each stage.

3.1. Selection of inventory model

The selection of inventory model plays adopts the strategy of combining case matching and rule matching. Case matching is a deterministic inventory model selection strategy. It compares the user' s problem with the case in the case library (actually also expressed by the IFTHEN rule). If the same case is found, it will be used the inventory model provided in this case is used to solve the problem-otherwise, the rule matching method is adopted. This method is an uncertain selection strategy. It can produce a variety of inventory models. The system also needs to compare and select the best on this basis." To determine the final inventory model rules to adopt production rules, that is, IF THEN IF-THEN rules are stored in the knowledge base, and the knowledge base management system maintains the reasoning engine using depth first The forward reasoning mechanism of the search strategy performs rule matching search. The selection conditions in the rules consist of inventory information in a standardized format, taking into account the components of the inventory model and the manager's experience judgment, and the specific design of the goods information.

The description of the model variables is shown in formulas (1) and (2):

$$x^{i}_{v,v+1} = \begin{cases} 1, \textit{Choose the } i-th \textit{ path between nodes } v \textit{ and } v+1 \\ 0, \textit{otherwise} \end{cases} \tag{1}$$

$$y_v = \begin{cases} 1, \textit{Choose to carry out logistics processing activities at node } v \\ 0, \textit{otherwise} \end{cases} \tag{2}$$

Among them, $C^{i}_{V,V+1}$ is the unit transportation cost between nodes v and v+1; q is the volume of goods in the logistics chain; $I^{i}_{V,V+1}$ is the length of the i-th path between nodes v and v+1; rv is the logistics at node v The unit processing cost of the processing activity; V is the set of available logistics nodes; I is the set of available logistics routes.

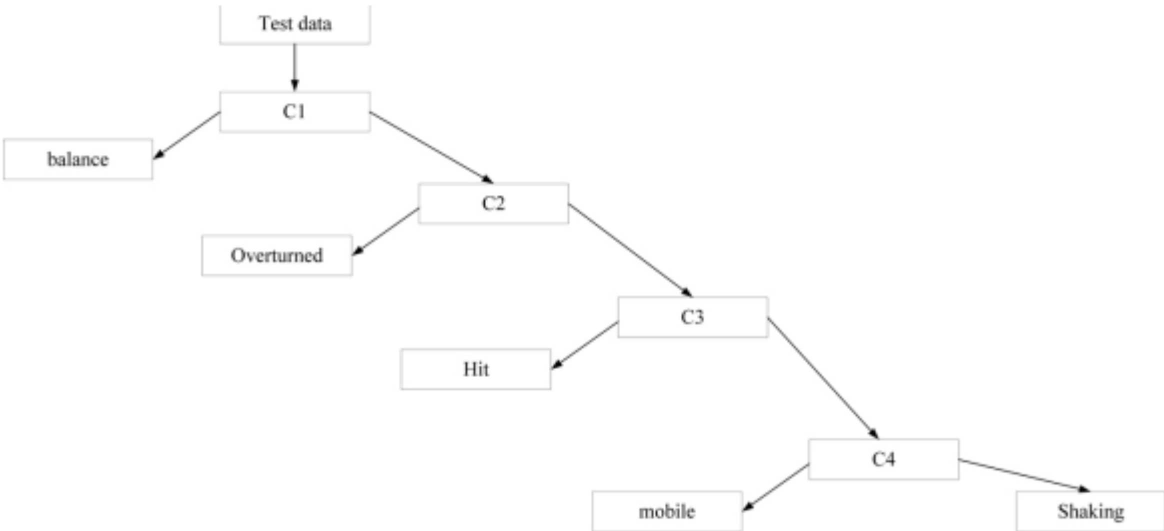

Figure. 3. Classification tree of the algorithm

The determination of cargo behavior in Figure 3 involves selecting and prioritizing different statistical characteristics of data. This process relies on defining cargo behavior and analyzing the characteristics associated with it. The system automatically extracts the first two pieces of information from the relevant database, while the user provides the remaining five pieces of information. Each field is represented in specific ways as follows:

7) Demand characteristics: The representation method uses two digits. "00" indicates definite demand with a constant value, "01" represents definite demand with variability, "10" signifies random demand without changes, and "11" denotes random demand with changes.
8) Replenishment strategy: A single digit is used to represent this field. "0" indicates instant replenishment, while "1" signifies a delayed approach.
9) Out-of-stock strategy: This field is represented using two digits. "00" indicates that out-of-stock situations are not permitted. "10" means that out-of-stock is allowed, and missing goods are immediately replenished upon order arrival. "11" indicates that shortages are allowed, and the missing goods will not be replenished.
10) Inventory strategy: A single digit is used for representation. "0" indicates continuous inventory, while "1" represents regular inventory.
11) Importance and ease of purchase: These aspects are expressed using vague language. The fuzzy comment sets are defined as follows:

- Importance set: (important a1, more important a2, general a3, less important a4, minor a5)

- Ease of purchase set: (easy to buy b1, easier to buy b2, general b3, more difficult to buy b4, difficult to buy b5)

Both sets use a 5-point system for representation, where "b1=a1=5", "b2=a2=4", "b3=a3=3", "b4=a4=2", and "b5=a5=1".

3.2. Comparison of inventory models

The system assesses and contrasts various inventory types chosen by the user, considering evaluation factors such as fixed costs, storage costs, stock losses, service levels, and management workload. It analyzes these indicators for the inventory models involved in the comparison and presents the findings to the user. By evaluating and comparing these aspects, the system provides the user with a comprehensive understanding of the different inventory types and their respective strengths and weaknesses.

The evaluation and comparison process of the selected inventory types conducted by the system encompasses several key indicators, including fixed costs, storage costs, stock losses, service levels, and management workload. By examining these criteria, the system compares the inventory models being assessed, thoroughly analyzing their respective performance in each area. The outcome of this comparative analysis is then communicated back to the user, enabling them to make informed decisions based on the detailed evaluation of each inventory type.

When evaluating and comparing the inventory types chosen by the system, various factors are taken into consideration. These factors comprise fixed costs, storage costs, stock losses, service levels, and management work volume, among others. The system meticulously assesses these indicators for the inventory models included in the comparison, conducting a thorough analysis of their performance. Subsequently, the system presents the results of the comparison to the user, offering valuable insights into the strengths and weaknesses of each inventory type. By providing a comprehensive evaluation and comparison, the system equips the user with the necessary information to make well-informed decisions regarding inventory management.

3.3. Inventory model selection

The system offers two methods for determining the optimal inventory beam type. The first approach involves the decision-maker using their personal experience to directly select the best inventory model by comparing the available options. The second approach is employed when the decision-maker finds the choice challenging and uncertain, and they seek assistance from the system to make the selection. To address the uncertainty and ambiguity associated with subjective and objective factors, the system utilizes the fuzzy comprehensive evaluation method as a means of reducing the decision-makers' biases in their decision-making process.

Upon completion of the selection process, the system saves the case as a reference in the case library within the knowledge base. This enables future retrieval and analysis of the chosen solution. Moreover, the knowledge base management system has the capability to gather and accumulate valuable empirical knowledge related to inventory lock type selection, as perceived by users. This knowledge is collected through the man-machine interface and can be utilized in subsequent model plow selections.

In summary, the system provides decision-makers with two options for choosing the best inventory beam type. They can rely on their own experience to make a direct selection or request assistance from the system when faced with difficulty and uncertainty. The system employs the fuzzy comprehensive evaluation method to minimize biases stemming from subjective and objective factors. The chosen solution is stored as a case in the case library, and the knowledge base management system can collect and accumulate valuable empirical knowledge through the man-machine interface for future reference in model plow selections.

4. Result and Discussion

The development of the system utilizes a hybrid approach known as the 3-layer C/S and BIS method. This method combines the three-tier client/server (C/S) structure with Business Information System (BIS) technology. The main business department employs the three-tier C/S structure, while other departments primarily utilize the system for information queries. By leveraging BIS technology, decision-makers and employees can access a wide range of information through the e-commerce platform. The platform serves as a hub for information dissemination, enabling users to place orders, publish information, and access various customer services via the Internet. To ensure security, the e-commerce platform is connected to the Internet through a firewall, safeguarding sensitive data and facilitating secure online transactions.

The system development strategy adopts a unique approach called the 3-layer C/S and BIS hybrid method. This approach combines the advantages of the three-tier client/server structure and Business Information System (BIS) technology. In the primary business department, the three-tier C/S structure is implemented, allowing for efficient processing and management of tasks. However, in other departments, the primary objective is information retrieval. Here, the system provides a platform powered by BIS technology, enabling decision-makers and employees to access a wealth of information. This integration of BIS technology ensures that relevant data can be disseminated effectively throughout the organization.

The e-commerce platform is a critical component of the system, facilitating connectivity between users and the Internet. Through the implementation of a firewall, the platform establishes a secure connection to the Internet, protecting sensitive information from unauthorized access. This secure connection enables users to perform a range of functions, such as placing orders, publishing information, and accessing various customer services. By leveraging the Internet's vast reach, the platform opens up new opportunities for businesses to engage with customers and streamline their operations.

The use of BIS technology on the e-commerce platform enables the release and querying of various information. Decision-makers and employees can leverage this technology to stay informed about market trends, customer preferences, and other pertinent data. The platform acts as a central hub for information dissemination, ensuring that the right information reaches the right people at the right time. With the ability to publish information and query data, users can make informed decisions, improving overall operational efficiency.

Overall, the 3-layer C/S and BIS hybrid method employed in the system development offers a comprehensive solution for organizations. By utilizing the three-tier C/S structure in the main business department and incorporating BIS technology for information queries, the system caters to different departments' specific needs. The e-commerce platform serves as a secure gateway to the Internet, empowering users to carry out essential tasks and access a wealth of information. With its ability to release and query various data, the platform enhances decision-making processes and enables organizations to stay competitive in the dynamic business landscape.

4.1. Logistics platform management subsystem

The logistics platform management subsystem plays a crucial role in overseeing various operations essential for efficient logistics management. It encompasses several key functions, including order processing, distribution planning, order planning, and real-time monitoring of delivery vehicles. Each of these functions contributes to the overall smooth functioning of the logistics platform and ensures timely and accurate deliveries.

One of the primary responsibilities of the logistics platform management subsystem is order processing. This involves the systematic handling and organization of incoming orders, ensuring that they are accurately recorded and processed. By efficiently managing the order processing stage, the subsystem ensures that all customer requests are received promptly and that the necessary actions are taken to fulfill them.

Another critical function of the logistics platform management subsystem is distribution planning. This entails strategizing and determining the most optimal routes and methods for distributing goods to various destinations. By analyzing factors such as delivery deadlines, product availability, and transportation capacities, the subsystem can devise effective distribution plans that minimize costs and maximize efficiency.

Additionally, the logistics platform management subsystem plays a vital role in order planning. This involves coordinating the timing and sequencing of orders to ensure optimal resource utilization and smooth order fulfillment.

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By considering factors like inventory levels, production capacities, and delivery schedules, the subsystem can effectively plan the order fulfillment process, reducing delays and minimizing bottlenecks.

Real-time monitoring of delivery vehicles is another crucial function of the logistics platform management subsystem. By leveraging advanced technologies such as GPS tracking and telematics systems, the subsystem can continuously monitor the location, status, and performance of delivery vehicles. This real-time monitoring enables efficient dispatching, route optimization, and proactive decision-making in response to unexpected events or changes in the delivery process.

In conclusion, the logistics platform management subsystem encompasses various essential functions that are vital for the smooth operation of logistics platforms. From order processing and distribution planning to order planning and real-time monitoring of delivery vehicles, each function contributes to optimizing logistics operations, ensuring timely and accurate deliveries, and enhancing overall customer satisfaction. Effective management of these functions is crucial for organizations to achieve operational excellence and maintain a competitive edge in the dynamic world of logistics.

4.2. Warehouse management subsystem

The warehouse management subsystem plays a crucial role in facilitating various warehousing operations, including the entry and exit of goods. It employs advanced bar code technology to accurately identify and describe the items, enabling the real-time monitoring and tracking of goods as they enter or leave the warehouse. This system ensures efficient and effective management of inventory movements.

In addition to its operational functions, the warehouse management system serves as a valuable tool for optimizing inventory and supporting decision-making processes. By establishing a seamless interaction with managers, the system gathers information regarding their concerns, requirements, and preferences. Based on this data, it generates optimization results and provides valuable insights to assist managers in making informed inventory-related decisions.

One key advantage of the warehouse management system is its ability to streamline warehousing processes. Through the implementation of bar code technology, the system simplifies the identification and description of goods, eliminating the need for manual data entry and reducing the risk of errors. This automation ensures the real-time collection of accurate data on goods entering or leaving the warehouse, enabling efficient tracking and inventory control.

Moreover, the warehouse management system contributes to improved decision-making by offering comprehensive support to managers. By understanding their specific challenges and objectives, the system can generate optimization outcomes that align with the managers' requirements. This empowers managers with data-driven insights and recommendations, enabling them to make well-informed inventory decisions that align with their business goals.

Overall, the warehouse management subsystem plays a vital role in modern warehouses by streamlining operations and optimizing inventory management. Its utilization of bar code technology ensures efficient and accurate identification and tracking of goods. Furthermore, the system's ability to interact with managers and provide optimization results empowers decision-making and enhances overall warehouse efficiency.

4.3. Transportation scheduling and monitoring subsystem

The transportation dispatching and monitoring subsystem is composed of a mobile target vehicle mounted unit and a dispatching center. 3 The mobile target vehicle-mounted unit includes a GPS receiving module, a GSM two-way wireless communication module, an antenna and other equipment, which can achieve two-way wireless communication with the monitoring center through GSM, and through the CPS module Collect vehicle positioning information, and send the positioning information and cargo information to the monitoring center through GSM short messages. The Sudu Center is composed of SMSP, server, SQL Server database and GIS. It can track and monitor the delivery vehicles, and use GIS, IDSS, computational intelligence and other technologies for static and real-time transportation dispatch. Among them, the real-time monitoring function can display the operating status of all or part of the vehicles on the same screen, realizing real-time dynamic monitoring of the whole process of logistics cargo distribution.

Distribution route planning is an important part of the transportation scheduling and monitoring subsystem, which can provide dispatchers with real-time vehicle scheduling and static support for powerful decision-making. The basic function is to embed the algorithm software into the GIS by setting the starting and ending points and nodes of the goods distribution on the map, so as to obtain the optimal route of the distribution, and provide an animated demonstration of the user's image.

4.4. E-commerce platform subsystem

The e-commerce platform adopts the B/S model, and its publishing form is a logistics website. The customer operation interface is a web browser. On the corresponding website, goods and orders can be tracked in real time, and the in-transit transportation of their goods and the completion of orders can be inquired. System personnel can review and preliminarily process orders placed by customers on the e- commerce platform, monitor and dispatch vehicles in real time, and publish relevant information on the platform. Transport dispatchers and customers can inquire about the cargo status in real time. The corresponding recorded cargo behaviors during the experiment are: impact, shaking, moving and overturning, and the detection results are consistent with the recorded results.

After detecting the four types of abnormal behavior data of the goods, it can be seen from the results that the algorithm can accurately detect the overturning and impact behavior of the goods, mainly because the intelligent algorithm in this paper is based on the most similar multi-feature recognition, and the feature is the priority. Sort by level to ensure that cargo behaviors with obvious characteristics can be detected first. By comparing the recorded results and detection results of the experiment, and observing the three-dimensional acceleration data signal characteristics of the cargo when the detection error occurs, it is found that the abnormal behavior characteristics of the cargo are fuzzy Sex has led to errors in the test results. The slight and stable movement is not detected, and it is considered that the cargo is in equilibrium; the rapid acceleration of the train starting and stopping causes the steady increase in the three-dimensional acceleration of the cargo, which is misdetected as the movement of the cargo itself; slight shaking of the cargo (The shaking amplitude is very small) will also be detected as movement.

From the above analysis, it can be seen that the intelligent algorithm for the detection of abnormal cargo behavior has high accuracy. In the existing 80 tests, the error rate is less than 5%. At the same time, the detection results verify that in the classification tree of the intelligent algorithm, the farther the cargo behavior from the root node (the deeper the leaf node) is, the more complicated the detection process, the less obvious the feature, and the higher the probability of detection error.

5. Conclusion

In this paper, a novel intelligent tracking system is introduced, aiming to enhance the perception of logistics goods status through the implementation of intelligent algorithms. The system focuses on acquiring real-time environmental parameter information and relevant geographic location data of the goods, enabling comprehensive monitoring and analysis. To validate its effectiveness, the system undergoes rigorous experimentation and testing within an actual vehicle environment. The findings demonstrate that the algorithm employed in the system successfully captures the movement behavior state of the goods with high accuracy. Moreover, it promptly notifies authorities in the event of unauthorized unpacking of the goods, ensuring quick response and effective security measures.

The primary objective of this research is to develop an advanced tracking system that leverages intelligent algorithms to address the demand for improved logistics goods status perception. By harnessing the power of intelligent algorithms, the system can seamlessly obtain crucial information about the goods' environmental parameters and their geographical location. This real-time data acquisition enables comprehensive monitoring, ensuring that any changes or deviations from the expected status are promptly identified and analyzed.

To evaluate the performance and reliability of the proposed system, a series of experiments and tests are conducted in a real-world vehicle environment. This setting closely simulates the conditions that logistics goods experience during transportation, providing a realistic platform for assessing the system's capabilities. The experiments confirm the

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system's ability to accurately capture the movement behavior state of the goods, enabling precise monitoring throughout the transportation process.

One key aspect of the intelligent tracking system is its proactive response to potential security threats. When unauthorized unpacking of goods occurs, the system swiftly detects the anomaly and generates an immediate alert to the relevant authorities. This timely notification ensures that appropriate actions can be taken to mitigate risks and prevent further damage or loss. By integrating intelligent algorithms into the tracking system, the response time to such incidents is significantly reduced, improving the overall security measures in logistics operations.

In conclusion, this paper presents an innovative intelligent tracking system that enhances logistics goods status perception through the application of intelligent algorithms. The system's ability to accurately collect real-time environmental parameter information and relevant geographic location data enables comprehensive monitoring and analysis. The experiments conducted in a vehicle environment demonstrate the system's accuracy in capturing the movement behavior state of the goods. Additionally, the system's prompt reporting of unauthorized unpacking enhances security measures and facilitates quick responses to potential threats. Overall, the proposed intelligent tracking system has the potential to significantly improve logistics operations by providing accurate and timely information about the status of goods during transportation.

References

[1] A. Stevenson, “Shining a light on care homes during the COVID 19 pandemic in the UK 2020,” Qual. Ageing Older Adults, vol. 21, no. 4, pp. 217–228, Jan. 2020, doi: 10.1108/QAOA-10-2020-0051.

[2] B. Abu-Salih, P. Wongthongtham, and C. Yan Kit, “Twitter mining for ontology-based domain discovery incorporating machine learning,” J. Knowl. Manag., vol. 22, no. 5, pp. 949–981, Jan. 2018, doi: 10.1108/JKM-11-2016-0489.

[3] S. Demirkan, I. Demirkan, and A. McKee, “Blockchain technology in the future of business cyber security and accounting,” J. Manag. Anal., vol. 7, no. 2, pp. 189–208, 2020, doi: 10.1080/23270012.2020.1731721.

[4] P. Helo and Y. Hao, “Blockchains in operations and supply chains: A model and reference implementation,” Comput. Ind. Eng., vol. 136, pp. 242–251, 2019, doi: https://doi.org/10.1016/j.cie.2019.07.023.

[5] A. Chikh and A. Chandra, “An optimal maximum power point tracking algorithm for PV systems with climatic parameters estimation,” IEEE Trans. Sustain. Energy, vol. 6, no. 2, pp. 644–652, 2015.

[6] H. Jiang, J. P. Wachs, and B. S. Duerstock, “Integrated vision-based system for efficient, semi-automated control of a robotic manipulator,” Int. J. Intell. Comput. Cybern., vol. 7, no. 3, pp. 253–266, Jan. 2014, doi: 10.1108/IJICC-09-2013-0042.

[7] S. Khodabandehlou, S. A. Hashemi Golpayegani, and M. Zivari Rahman, “An effective recommender system based on personality traits, demographics and behavior of customers in time context,” Data Technol. Appl., vol. 55, no. 1, pp. 149–174, Jan. 2021, doi: 10.1108/DTA-04-2020-0094.

[8] P. Helo and A. H. M. Shamsuzzoha, “Real-time supply chain—A blockchain architecture for project deliveries,” Robot. Comput. Integr. Manuf., vol. 63, p. 101909, 2020, doi: https://doi.org/10.1016/j.rcim.2019.101909.

[9] M. A. Salam and S. Bajaba, “The role of transformative healthcare technology on quality of life during the COVID-19 pandemic,” J. Enabling Technol., vol. 15, no. 2, pp. 87–107, Jan. 2021, doi: 10.1108/JET-12-2020-0054.

[10] A. Efendi, D. Purwana, and A. D. Buchdadi, “Human Capital Management of Government Internal Supervisory at the Ministry of Defense of the Republic Indonesia,” Int. J. Appl. Inf. Manag., vol. 2, no. 2, pp. 81–89, 2021, doi: 10.47738/ijaim.v2i2.30.

[11] S. Sedkaoui and M. Khelfaoui, “Understand, develop and enhance the learning process with big data,” Inf. Discov. Deliv., vol. 47, no. 1, pp. 2–16, Jan. 2019, doi: 10.1108/IDD-09-2018-0043.

[12] R. Subrahmanian, “Gender equality in education: Definitions and measurements,” Int. J. Educ. Dev., vol. 25, no. 4 SPEC. ISS., pp. 395–407, 2005, doi: 10.1016/j.ijedudev.2005.04.003.

[13] U. Wehn and C. Montalvo, “Knowledge transfer dynamics and innovation: Behaviour, interactions and aggregated outcomes,” J. Clean. Prod., vol. 171, pp. S56–S68, 2018, doi: 10.1016/j.jclepro.2016.09.198.

[14] W. Al-Jedibi, “The Strategic Plan of the Information Technology Deanship - King Abdulaziz University- Saudi Arabia,” Int. J. Appl. Inf. Manag., vol. 2, no. 4 SE-Articles, pp. 84–94, May 2022, doi: 10.47738/ijaim.v2i4.40.

[15] A. M. Westerling, V. E. Haikala, J. Simon Bell, and M. S. Airaksinen, "Logistics or patient care: Which features do independent Finnish pharmacy owners prioritize in a strategic plan for future information technology systems?," J. Am. Pharm. Assoc., vol. 50, no. 1, pp. 24-33a, 2010, doi: https://doi.org/10.1331/JAPhA.2010.08176.

[16] N. A. AlQershi, S. S. M. Mokhtar, and Z. Bin Abas, "CRM dimensions and performance of SMEs in Yemen: the moderating role of human capital," J. Intellect. Cap., 2020, doi: 10.1108/JIC-05-2020-0175.

[17] B. Han, M. Kim, and J. Lee, "Exploring consumer attitudes and purchasing intentions of cross-border online shopping in Korea," J. Korea Trade, vol. 22, no. 2, pp. 86–104, Jan. 2018, doi: 10.1108/JKT-10-2017-0093.

[18] G. Maguolo, M. Paci, L. Nanni, and L. Bonan, "Audiogmenter: a MATLAB toolbox for audio data augmentation," Appl. Comput. Informatics, vol. ahead-of-p, no. ahead-of-print, Jan. 2021, doi: 10.1108/ACI-03-2021-0064.

[19] V. Mittal and T. V Raman, "Financing woes: estimating the impact of MSME financing gap on financial structure practices of firm owners," South Asian J. Bus. Stud., vol. 2, no. 3, Jan. 2021, doi: 10.1108/SAJBS-07-2020-0228.

[20] Y. Liu, R. Sun, and S. Jin, "A survey on data-driven process monitoring and diagnostic methods for variation reduction in multi-station assembly systems," Assem. Autom., vol. 39, no. 4, pp. 727–739, Jan. 2019, doi: 10.1108/AA-10-2018-0174.

[21] M. Kharub and R. Sharma, "Comparative analyses of competitive advantage using Porter diamond model (the case of MSMEs in Himachal Pradesh)," Compet. Rev. An Int. Bus. J., vol. 27, no. 2, pp. 132–160, Jan. 2017, doi: 10.1108/CR-02-2016-0007.