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Research on Intelligent Inventory Management System Based on Automation and Real-Time Data Processing

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Abstract: With the expansion of enterprise scale and business complexity, traditional manual recording and manual management methods can no longer meet the needs of modern enterprises for accurate inventory control. This paper studies and designs an intelligent inventory management system, which aims to improve the efficiency and accuracy of inventory management, reduce errors, optimize costs, and enhance the competitiveness of enterprises through automation and digitalization. The system adopts modern technical frameworks such as Spring Boot and Vue, combined with UML diagram for system design, realizes the core functions such as warehousing, warehousing, inventory management and report data analysis, and considers non-functional requirements such as ease of use, scalability, security, etc., to ensure the efficient operation of the system and the convenience of operation.

Keywords: Inventory Management System, Spring Boot, Vue, UML Diagram.

1. Introduction

As enterprises grow in size and business complexity, manual recording and manual management are no longer suitable for the needs of modern enterprises for precise inventory control. Inbound and outbound management is the key to business operations, and its efficiency and accuracy affect production efficiency and costs. Therefore, it is essential to develop an efficient inbound and outbound management system.

With the continuous development of computer technology and the continuous improvement of intelligent technology, Wal-Mart, as the world's largest retailer company, at the beginning of the 21st century, has reformed the logistics industry by using radio frequency identification technology on a large scale around the world. At present, the technologies on which the information-based warehouse management system realizes the intelligent operation of warehousing are mainly wireless communication technology, RFID technology, and sensor technology [1]. In terms of intelligent manufacturing, Germany among European countries also has obvious advantages, and factory robots made in Germany perform well in intelligent warehouse management.

Compared with foreign countries, the development of warehouse management in China started late. At present, the mainstream technology on which China's warehouse management system relies is barcode recognition [2]. The earliest enterprise in China to realize intelligence in warehouse management is Baisha Logistics Company. Baisha Logistics Co., Ltd. is the first enterprise in China to apply RFID technology and barcode identification technology to warehousing and logistics [3]. With the continuous development of computer technology and the continuous support of the Chinese government for Internet e-commerce and automation industry, the level of intelligent warehouse management in China is expected to improve rapidly [4].

The intelligent inventory management system designed in this paper adopts automation and digital technology, realizes real-time monitoring through the Internet of Things, uses big data analysis to optimize decision-making, and applies artificial intelligence to improve automatic order processing, reduce errors, reduce costs, and enhance transparency and flexibility. The system interface is user-friendly, supports mobile access, improves management efficiency, enhances enterprise competitiveness, and supports lean management and sustainable development.

2. Feasibility analysis of the inventory system

Not every problem has a simple and obvious solution, and in fact, many problems cannot be solved within the predetermined system size or time frame. If there is no feasible solution to the problem, then any time, manpower, software and hardware resources and funds spent on this project will be a wasteful waste.

This paper will analyze the feasibility of an intelligent inventory management system from three aspects: economy, technology and operation.

2.1. Economic feasibility

Development costs are concentrated on the amount of software, hardware, and code, and are mainly aimed at small and medium-sized enterprises with limited funds. In terms of software, it adopts a free Windows system and MySQL database, as well as an open-source Java IDE IntelliJ IDEA and a Git version control system. In terms of hardware, it is recommended to use cloud services, which cost about 2,000 to 3,000 yuan, depending on the service configuration and usage time. The code and data are stored in the cloud, which costs about 1,500 to 2,000 yuan, depending on the storage needs and access frequency. Network equipment can leverage existing resources without additional investment.

A development engineer with a monthly salary of 10,000 yuan will be paid about 1 yuan per minute based on 22 working days per month[5]. Assuming that each line of code takes 10 minutes to write, the code cost is about 10 yuan per line. Taking 2,500 lines of code as an example, the labor cost

is about 25,000 yuan, and the development cycle is about two months. Including the maintenance cost, the total cost of the system is about 150,000 yuan. Compared with traditional warehouse management, the system can save about 180,000 yuan/year, showing obvious economic benefits, so it is economically feasible to develop an intelligent inventory management system.

2.2. Technical feasibility

The front-end uses Vue.js to build a dynamic user interface, and the back-end uses the SSM framework, where Spring manages the business logic, SpringMVC handles web requests, and MyBatis interacts with the MySQL database. Project dependencies and builds are managed through Maven, front-end and back-end development is separated, and the front-end communicates with the backend through Ajax. Eventually, the application is deployed on the Tomcat server. Using the existing technology[6], the development of an intelligent inventory management system is technically feasible.

2.3. Operational feasibility

With the advancement of science and technology, computerization and intelligence have become an inevitable trend of social development [7], which has brought about diversified operation methods and improved work efficiency. The interface of this system is simple and intuitive, supports mouse and keyboard operation, and is easy for new users to quickly get started, showing a high degree of feasibility at the operation level.

3. Demand analysis of the inventory system

3.1. Core functional requirements

(1) Warehousing management: real-time recording of material warehousing information, including name, specification, quantity, etc.; Support the warehousing application, review, and confirmation process; Inventory data is automatically updated.

(2) Outbound management: support outbound application, review, and processing processes; Automatically generate outbound instructions; Synchronize and update inventory data.

(3) Inventory management: provide real-time inventory inquiry; Support inventory counting and adjustment; Set up inventory alert notifications.

(4) Report and data analysis: generate inbound and outbound reports, including daily reports and monthly reports; Provide inventory reports, inventory analysis and optimization suggestions.

3.2. Non-functional requirements

(1) Ease of use: Provide a concise and clear user interface, support shortcut keys and batch processing, and clear error prompts.

(2) Scalability and customization: Modular design and open interfaces are provided to support integration with other systems.

(3) Security: Encrypt sensitive data, record operation logs, back up data regularly, and comply with laws and regulations and information security level protection requirements.

4. An overview[8] of the functionality of the inventory system

Inventory management[9] is mainly the recording, operation and adjustment of all kinds of items, in which the warehousing and warehousing process is the core and key business in warehouse management, and there is a certain dependency between these two businesses (all affected by inventory), in order to ensure the stable operation of the system, the activity process of this kind of business needs to be designed in detail, as follows.

(1) warehousing business process: warehousing business is the core link of warehousing business, which covers warehousing preparations such as cargo forecasting, warehousing list preparation, yard arrangement, etc., to receiving goods, checking packaging and marking of goods transportation, and then to the quality inspection of goods, filling in the acceptance record of goods acceptance, as well as putting goods on the shelves and updating inventory information on the shelves, and finally handling warehousing procedures and summarizing the whole process of optimization. This series of operations ensures that the goods can enter the warehouse safely, orderly and efficiently, and provides a strong guarantee for the normal operation of the enterprise. According to the above activity diagram [10] describing the business, Figure 1 shows it:

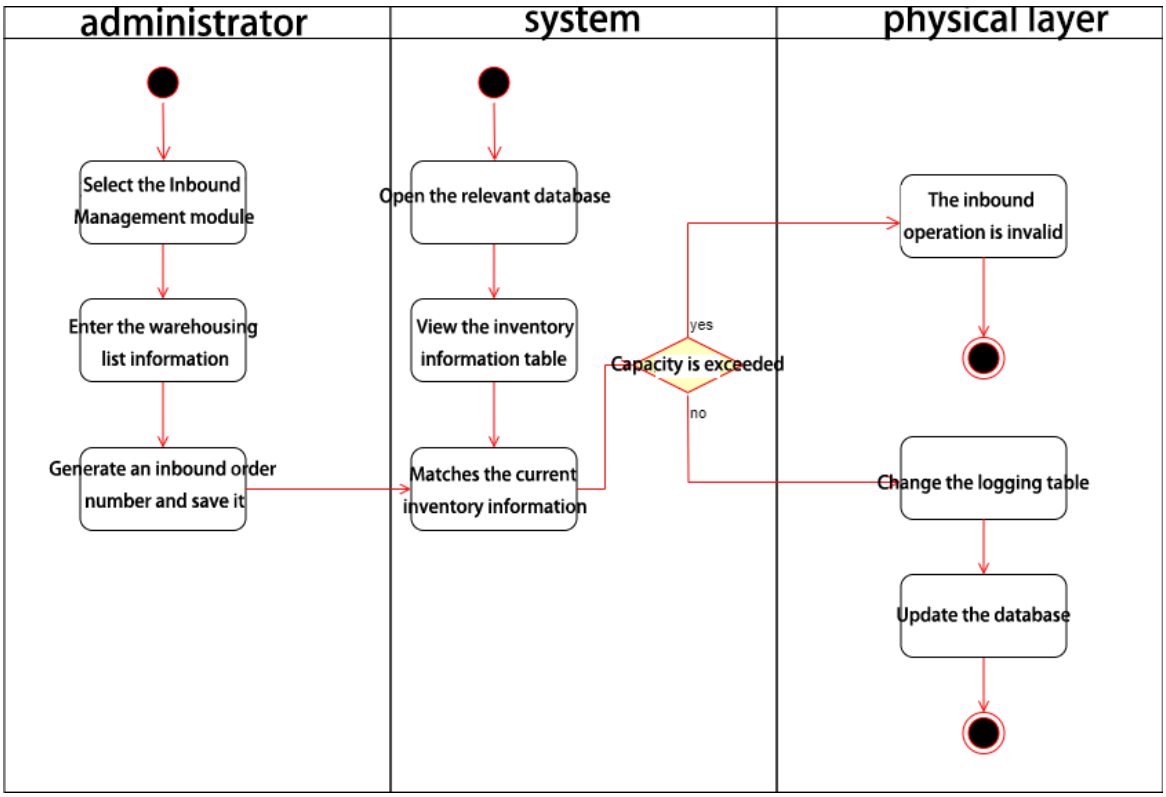

Figure 1 Inbound Business Activity Diagram

After the administrator starts the warehousing process and selects "Inbound Management", the system responds and opens the relevant database to prepare for the processing of inventory information. The system checks the capacity of the inventory information table, and if it exceeds, it will immediately report the error "Inventory is full" and terminate the subsequent operation. If the capacity is not exceeded, the system requires the user to enter the inbound list and verify that the tracking number matches the inventory information table. If the tracking numbers do not match, an error will be reported, and if the tracking numbers match, the inventory information table will be updated and a log record will be generated. Finally, the system notifies the administrator that the warehousing operation is valid and confirms that the warehousing operation is successful.

(2) Outbound business process: Outbound business is a key link in the field of logistics, which mainly involves receiving and reviewing outbound orders, picking goods according to orders, packaging and marking goods, reviewing before leaving the warehouse, loading goods and handling delivery procedures, as well as follow-up cargo tracking and customer service to ensure that the goods are delivered to customers accurately and safely. The entire business activity diagram is shown in Figure 2:

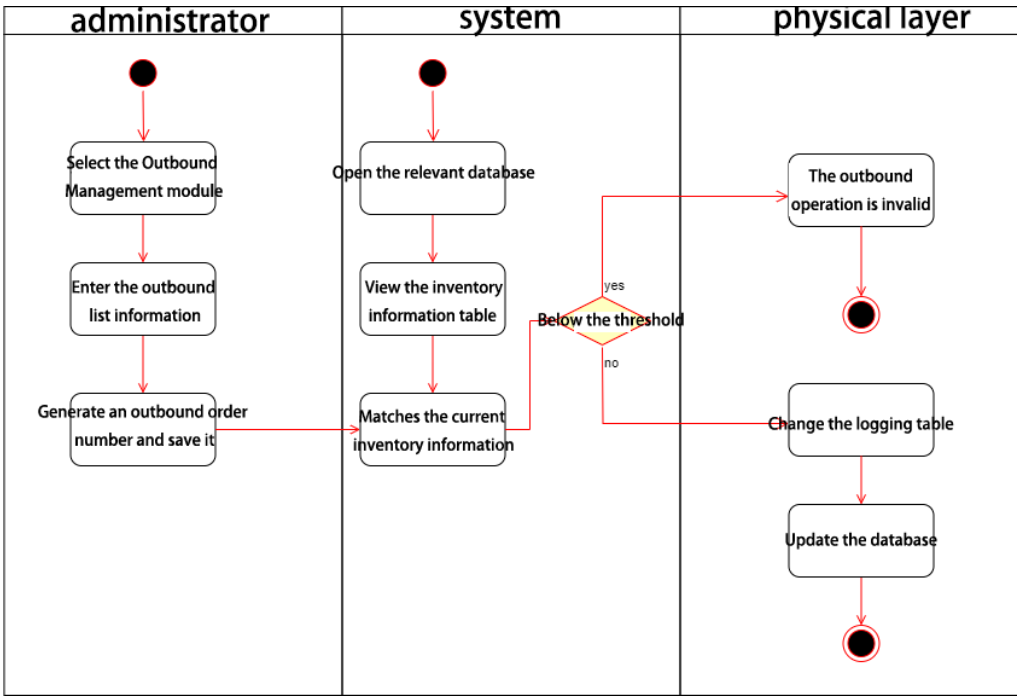

Figure 2 Outbound Business Activity Diagram

In the administrator login system, select the "Outbound" module. The system checks the inventory to ensure that the quantity is sufficient and generates an outbound list with detailed product information. The outbound order matches the inventory, and the inventory data is updated after verification to ensure that the operation is accurate. The system records the outbound order number and the new inventory quantity, which may be stored in the log table for future reference. Finally, the system confirms the validity of the outbound operation, and if it succeeds, it displays "Outbound Valid", and if it fails, it prompts "Outbound Invalid" with an error description. The whole process is automated, which improves the efficiency and accuracy of outbound delivery, while ensuring the real-time and traceability of data.

5. System design

5.1. Overall architecture design

The system architecture design scheme of the system is as follows: the system architecture is generally divided into six parts, namely the front-end UI, the display layer, the business layer, the data layer, the database, and the operating environment, in addition to the addition of logging and permission control components.

(1) Front-end display: Use HTML, CSS, JQuery and images to build a beautiful and easy-to-use user interface.

(2) Front-end interaction: Realize data exchange between the front-end and the server through GET and POST requests.

(3) Business logic: The core layer handles business logic, including content, users, system settings, statistical reports and log management.

(4) Data processing: responsible for data storage, query, and processing, including stored procedures, data caching, transaction management, and database reads and writes.

(5) Data storage: Use MySQL and other systems to store business data, such as commodity, user and order information.

(6) Infrastructure: Provide a running environment, including Alibaba Cloud, independent servers or virtual hosts, to ensure that the system is stable and scalable.

5.2. Software Functional Architecture

(1) Warehouse management function design

The warehouse management module mainly includes warehousing management, outbound management, and warehouse inventory management. The warehouse management sequence diagram [11] is shown in Figure 3.

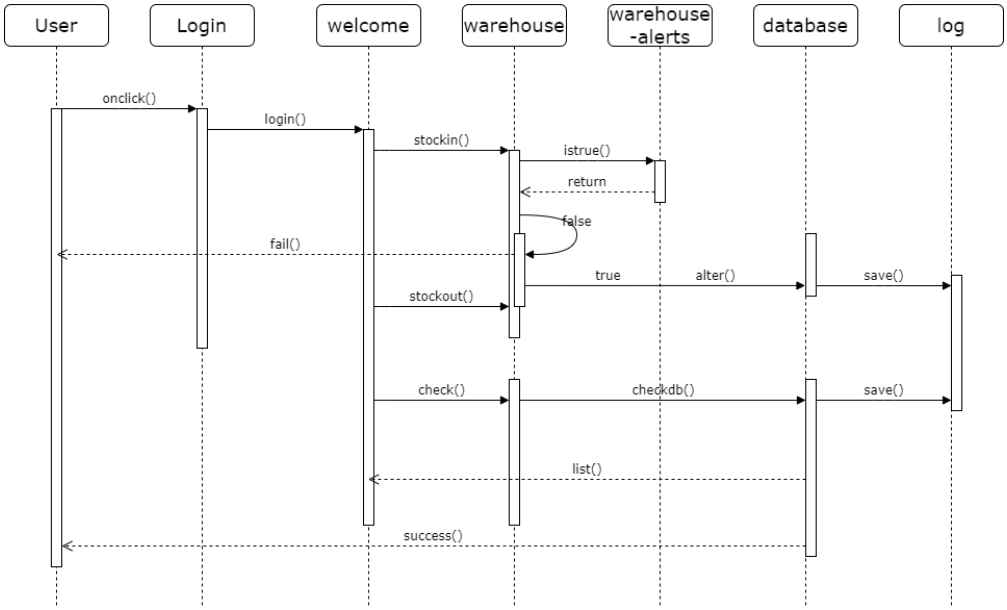

Figure 3 Warehouse Management Timing Diagram

As can be seen from the above figure, User is the warehouse administrator, and after clicking on the Login page and logging in successfully, it will enter the welcome page, warehouse is the basic class of warehouse management, which contains methods related to warehouse management, such as warehousing management method (stockin( )), outbound management method (stockout( )), warehouse inventory method (check( )), etc. Therefore, the actions performed by the administrator on this page will trigger the corresponding method[12].

When the warehousing management method is triggered, it will interact with the warehouse-alerts data table through the interface, judge whether the current inventory has reached the warning state through the istrue( ) method, prompt the user with error information through the fail( ) method when the early warning state is reached, and interact with the database if it is not reached, complete the operation on the data structure, and write the record to the log data table. When the inventory method is triggered, the database is directly called by the checkdb( ) method, and the corresponding list is returned according to the inventory conditions, and the records are written to the log data table.

If the fail( ) method is not triggered, the success( ) method is triggered to prompt the user that the operation is successful.

(2) Functional design of statistical reports

The statistical report module mainly includes warehousing detail records, product sales statistics, and report printing. Figure 4 shows the time series diagram of the statistical report.

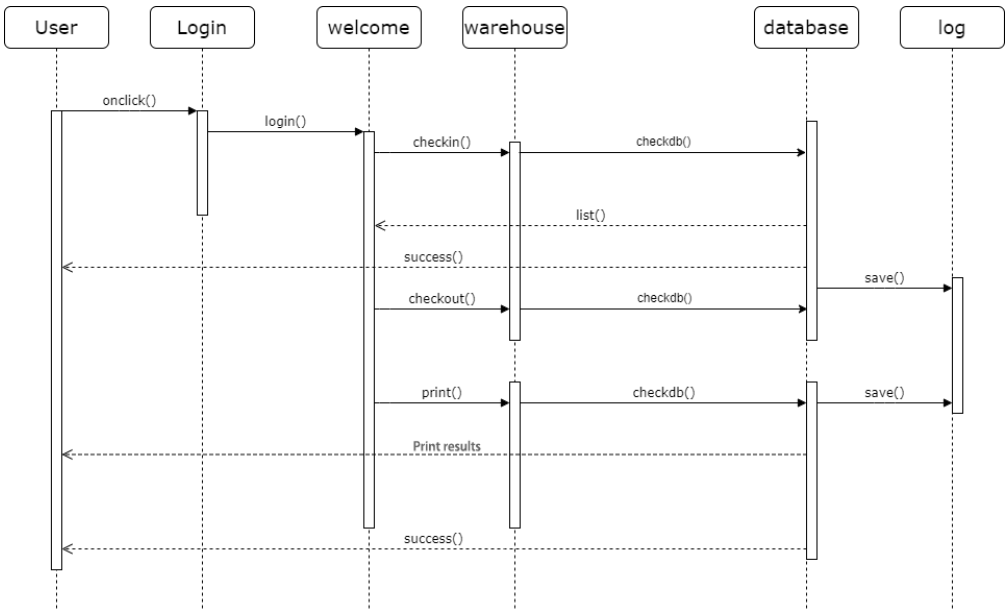

Figure 4 Statistical Report Timing Diagram

First of all, after logging in to the system, the administrator can check the inbound and outbound details through the checkin( ) and checkout( ) methods, and the system will access the database through checkdb( ), call the relevant data and return the list list, prompt the user that the operation is successful (success( )), and write the operation record into the log data table.

The user can also print the required report through the print( ) method, and the system will still access the database through checkdb( ), connect to the printer and print out the relevant results directly to the administrator, prompt the operation to be successful, and write the operation record to the log data table.

6. Conclusions

The inbound and outbound management system adopts advanced automation and real-time technology, which changes the traditional warehouse management method and makes the inventory inbound and outbound operations more efficient and accurate. Through integrated algorithms and process optimization, the system ensures that every inventory change is recorded and processed in a timely manner, thereby significantly reducing human error and delays. In addition, the system has powerful data analysis capabilities, which can generate detailed statistical reports and query results, which not only help with day-to-day inventory control, but also provide management with the key information they need to make decisions. The report printing function makes it easy to convert this data into paper documents to meet the needs of different occasions. Looking forward to the future, we will continue to upgrade and improve the system, add new functions, and improve the stability and response speed of the system, in order to better adapt to market changes and the development of enterprises, and meet the warehouse management needs of more industries and enterprises.

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