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Research Article

Logistics and Warehousing Intelligent Management and Optimization Based on Radio Frequency Identification Technology

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In today's competitive global business environment, companies and organizations are emphasizing return on assets. By analyzing the status quo of Internet of things and warehouse management, this paper puts forward the application of radio frequency identification technology in logistics warehouse management. Based on the intelligent management of logistics and warehousing, the overall structure of intelligent management of logistics and warehousing based on radio frequency identification technology is established, and the functions of each functional module of the system are introduced in detail. Warehouse management system uses B/S architecture mode design; warehouse management system determines the location of goods in the warehouse management program, through radio frequency identification technology reader collection of goods in and out of the warehouse data and data processing results reported to the warehouse management system. Through the optimization of warehouse management process, the intelligent management of logistics and warehousing is realized efficiently. By testing the response time of the system and comparing the test efficiency before and after optimization, the reliability and efficiency of the warehousing intelligent management system are verified, which provides a basis for the study of logistics warehousing intelligent management.

1. Introduction

As Internet network computing application system is widely adopted by some companies, for involved department agencies, chain/concessions, and warehouse dispersed locations, network platform system structure complex large-scale integrated material management information system provides application platform, and the application of material management system for the enterprise provides some available techniques and methods [1]. With the research and development of Internet of things technology, radio frequency identification technology, as one of the important core technologies, has been rapidly promoted and developed. With the successful application of radio frequency identification technology in ID card, ticket system, railway locomotive number identification system, and networked expressway nonstop charging system, the radio frequency identification technology industry has developed rapidly [2]. Material management system has launched MPR, MPRII, ERP, and other software based on material management. SAP, ORACLE, IBM, CA, and SSA are all world-class business software suppliers. Material management information system uses scientific and modern management methods based on the network environment and large database platform for comprehensive management of logistics and the overall control and management of the material flow so that enterprises in the market economy environment develop and grow. The system makes full use of the Internet environment and supports LAN and WAN environment; the material procurement information is open so that more enterprises bid to improve the quality of shopping and reduce the cost of shopping. At the same time, online procurement can be carried out, which can increase the transparency of material procurement, reduce material procurement costs, and reduce circulation links.

With the rapid increase of people's demand for logistics, logistics data shows explosive growth in a short time. With the continuous construction of digital logistics warehouse management, the construction of logistics warehouse management system has gradually attracted public attention. Under the influence of the Internet, the management mode of all walks of life has changed greatly, and the management of logistics and warehousing has also undergone great changes under the influence of Internet technology [3]. Logistics warehousing management is the process of keeping and storing goods in the warehouse by using certain ways and means. With the gradual development of logistics, warehousing has become a particularly important link in the logistics supply chain and has played a huge role. In order to improve the level of storage management, scientific management of storage goods can reduce the storage cost of goods, but also improve the competitiveness of goods. The management requirements of enterprises for logistics and warehousing are not only simple management of goods but also the process of controlling and managing the flow and storage of existing goods [4]. The former logistics warehousing management mode is manual management mode, through the form of bookkeeping to record the goods in logistics warehousing and warehousing information and warehousing information [5]. Such management is cumbersome and has low efficiency and high energy consumption. The expansion of warehouse management scale also brings the diversification of system business and the complexity of functions, which brings a new challenge to the system's computing and decision-making ability.

Radio frequency identification (RFID) technology completes contactless ground information transmission through spatial coupling of radio frequency signals and achieves identification purposes according to the transmitted information [6]. RFID systems are generally composed of electronic transitions and readers. Among them, there is electronic data in the electronic tag, which is regarded as the symbolic information of the object to be identified. The reader and the e-tag can exchange information according to the communication protocol. In general, the reader sends commands to the e-tag, and the e-tag sends identification data back to the reader according to the received commands [7]. This kind of communication can realize the construction of digital logistics storage management system without contact. Ding et al. designed the warehouse management system of commercial outlets, designed the technical framework of the system with B/S technology, and used database and Java in the background to inquire inventory information, inbound and outbound, and user information [8]. After Pluhina et al. grasped their requirements, they designed the relevant sales warehouse management system, which can improve the flexibility and real-time performance of enterprise code, and the paperless information processing method can effectively improve the efficiency of sales operation [9]. Ren et al. realize the development of warehouse management, comprehensive query management, and warehouse management through software system design. Managers can track the inventory of goods in real time through the system, realize the storage of the number of customers, and make use of science and network to enable relevant departments to achieve warehouse management [10]. Li et al. designed and implemented a warehouse management system based on RFID, introduced Web Service technology to realize data interaction between multiple platforms, and combined with C/S and B/S architecture to design the system. The whole system is compatible with a variety of reading and writing devices and applications [11]. Tang designed and implemented a warehouse management system using B/S architecture, which adopted Java WEB three-tier architecture in J2EE system to reduce coupling degree of the system and improve scalability and easy maintenance. SQL Server was used in database to improve concurrent data and computing capability of the system [12]. Cui et al. use AOP technology in the design of its warehouse management system, which makes the code of the system highly modularized and structured, only paying attention to the local content while ignoring the information transmission between modules, reconstructing the business system and simplifying the system structure [13].

2. Key Technology

2.1. Internet of Things Analysis. With basis and support of the Internet of things or traditional Internet technology, through the traditional RFID (radio frequency identification) technology, two-dimensional bar code technology, the information such as camera, infrared sensing, and GPS sensors, extract the different format information content, information awareness and capture have real-time performance, and through the contract agreement to upload information in the Internet content, and the realization of information exchange and capacitive, but also intelligent information tracking, identification, and positioning. The three-tier architecture of the Internet of things mainly includes the network layer, the perception layer, and the application layer. Its main purpose is to realize the mutual communication between objects. Based on the Internet, sensor devices are extended and expanded to create communication bridges between objects and realize the mutual communication and transmission of information [13]. The main features of the Internet of things are as follows: real-time perception and capture of external environmental information can be achieved through two-dimensional code technology, radio frequency identification technology, sensor technology, and camera technology. By analyzing a large amount of perceptual information and data through a variety of intelligent computing technologies, intelligent control and decision-making can be realized. Make the object and the Internet combine with each other, according to a variety of communication network technology anytime and anywhere to achieve reliable information interaction transmission and sharing. The development of the Internet of things is to enter the next field through the development of various sensors, RFID technology, video recognition technology, and positioning technology. Based on the computer Internet, the terminal sensing device realizes online monitoring, control and interconnection, online upgrade, and alarm linkage through the existing ubiquitous network

communication technology, so as to realize the integration of monitoring and management of all objects. At present, it is mainly used in intelligent transportation, smart power grid, smart home, and intelligent logistics.

2.2. Radio Frequency Identification Technology. Radio frequency identification technology is through the magnetic field, electromagnetic field, the use of radio frequency through noncontact two-way communication, to achieve data identification, exchange, and high-speed identification of moving objects, but also can identify multiple targets. Attach importance to RFID technology, which can promote the retail industry automation and rapid development, to achieve transparent logistics supply chain management. The working principle of RFID technology is through inductive coupling or electromagnetic scattering coupling, to achieve contactless information transmission. The coupling modes of RF signals between electronic tags and readers mainly include coupling with spatial high-frequency alternating magnetic field, based on the law of electromagnetic induction. After the electromagnetic wave that has been emitted touches the electronic tag, it is reflected, the encoded information in the electronic tag is brought back, and the spatial propagation law of electromagnetic wave is taken as the basis. It can be seen that in the process of information exchange, readers play the role of processing and control, which belongs to the core part of the system. The RF module is mainly composed of the RF module to transmit and receive the RF carrier, and the read/write module can decode the received signal to obtain the label or encode the written label information and send it to the RF module [14].

2.3. Logistics Warehouse Management. Warehouse management refers to the management of the warehouse and the goods stored because of stagnation in the warehouse, including warehousing management, goods information management, and many other aspects. With the development of society, modern warehousing not only plays a role of material storage but also plays a role of logistics operation center, and the emergence of warehouse management system based on modern information technology and automation technology has improved the efficiency of warehousing operation [15]. Efficient warehouse management can effectively reduce storage costs, improve the speed of operation execution, is the key to efficient management, and maintain competitiveness of enterprises. At present, there are many modes of warehouse management, including self-built warehouse management mode, leased warehouse management mode, and third-party warehouse management mode. The self-built warehouse management mode is that the enterprise builds the warehouse by itself, and the warehouse belongs to the enterprise itself, so the enterprise can manage the warehouse to a greater extent according to its own ideas, which makes the warehouse management more flexible and reasonable and reduces the storage cost to a certain extent. The leasing warehouse management mode is the enterprise leases the business warehouse for storage; this mode can reduce the enterprise capital investment, reduce the difficulty of self-management, and reduce the storage cost. The third-party warehouse management mode refers to that the enterprise loses the warehousing management activities to the outsourcing company, and the mature third-party enterprise provides comprehensive storage and logistics services, which greatly reduces the enterprise's warehousing input and facilitates the enterprise to shift its focus to the competitive part.

2.4. Application of RFID Technology in Warehouse Management. In the field of logistics, warehousing has always played an important role. The current storage market development for order processing speed is more and more high; order volume is also more and more, which puts forward higher requirements for warehouse management. RFID identification without manual intervention, multilabel identification increases the efficiency of operations; it has the advantages of long identification distance and high identification accuracy. RFID technology can achieve more advanced management through warehousing of goods, receiving and checking goods, goods location adjustment, inventory, and sorting and warehousing operations and can improve the quality and efficiency of enterprise storage management. With the RFID electronic tag when the goods arrive in warehouse, warehouse staff can read and write with RFID handheld device to identify the data on the RFID electronic tag information, at the same time acquire information transmission to the background RFID inventory management system, and then inform warehouse staff RFED warehouse management system by the corresponding goods shipped to the correct location. Warehouse staff according to the RFID warehouse management system instructions will ship to the correct location of goods, after the completion of the RFID warehouse management system instructions, RFID fixed reader on the shelf will read RFID electronic tags into the new storage information to send to the RFID warehouse management system and update the goods information. The accuracy of cargo information is guaranteed [16]. When goods need to be shipped out, the RFID fixed reader at the door of the warehouse will automatically read the information on the RFID electronic label and will read the type, batch, quantity, and time of the goods to send information to the RFID storage management system. The RFID warehouse management system will immediately verify whether the information of the goods is correct and arrange warehouse staff to carry out the goods out of the warehouse. The whole process can be achieved with technology. The warehousing process simplifies the traditional goods acceptance procedure, and the storage location management can be arranged more quickly and accurately, improving the overall level and efficiency of warehouse management.

3. Logistics and Warehousing Intelligent Management System Based on Radio Frequency Identification Technology

3.1. Overall System Architecture Design. The intelligent management system of logistics and warehousing is mainly responsible for the management of warehouse goods data.

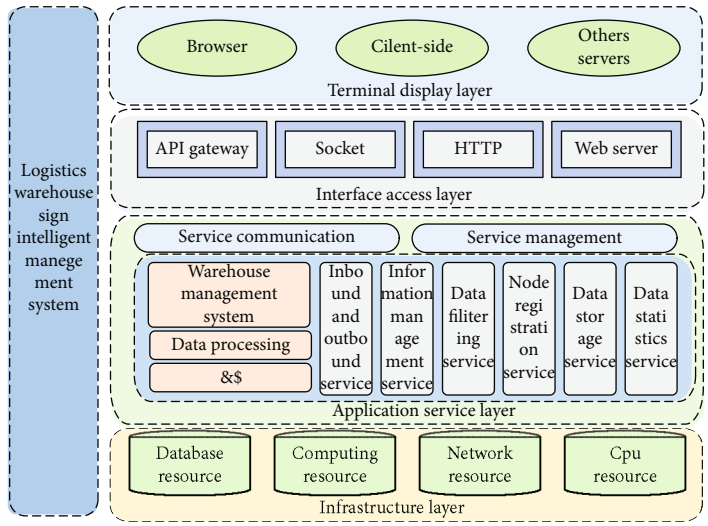

Figure 1: Logistics warehousing intelligent management overall architecture diagram.

The overall architecture of intelligent management of logistics and warehousing based on radio frequency identification technology is shown in Figure 1. Handheld reader, managers can operate manually read the electronic tag information or use a fixed reader read label data information automatically; based on the user preset configuration information, the data undergoes legal verification and filter cleaning operations such as processing, and then, after cleaning the data, it is uploaded to the warehouse management system database. When the user calls the interface to access the warehouse management system and requests the scheduling task, the warehouse management system will send the task to the decision-making platform system. After receiving the task, the decision platform system will return the scheduling result to the warehouse management system and further return to the client after processing, so as to achieve fast and efficient warehouse scheduling.

The whole system architecture mainly includes infrastructure layer, application service layer, interface access layer, and terminal display layer. The infrastructure layer mainly provides hardware resources to ensure the normal operation of the system, including database resources, computing resources, and network resources. The implementation of this layer can be built by itself or adopt mature cloud services. Application service layer uses the Docker technology as well as the container of Cabernets technology implementation services and service management, the container to make use of the layer of shielding low-level details; the design of the individual service is more focused on the business logic of the service itself; at the same time, the layer provides service communication, management, and other functions and convenient deployment and management of the system. The interface access layer contains the entry logic of each service, and each service can be accessed through HTTP, Socket, Web Service, etc. In addition, users can quickly locate and access corresponding services through the API gateway. The terminal display layer provides different display interfaces for different terminal devices for users to operate and manage the system.

3.2. Warehouse Management System Architecture Design. The warehouse management system uses B/S architecture mode to design; users can access the warehouse management system directly through the Web. The architecture is easily accessible to clients through a browser because the server side is installed on a Web server. The architecture of warehouse management system is mainly divided into application service layer, data access layer, and data storage layer. The application service layer mainly realizes the management service needed in the process of warehouse management and provides user access interface for managers to call. The data access layer provides various data access interfaces, and any data addition, deletion, modification, and check operations need to be implemented with this layer. Data storage layer, namely, database, mainly realizes persistent storage of data [17]. The development platform of warehouse management system adopts J2EE platform to decompose the system function modules into discrete services. Different services interact with each other through RPC, thus reducing the coupling of the system and providing more flexible service support. By effectively splitting individual applications, micro service architecture can achieve agile development and deployment and improve system scalability, high availability, and high fault tolerance.

The micro service architecture of the warehouse management system is shown in Figure 2. According to user instructions, the user view layer invokes relevant background services through API gateway, exchanges data with background, and then renders the page and presents it to users. The application service layer mainly provides some key services of the warehouse management system by calling the data processing logic service of the data access layer. The data access layer is mainly used to improve some basic logical services related to the increase, deletion, change, and check of the database. The database is divided into different subfunction databases according to service functions. Each subfunction database focuses on the data management of the current subfunction and reduces the degree of coupling between data. In order to improve database hit ratio, cache

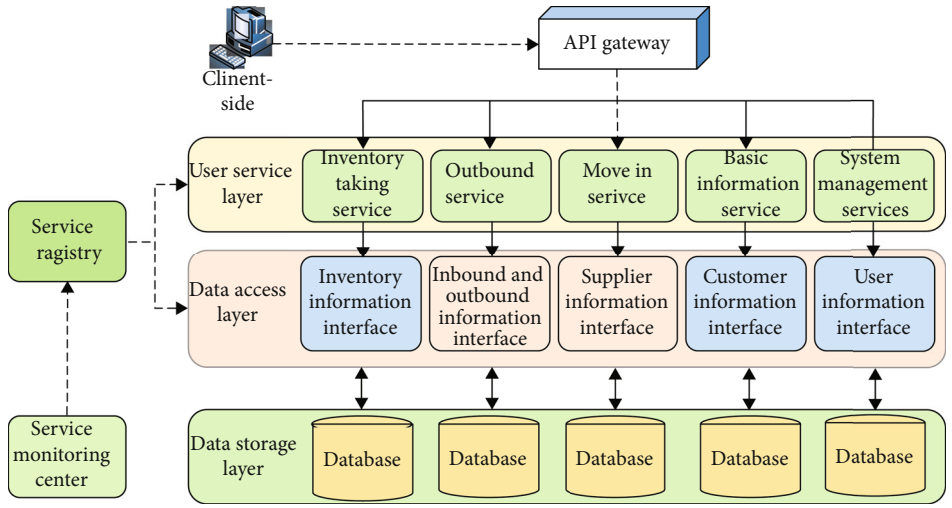

Figure 2: Warehouse management system micro service architecture diagram.

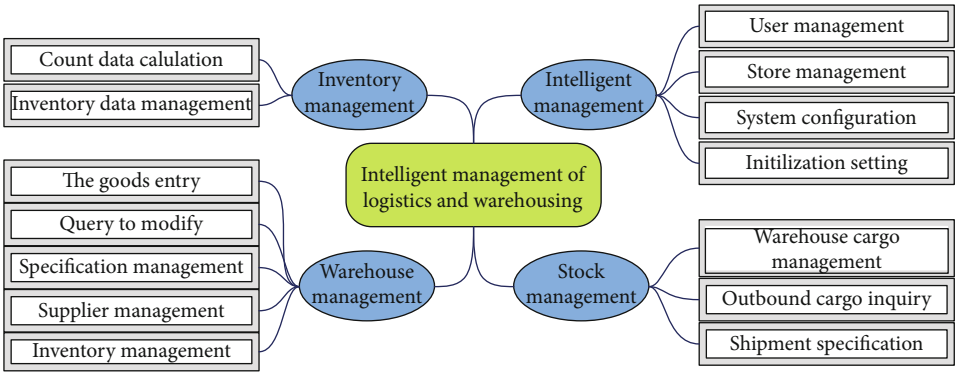

Figure 3: Logistics and warehousing intelligent management function structure diagram of radio frequency identification technology.

database can be added as required to improve data access performance [18]. Through the use of Springboot integration Mybatis, Shrio, and other frameworks the functional services of the system is achieved, combined with Kubernetes own service registration discovery function, service registration discovery, and service monitoring and governance functions. The registry notifies the consumer of the IP and port of the registered service, and the remote call is almost invisible to the user. In addition, the micro service monitoring center can be used to monitor the number and status of service providers and consumers, including configuration information, fusing monitoring, log information, and HTTP tracing.

3.3. System Function Design. The core of the system function is the electronic tag of RFID equipment, which stores the management information of the target object. Warehouse management personnel can use the management system to query and master the basic information of the target object quickly and conveniently. The system database takes the real-time updated data information as the fundamental data and is implemented under the existing traditional logistics mode to improve the scientific nature of enterprise logistics management [19]. The structure diagram of logistics and warehousing intelligent management function of radio frequency identification technology is shown in Figure 3.

The super administrator is the main user of the module, mainly managing user information and user permissions. User management is mainly aimed at the information management of system login users. Role management mainly refers to purchasers, operators, super administrators, etc. Rights management allows users to modify their rights by assigning different rights to different roles or adding new rights. In addition, the super administrator has the highest rights. The warehouse administrator and operator are the main users of this module, which mainly manages the information of warehouse, customer, and supplier and mainly provides adding, deleting, querying, and modifying related basic information. Through this module, it can be very efficient to achieve the warehouse management of the comprehensive query and convenient management of the operation and analysis. At the same time, this module also provides the related operation interface in the background for other upper modules to call.

As the basis of warehouse management, inventory management module plays a very important role. The warehouse administrator acts as the primary user of this module. This module provides related functions including inventory

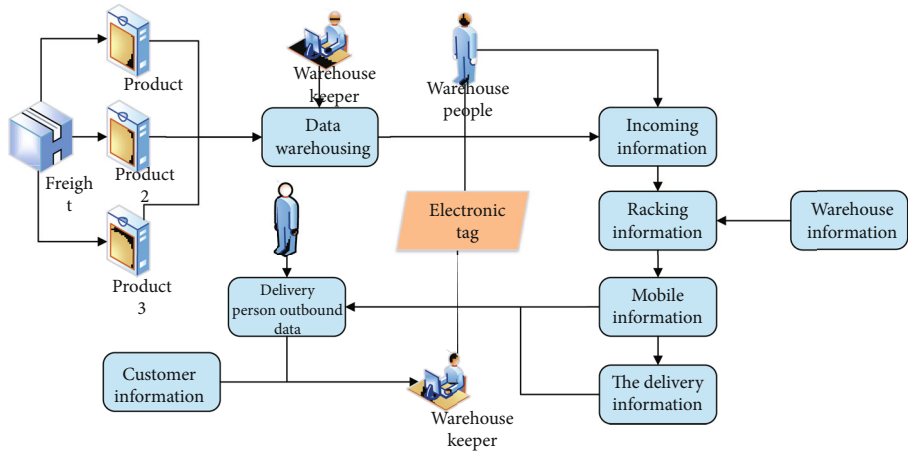

Figure 4: Database diagram for storage processing.

check, inventory query, and inventory warning. Any query and update of inventory information can only be carried out by invoking the service of this module. Among them, inventory taking is responsible for inventory taking and correcting the difference between actual inventory and system inventory, inventory query for each warehouse in each goods quantity display, to achieve real-time statistical function. Inventory early warning is real-time monitoring of inventory capacity; when the inventory capacity is found to be too much or too little, the launch of early warning prompts the warehouse administrator to carry out relevant remedial measures.

Warehouse administrator as the main user of the module, the module is mainly aimed at the warehouse management in the warehousing management part; warehousing operation needs the cooperation of operators to complete. In the storage management module, the storage order management mainly provides the query and updates operation of the storage order record, which needs the support of supplier information and warehouse information. As the main module of the warehousing process, warehousing operation is initiated by the warehouse administrator, and the operator operates the complete warehousing process. Abnormal warehousing belongs to the auditing part of the warehousing process. As a part of the warehouse management, the exit module needs the cooperation of operators. In the outgoing management module, the outgoing order management mainly provides the operation of adding, deleting, modifying, and checking the outgoing order. The outgoing operation is also initiated by the warehouse administrator and the whole process of updating the inventory information and abnormal outbound verification outbound process accuracy.

3.4. Database Design. The storage logistics management system is composed of two parts, which are used to store target information and background management, as well as the front-end RFID reader. The system extracts the collected information according to the unique identifier, so as to achieve the purpose of identifying and classifying the read information in the tag effectively. Then, the characteristic information or target identity is stored in the database, which can facilitate the future users to query some conditions, including logistics information and characteristic information query. A long time of accumulation will lead to the storage of complex data in the database; the data set of characteristic information extracted by RFID presents a linear rise in accumulation characteristics. It can be seen that high-performance large database is the key point in database selection. Database relationships can be illustrated from e-R entity relationship to database model, which is a good illustration of the modelling process. It can be understood as the data entity to the database system in recognizable form. The database diagram for storage processing is shown in Figure 4.

Management system is the process of management operation, mainly through the development of electronic labels and binding related goods information, to ensure that each cargo has the elevator tag and the RFID reader to read the range of goods can be correctly read. The production management host computer inputs the named electronic tag, and when using it, the production management host computer enters the RFID reader to read the information data of the tag ID. At the same time, this feature should include the option to effectively store to the database [20]. The entity information stored in the database includes customer information, beacon information, basic information, and log information. Their main attributes are as follows: basic information of customers is stored; to store the beacon information of items; storage of basic information of goods, basic information is long-term invariable basic information; store the log information of items; a real-time library of the history of items is stored.

4. Realization and Optimization of Logistics Warehousing Intelligent Management System

4.1. Each Function Module Realization. The intelligent storage location management mainly uses the programmer to uniquely mark the container, and then, the program automatically generates the number information corresponding to the storage location [21]. The detailed business process

is as follows. First of all, by the authority of the highest management personnel on the database cargo space empty database information operation and then in accordance with the code of the only mark, the warehouse automatically generated corresponding numbering rules, on the warehouse withered new initialization, and reserve some cargo space to meet the inventory expansion function. The output storage location label is associated with the physical information of the corresponding goods entity one to one, and the actual storage location information is added by the storage location management personnel for each storage location. The location manager checks whether there is wrong location information; if there is wrong, the location manager adjusts the location information. Thus, the effective combination of the location information and the entity can be realized smoothly. RFID reader has been applied in each warehouse; when the warehouse is empty, it prompts the staff that the warehouse is free, and the basic information can be displayed when the warehouse is available.

The inventory business of goods is analyzed by the upper computer on the inventory site for inventory plan, and then, the upper computer sends inventory information instructions to the mobile inventory; the mobile inventory receives instructions and carries out instruction analysis and selects the RFID identification equipment. Finally, the inventory taker drives the vehicle carrying RFID equipment through the container and uploads the information to the corresponding upper computer by reading the item tag code and RFID tag. After data analysis and classification, the upper computer uploads the data to the database for comparison. If the confidence stored in the database is found to be different from the information read by the RFID device, the system will send an alarm to the computer. This business requires real-time inventory of real goods and real-time dynamics. Inventory management personnel of the warehouse receive the inventory plan and can master the specific information status of logistics goods such as quantity of goods in real time. According to the subsequent feedback, they can proofread, adjust, and upload the status of goods in question.

Generate the notice containing the information of goods location in the system, and prepare the goods for warehousing. The warehouse entry notice should contain information such as batch number of goods, stock location, warehousing sponsor, warehousing time, consignee, and description of goods. Before purchase, the warehouse management personnel will check and accept the goods, mainly check and accept the quantity and quality of the goods, and compare the information of the goods with the information of the goods on the purchase notice to see if it is consistent. If the feedback acceptance is qualified, the warehouse will be handled immediately. If the feedback is not qualified, the information status of the goods should be timely submitted to the application for further approval, and if necessary, a video recording should be kept. At the same time, the system will automatically generate acceptance of unqualified goods report, in order to facilitate the future information query.

In the outbound business, the most important thing is to register the goods and take out the goods at the same time, transfer the outbound information at the same time, proofread and verify with the inbound information, and finally save the data. In the outbound management module, it is divided into initiator, batch number, outbound time, quantity, etc., according to functions. When issuing the outbound request, if the quantity of the corresponding goods is insufficient, it will automatically prompt whether to add. When the quantity of goods out of the warehouse is enough, just submit the corresponding information of the required goods out of the warehouse, wait for approval, and wait for the warehouse.

4.2. Management Process Optimization. After the application of RFID technology, the process of operation should minimize the operation of warehouse staff on the goods to ensure that the goods are not subject to accidental physical damage. In order to optimize the warehousing business process, it is necessary to add the application of RFID technology on the basis of the traditional warehousing operation process of warehouse management. The warehouse supervisor shall paste RFID electronic tags on pallets and shelves; RFID fixed reader shall be installed at the entrance of receiving area. Warehouse personnel need to be equipped with handheld RFID readers. At the same time, it is necessary to provide suppliers with pallets and loading workers and truck drivers with RFID electronic tags so that RFID technology can be effectively applied to the upstream of the supply chain. The starting point of warehousing operation is different, and RFID technology is effectively applied to suppliers. In the traditional warehousing operation, the starting point of warehousing operation refers to the successful inspection of goods by the warehouse inspector after the vehicle arrives at the warehouse. After the application of RFID technology, the warehousing operation starts from the supplier loading the goods, and the loading workers will classify the goods according to the goods information of the RFID reader in their hands. At the same time, the loading workers need to verify the actual situation of the goods and check the quality of the goods. After verifying the information of the goods, the goods will be directly placed on the pallet with RFID electronic tag provided and loaded. Through the RFID system and the original warehouse management system, GPS and GIS combined to achieve the binding of vehicle and cargo. After binding, the warehouse supervisor can track and monitor the vehicles in transit in real time. According to the vehicle condition information, accurately grasp the arrival time of cargo vehicles, and then, make preparations for the warehouse pickup and unloading.

4.3. Optimization in Library Management. In the warehouse management operation, RFID technology can be mainly applied to three aspects: inventory, goods location management, and the company's RFID warehouse management system to control the information of goods. The traditional stock-taking method requires a lot of manpower to count the goods one by one, so the disassembly and reorganization of the goods is inevitable, which not only takes time and manpower but also causes damage to the goods. After the application of RFID technology, the inventory count no

longer requires a large number of manpower, and the warehouse inventory clerk only needs to read the electronic label information on the pallet with the handheld RFID reader and check the quantity of goods, which can greatly improve the inventory efficiency.

4.4. Optimization of Outbound Operation Process. The outbound process is complex, requiring the warehouse supervisor to accept orders and a large number of manpower to sort goods. At the same time, there will be many outbound orders and complex types of goods in the order, but a small number of outbound orders, which increases the difficulty of goods sorting. In addition, due to the fact that inventory information will not be accurate situation, the staff in the goods sorting needs to constantly modify the shipment quantity on the order, further increasing the difficulty of warehouse. In the use of RFID technology, RFID storage management system ensures the accuracy of inventory information so that customer orders can be timely after the arrival of the order processing work, no longer done by the staff using bar code reader to read the bar code on the goods and repeatedly modify the shipping order. At the same time, when the goods are out of the warehouse, the RFID storage management system can accurately refer to the dispatch of cargo vehicles, perfect realization of vehicle and cargo binding, so that the goods and vehicle information sharing degree is high, improving the efficiency of goods out of the warehouse.

5. System Testing

5.1. System Development and Operation Environment. The development platform of the system is Microsoft Visual Studio 2010, the database is SQL Server 2005, the development language is C#, and the operating system is Windows 7. In order to ensure the efficient and stable operation of the material warehouse management system, the system should run in a stable operating system environment, and the material warehouse management system is recommended to run in Windows 7 system.

5.2. RFID Read and Write Test. RFID reading and writing test is a necessary test to ensure the realization of the system in addition to functional test. The test results directly determine the data transmission between the system and the equipment. This test requires RFID reader to ensure data writing, display, and persistent input. Communication quality is tested through different distances, and the test results are shown in Figure 5.

According to the analysis of test results, when using a single tag, the system can effectively scan and recognize the electronic tag within 3-3.6 meters, and the coordinate point recognition rate is 91.8%. When multiple tags are used, the system can effectively scan and recognize electronic tags within 3-3.6 meters, and the coordinate point recognition rate is 82%. By testing the system at different temperatures, it is found that the information uploading system and information management system can operate normally when the temperature ranges from 60°C to minus 15°C, meeting the actual use environment and functional requirements of logistics management.

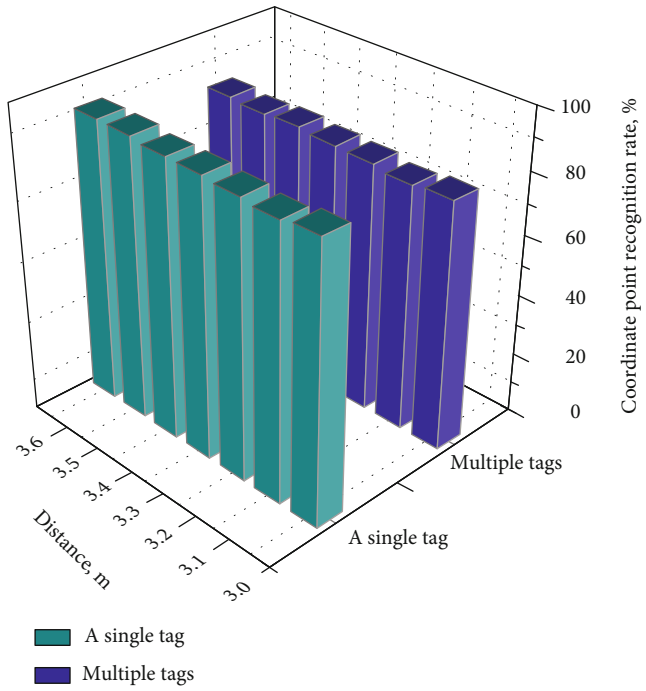

Figure 5: Test results of coordinate point recognition rate.

5.3. Query Response Time Tests. The essence of the warehouse management system is the increase, deletion, change, and check of the database, so in the performance test of the system, the user through the browser of the warehouse management system current all goods query operation can be said to be the most time-consuming operation of the system. In order to test query response time, goods information was added in batches to the database, and the test results of paging query are shown in Figure 6 by setting the number of paging records at different levels.

Through the response time test above, we can see that when the number of page records is set to 10, the response time of page query is about 50 ms, which can fully meet the performance requirements of users in related operations.

5.4. Comparative Analysis of Management Process Optimization Efficiency. In warehouse management system with the application of RFID technology, the overall operation efficiency of the warehouse will be greatly improved. Through the above optimization scheme design, the overall operation efficiency of the warehouse is predicted and compared, mainly from the data acquisition, storage process operation efficiency, warehousing business process operation time, and other three aspects, in order to prove the optimization effect of RFID technology. The picking speed of orders and goods will directly affect the efficiency of warehousing operations. A certain number of orders and goods are simulated here. According to the actual situation and operation process of warehousing, the operation consumption time of manual operation, barcode scanning, and RHD technology is simulated and compared. After

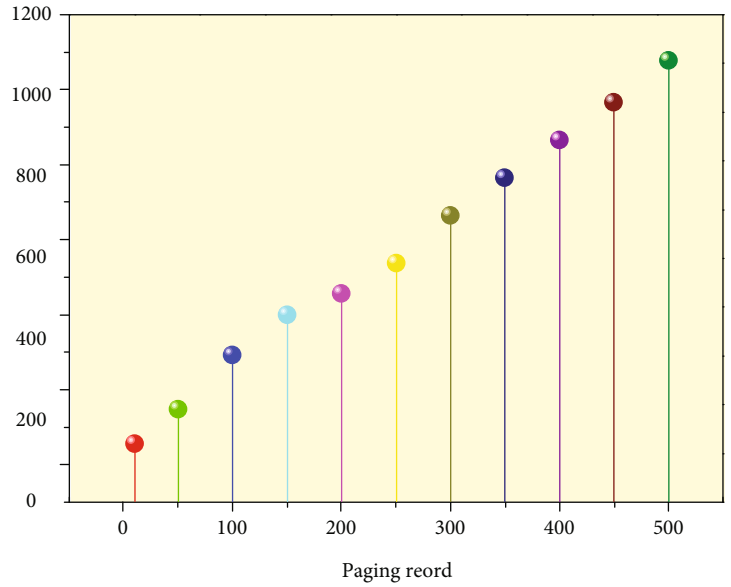

Figure 6: Query the response time test results.

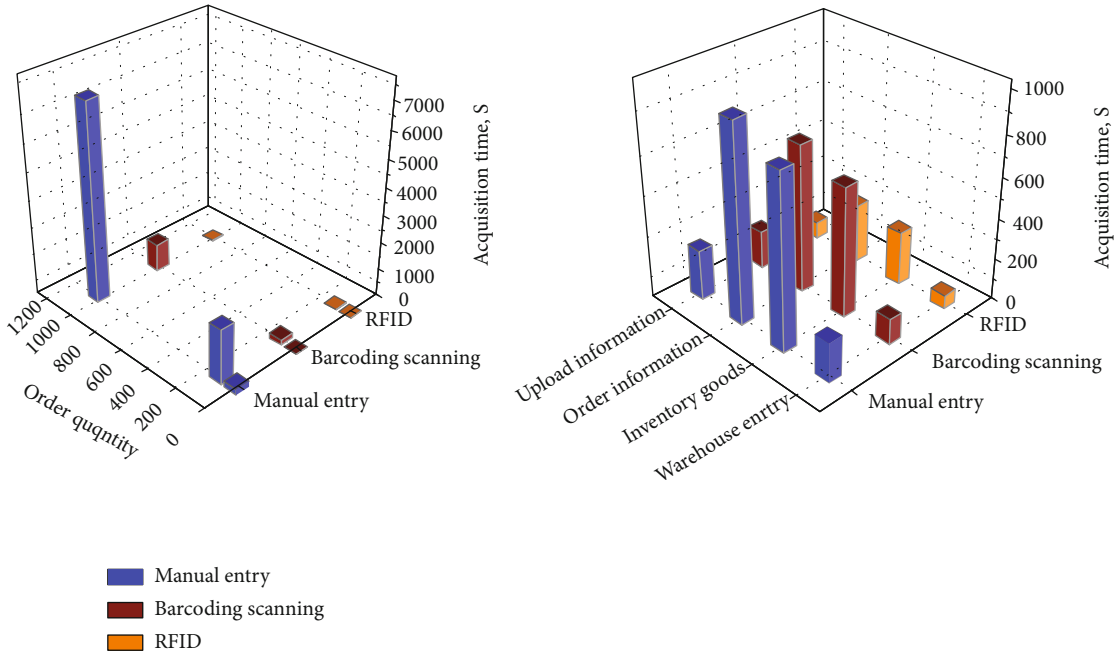

Figure 7: Comparison test diagram of information acquisition and process efficiency.

simulating the data acquisition time of RFID technology, the storage data acquisition is predicted and compared. The test results are shown in Figure 7.

As can be seen from the figure, in data acquisition, RFID technology takes less time than the original manual input and barcode technology and has significantly improved the optimization effect on data acquisition. In terms of the efficiency of warehousing process, the more orders and goods are carried out, the more obvious the advantages of RFID technology, compared with the traditional bar code technology which can save about one-tenth of the time, save a lot of manpower, and reduce labor costs.

The in-and-out operation process is the two most important parts of warehousing business. The actual in-and-out time of traditional warehousing business is compared with the speculated in-and-out time after the application of RFID technology. The test comparison of in-and-out operation process is shown in Figure 8.

As can be seen from the figure, the warehousing in-and-out operation time is shorter than the original warehousing in-and-out operation time, which can save about two-thirds of the time and improve the overall storage operation efficiency. The above comparison analysis based on RFID warehouse management optimization efficiency is only the

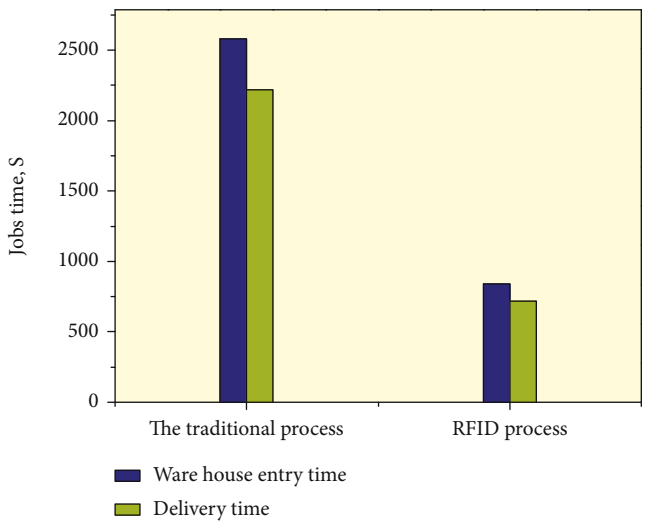

Figure 8: Comparison diagram of warehouse operation process test.

prediction analysis of the overall optimization scheme design, and the overall optimization effect will definitely be significantly improved.

6. Conclusion

For the traditional warehouse management system, manual input is more complicated, and the large amount of data is prone to error and long inventory cycle problems; this paper puts forward the barcode and radio frequency identification technology combined with the warehouse management system, which can effectively ensure the interests of logistics warehousing and service quality. In the warehouse management system operation process based on the warehouse management activity rules, the business process of the system designed in this paper is described, and the schematic diagram of the system's functional structure is given. The module of goods inventory, intelligent management module of goods location, warehousing module, and warehousing module are simply analyzed and discussed, through the system structure and level design and the analysis of the system data business process, the warehouse logistics management system. The system function modules are divided to achieve the display of system modules and test the system. The page query response time is about 50 ms, which fully meets the performance requirements of users in related operations. The optimization effect of data acquisition has been significantly improved. In terms of the operational efficiency of warehousing process, the more orders and goods, the more obvious the advantage of RFID technology, which can save a lot of manpower, reduce labor costs, and improve the overall operational efficiency of warehousing. The system only realized the main function; comprehensiveness is not enough, which needs further research and supplement. In addition, the realization of some functions of the existing system may be relatively rough, and system optimization is the main direction of the subsequent improvement of the system.

Data Availability

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

Conflicts of Interest

The author declares that there are no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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