RFID-based big data logistics--Take logistics warehouse management as an example

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Abstract

The development of science and technology has promoted the emergence of various new technologies, among which radio frequency identification (RFID) technology has been widely used in various fields. As the foundation of the big data industry, RFID is one of the indicators of the level of the big data industry index. The implementation of RFID technology in the logistics industry has been continuously carried out. The logistics management informationization has always been the focus of the industry. This paper mainly introduces RFID and big data logistics, and takes logistics warehouse management as an example to illustrate RFID vs. big data. The impact of logistics warehousing. With the rapid development of information technology such as mobile Internet, cloud computing, and Internet of Things, the value of big data has been discovered, explored and utilized, and it has become the theoretical basis for people to make scientific decisions. In today's big data era, big data has been applied in various fields and has become a new growth point for China's economic development. RFID technology is one of the representatives of modern communication technology, and only needs long-distance wireless radio frequency for data recognition to achieve specific operations. RFID technology generates a lot of valuable information in the logistics process. By analyzing this information, the management efficiency and quality of the entire logistics system can be improved.

Keywords

RFID, big data logistics, big data, logistics and warehousing management

1. RFID Technology

Radio Frequency Identification (RFID), abbreviated as RFID, is a modern communication technology that does not require direct contact to identify data only through long-range radio frequencies. Originally introduced in the 1980s, RFID was originally used in special industrial applications where bar code tracking technology could not be used, and was used by companies to locate, validate, and track inventory products or other targets. In the specific application process, the composition of the RFID system will be different according to the purpose and environment, but from the working principle, the system generally consists of three parts: signal transmitter, signal receiver and transmitting and receiving antenna. 1 Signal transmitter: In RFID systems, signal transmitters exist in different forms for different application purposes, typically in the form of labels. The tag is equivalent to the bar code symbol in the bar code technology and is used to store information that needs to be identified for transmission. In addition, unlike bar codes, tags must be able to actively transmit stored information automatically or under external force. Tags are typically low electrical integrated circuits with coils, antennas, memory and control systems. 2 signal receiver: In RFID systems, the signal receiver is generally called a reader. The basic function of the reader is to provide a way to transfer data with the tag. In addition, the reader provides fairly complex signal state control, parity error

checking and correction functions. 3 Transmitting and receiving antenna: The antenna is a transmitting and receiving device for transmitting data between the tag and the reader. RFID technology is very practical in the warehouse management that tracks many cargo resources and has limited staff. It can accurately locate resources and save manpower and material resources.

RFID is a form of label. It encodes special information into the electronic tag, which is pasted on the object to be identified [1]. It uses wireless radio frequency for non-contact two-way communication. In order to achieve the purpose of identification and data exchange. Maximize efficiency to meet output and accuracy requirements.

2. Big Data and Logistics

Big data, or huge amount of data, means that the amount of data involved is so large that it cannot be acquired, managed, processed, and organized in a reasonable time through the current mainstream software tools to help the company's business decisions. Information. Big data has the characteristics of Volume, Velocity, Variety, and Value. It has the characteristics of large scale and rapid growth. The growth rate of unstructured data is 10 to 50 times faster than that of structured data, and it will soon occupy 90% of all data. As a result, big data is not only large (10 to 100 times larger than traditional data warehouses), but also exponentially growing (about 60% a year), even faster than Moore's Law [2].

The ever-increasing amount of data requires new processing technologies, and big data technology has emerged in the industry. Big data technology refers to the processing technology that helps enterprises to process massive amounts of data that cannot be processed by conventional software in a reasonable period of time. Generally, it has four large data scales (TB, PB level), various types, fast processing speed, and low data value density. Common commonality [3]. In recent years, with the gradual maturity of big data technology, it has been applied to many fields. Since logistics enterprises need to timely transmit and share resource information, they need to transmit and process large amounts of data. Therefore, big data technology provides a potential solution for solving the problem of data transmission and sharing of logistics enterprises. At the same time, big data technology can also help companies to make more reasonable schedules, program planning, etc., information resources can be processed and shared in a timely manner, which is conducive to corporate decision-makers to grasp the company's dynamics in the first time to make the right decision. In addition, big data technology can further explore the data of logistics enterprises, find out the potential value of data, use data to create value and enhance the profits of enterprises, so that the data is more readable and practical [4].

The most fundamental problem in big data research is how to efficiently store, analyze, and process massive amounts of data so that it can serve people. The key to realizing the value of data is to deliver the right information to the right people at the right time and to be used correctly. The future will belong to companies that are able to control the data they own. They integrate data about the company's own business and customers, analyze and process it, discover hidden information, and use it to predict future trends. Support for decision making. The application of big data in logistics enterprises is the combination of big data industry and logistics industry. Logistics enterprises use big data technology to extract the information value hidden behind the data, and give full play to the development advantages brought by big data to logistics enterprises in strategic planning and business. Mode and human capital to make all-round deployment, provide strong support for strategic decision-making, operational planning, resource planning, human efficiency improvement, and cost control in the process of enterprise logistics operations, thus helping enterprises optimize management and improve industry competition. force.

3. RFID and Big Data Logistics

RFlD is the foundation of the big data industry and one of the indicators of the level of the big data industry index. The logistics industry is considered to be a labor-intensive, low-tech value-added

industry, which is not conducive to the long-term development of the logistics industry. The combination of the big data industry and the logistics industry has increased the added value of the technology in the logistics industry, but it also means that all supporting hardware and software in the logistics industry need to be upgraded simultaneously. RFID is a system technology based on electronic tags and supporting other peripheral infrastructure such as external antennas, readers and printers. RFID is also known as electronic tag system technology. Using the label form of RFlD, the special information code is written into the electronic label, pasted on the object to be identified, and the non-contact two-way communication is performed by the wireless radio frequency method, and the data exchanged at the same time is recognized to meet the requirements of effective output and accuracy. . The big data logistics system is mainly composed of the following parts, including data server (including software and hardware system), RFID barcode scanner (for scanning and entering cargo information), and RFlD label printer (for printing RFID label information based on cargo information). , RFID handheld terminal (for scanning and detecting goods with RFID tags and producing related reports sent to designated computers for operator access), peripheral readers and antennas (for receiving signals from electronic tags and sending signals to the server) Processing on the basis) [5]. Among them, in order to ensure the security of the system, the data server of the big data logistics system only communicates with the client for the designated port, and other ports are closed. In addition, the client uses a software registration and system hardware binding mode to enhance the security and reliability of the big data logistics system.

4. Application of RFID in Big Data Logistics Warehousing Management

RFID technology has been continuously implemented in the logistics industry, and logistics management information has always been the focus of the logistics industry. Under the definition of big data logistics, warehousing logistics, as an important part of logistics operation, will generate a large amount of data such as warehousing, warehousing and selection in the daily operation process. These data are huge and cumbersome. How to connect these information, collect and integrate the data of each node, and process and transform it into valuable information through big data technology is the most concerned issue in the whole warehousing and logistics industry. Moreover, network layout is the key link of big data logistics, and the data development and application under its layout has practical significance. RFID has the ability to collect data in batches, real-time data feedback capability and high-efficiency return of application. It not only saves manpower and material resources, but also avoids errors such as wrong scanning, missing scanning, and re-flashing when using two-dimensional code system. The accuracy of the layout requirements, and make full use of all the data information collected in the layout [6]. After the network layout is unfolded, the application of the RFID warehouse management system takes advantage of the advantages of analysis, optimization and control of the big data logistics itself, which can realize all the services such as automatic identification, positioning, transportation, access and delivery of goods from the storage. Intelligent visual management of processes.

4.1 Application of RFID in Big Data Logistics Warehouse Management Process

The introduction of RFID technology in big data logistics warehousing management has improved the efficiency of warehousing management and automated the warehousing management. The specific application of RFID technology in big data logistics warehouse management mainly includes three processes, namely, the inbound process, the in-process process and the outbound process. The following will be specifically analyzed.

(1) warehousing process management application

In the traditional logistics warehousing management, only the information of the materials is recorded in the goods storage, and the space of the warehouse is not used reasonably. The manual recording and the barcode method are easy to cause the information to be missing and inaccurate. At the same time, there is no reasonable transportation method and route for planning materials; after the materials are

put on shelves, the exact quantity of materials cannot be obtained, which makes it difficult to check. In view of the above problems, the introduction of RFID technology can improve the optimization of the warehousing process, improve management efficiency and reduce fixed costs. The specific warehousing flow chart is shown in Figure 1.

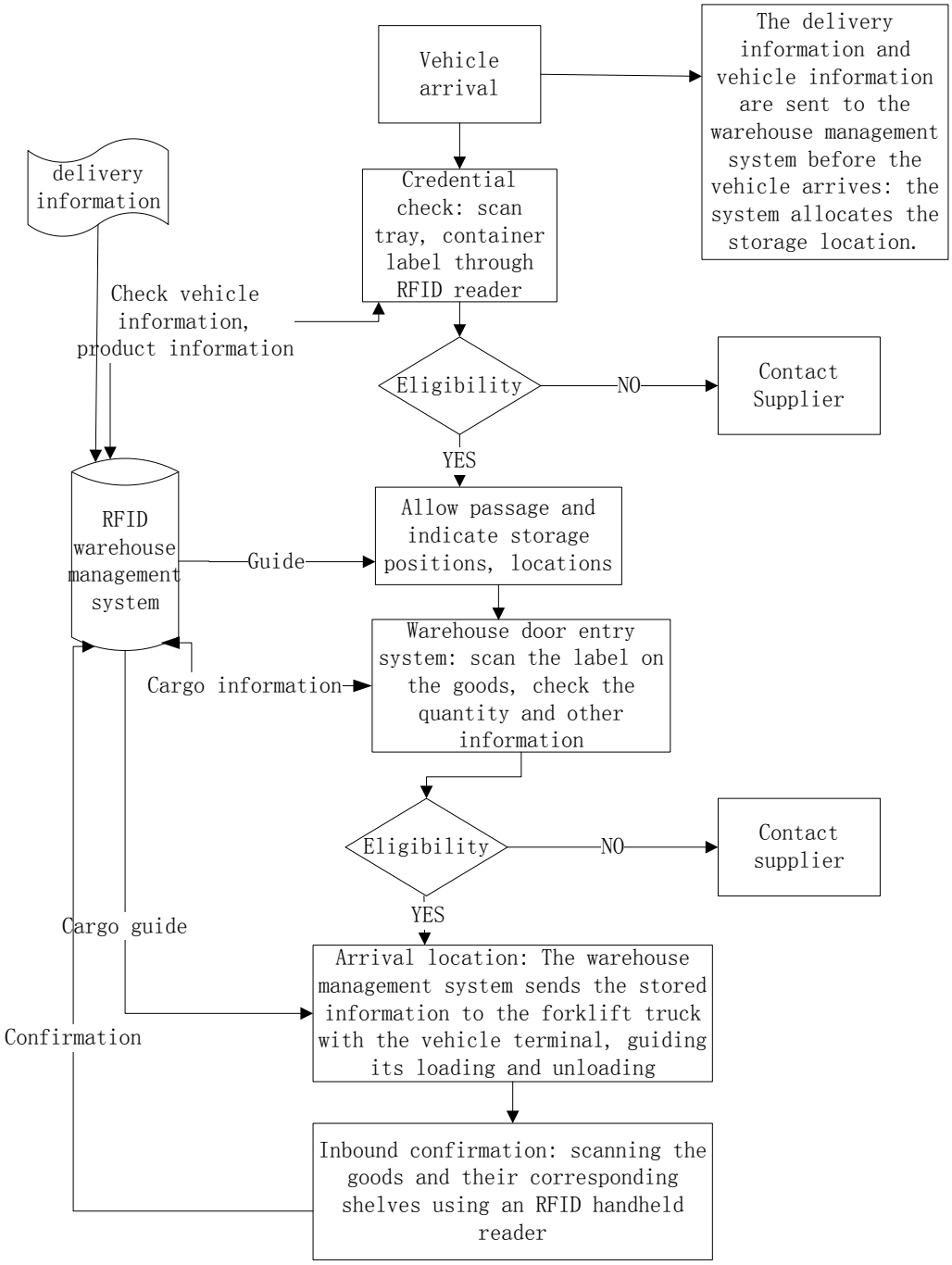

Fig.1 RFID system warehousing flow chart

1. Assembly phase

When assembling materials in the country of origin, enter the detailed information of each material into the computer, including material specifications, origin, type, production batch, etc., then record and input the barcode label in the computer related software, and follow all the barcode labels. Certain regulations are classified and packaged. The various types of detailed information are input into the RFID tag and embedded in the packaging of various products, and the transportation path and schedule of each product are generated by the computer-related software, and the materials are transported according to the transportation route and the dispatch table.

2. Transportation phase

Before the start of transportation, the information of various materials is transmitted to the server of the enterprise's RFID system and transmitted to the cloud server synchronously. In the transportation process, develop a scientific and rational transportation plan and optimize the transportation route to complete the transportation process efficiently. At the same time, GPS and GIS technology are used to match materials to transport vehicles, and to locate transportation positions. And the development of a comprehensive emergency plan can effectively reduce the risks and losses of materials in the transportation process.

3. Storage stage

After the enterprise obtains the material information through the RFID system in the assembly stage, the storage department management system synchronizes the information to the cloud, then plans and allocates the storage space in the current storage area, and synchronizes the information of each RFID location to the cloud. When the transportation vehicle arrives, the storage management personnel use the RFID tag and the reader to verify and confirm whether the material product is consistent with the cloud information before the goods are put into storage, and after issuing the confirmation, the instruction is issued, and the materials of each RFID tag are arranged into the warehouse according to the plan.

4. Inspection stage

Inspection is the final stage of material storage. The verification is mainly done by using fixed and handheld mobile RFID tag readers, then reading the RFID tag information and checking with the existing information in the RFID software processing system. Ensure the accuracy and completeness of each information. Also upload the cloud server for secondary comparison, further confirm the accuracy of the inbound materials information, and finally print the inventory list to complete the inspection phase. The RFID system will electronically operate the entire process in the above stages to ensure the quality, quantity and records of the materials in the warehousing stage are accurate, and provide accurate data support for the materials in the warehouse and outbound management.

(2) In the library process management application

Through the management of the warehouse in the system, the enterprise improves the management level of the enterprise materials in the warehouse, reduces the risk of loss in the warehouse, and improves the accuracy of the inventory access, thereby improving the overall efficiency of the enterprise. For enterprises with a variety of materials and large quantities of goods, the use of systems for enterprise material management can fundamentally solve the problems of high error rate and backward management methods of traditional enterprises, and at the same time prepare for material delivery in advance [7].

In the process of library management, enterprises use the RFID system to control the materials in the warehouse in real time. When the materials are in stock, there is no need to check out the boxes, which avoids the cumbersome traditional inventory methods. In enterprises with large cargo volume, the use of systems for material management can fundamentally solve the problems of high error rate, backward management mode and low efficiency, and guarantee the safety of goods out of the warehouse. At the same time, RFID technology can optimize the warehouse location, inventory inventory, improve efficiency and save business costs.

In the traditional logistics warehousing system, the channels of information communication and feedback are not smooth, which makes it impossible to grasp the internal situation of the warehouse in real time, which is likely to delay the return and replenishment information, affect the accuracy of the inventory information, and even affect the normal operation of the enterprise. After the introduction of the RFID system, after the customer sends out the demand information, the information arrives at the warehousing department through the internal server and related software, thereby performing related business processes. Through the system, it can play a role in speeding up the response, reducing the cost of the enterprise, and expanding the profit of the enterprise. At the same time, after the operators

in the warehouse summarize the materials, the software obtains the inventory boundary position according to the existing inventory status, so as to issue a replenishment reminder to the relevant management personnel, and the relevant departments can replenish the goods after receiving the reminder, which can be timely and effective. Have to solve the problem of inventory optimization.

(3) Outbound process management application

In the warehousing management, the company always pursues the efficiency and speed of the outbound warehouse. After the introduction of RFID technology, the efficiency of the outbound process is improved rapidly, mainly reflected in the following aspects: after the customer issues the order information, the material allocation processing system sends the order information to The enterprise RFID system, the relevant system then sends the specific information to the warehouse operation layer, the operation layer locates the matching product according to the order information, determines the specific location of the materials to be delivered, and arranges the pickup. In the process of material outbound, the RFID reader is used to obtain the relevant material data information and upload it to compare with the customer's demand information, and then confirm the error and then go out of the warehouse. After leaving the warehouse, use GPS and GIS technology to monitor the transportation process in real time to ensure transportation safety. The specific operation flow chart design is shown in Figure 2.

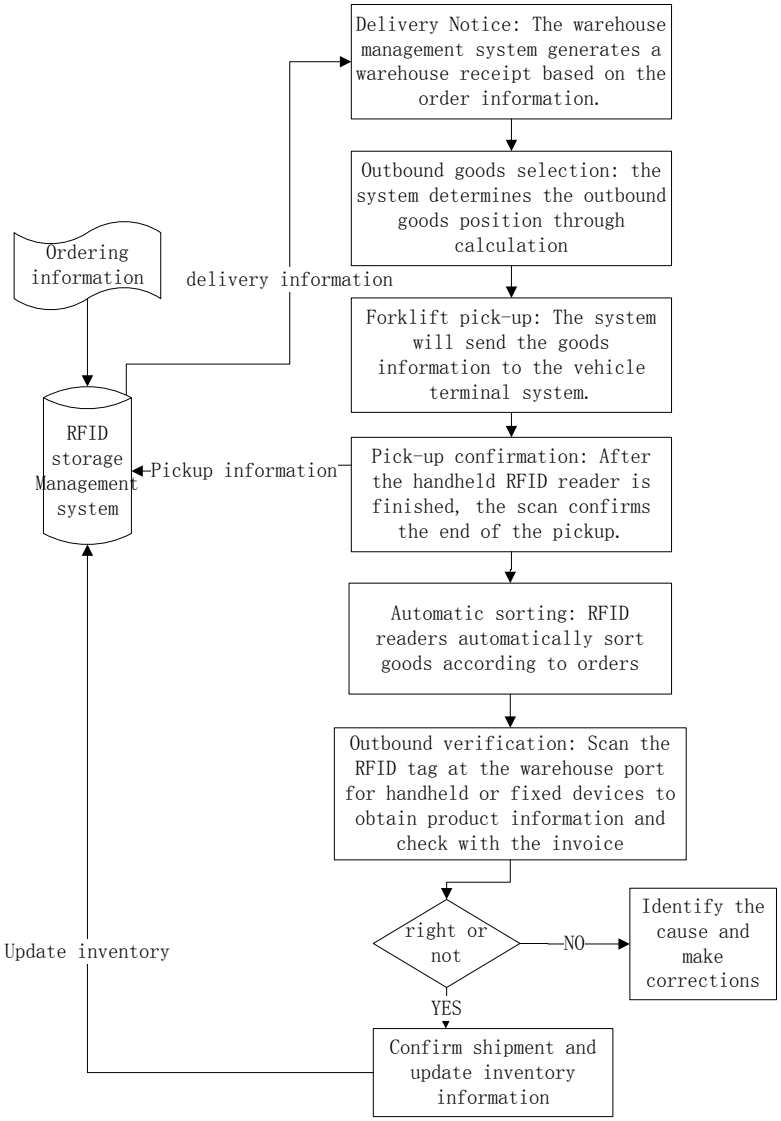

Fig.2 RFID optimization of big data warehousing logistics

4.2 RFID Optimization of Big Data Warehousing Logistics

(1) Improve the efficiency of labor use

The labor force is the largest cost in storage and is responsible for the extraction and packaging of goods. The most time-consuming part of the workforce is commuting. Warehouses are usually large, and it is one of the most wasteful activities for workers to walk and cycle between goods. Moreover, in the process of picking up the goods, the system usually orders the pick-up personnel, and the pick-up personnel complete the pick-up tasks in the order of the goods on the collection list. The processing of the order batch mainly depends on the experience of the pick-up personnel. They set the screening conditions of the order, which may cause problems such as the dispersal of the picking location and the unreasonable picking path. Eventually, the warehouse operation efficiency is low. Using RFID technology, as well as big data and machine learning, companies can send order information to the warehouse RFID management system, use the back-end system software to perform related calculations, sort the materials through forklifts and other machinery, and then use the software to make the goods out of the warehouse. The transportation mode, the transportation route planning work, and the geographical classification of the orders with similar attributes, the orders of the local areas are grouped together, and the workers pick up the goods according to the optimal path, just like in the convenience store. Walking through a shelf, you can return home with full load, thus saving time for picking up goods, which greatly improves labor efficiency and improves inventory management.

(2) Optimize warehouse inventory

Traditional logistics companies usually analyze and determine the inventory according to market research, visiting customers and combining their own experience judgments. Such predictions are not only time-consuming, low-accuracy, and easy to lag, but also increase the storage costs of logistics enterprises. The use of RFID tags in warehouses enables real-time control of specific information on existing materials in the enterprise warehouse, while inventorying goods. And combined with big data forecasting technology, it can accurately grasp the life cycle of products and markets, deeply explore consumer preferences, predict consumer demand, help logistics companies optimize warehouse inventory, and make reasonable orders. At present, Jingdong has combined a sales forecast and sales plan to establish a unique intelligent single quantity forecasting system. The system is a big data platform based on real-time computing. Through the study of historical sales data, it can automatically select the sales plan, predict the future sales volume of a certain commodity, and output the sales forecast. The forecast accuracy of the single product has reached 85% [8]. Big data technology can also be applied to the calculation of the length of future cargo replenishment and the analysis of other uncertain factors in a region. Combined with the warehouse cargo management system, warehouse managers can be reminded to replenish at the most appropriate time. Reduced customer waiting days and guaranteed minimum storage costs.

(3) Optimize the storage partition

A reasonable warehouse partition and a suitable position are essential for the proper use of the warehouse. For a specific logistics enterprise warehousing system, the rules for the goods entering and leaving the warehouse will not change much in a period of time, which means that certain goods must enter and leave the warehouse frequently during a certain period of time, and some goods are in certain The frequency of entering and leaving the warehouse during a period of time is relatively low. In this case, it is possible to place goods that are frequently in and out of the warehouse at a place closest to the pickup truck, and the goods with a low outbound frequency are placed in an area relatively far from the exit. However, the law of import and export is not static, and the demand for goods will change with factors such as government policies, seasonal changes, and customer migration. Therefore, RFID technology can be used to obtain product demand information and product in and out of the library information. Then use big data technology to statistically analyze various data information such as inbound and outbound information and external factors, and use artificial neural network, decision tree, cluster analysis, etc. to mine data, and carry out the types and quantities of goods that will be shipped

out in the future. Trend forecasting provides information support to help warehouse managers adjust warehouse partitions and location distribution in time to ensure maximum logistics efficiency.

(4) Improve the efficiency of warehouse operation

Using RFID technology can improve the efficiency of the warehouse. It is embodied in the short inspection time and high efficiency in the warehouse inspection; the warehouse inventory is accurate and fast; the warehouse items are easy to query; the warehouse picking efficiency is high. The use of RFID in the warehouse storage process can solve the problem of item query. Each item is labeled with a radio frequency tag. When it is shipped from one place to another, the reader recognizes the item and informs the computer network where it was placed so that the warehouse staff can quickly find the item and view it. The status of the item, the warehouse management center can also know the inbound and outbound status of the item in real time. In the process of warehousing, the use of this technology solves the problems of long picking and unloading time, first-in-first-out items, and so on. The RFID radio frequency tag is attached to the packaging material, and the RFID reader can read the information such as the category, quantity, and delivery location of the packaging material, and the RFID can be used to pick up the goods very quickly [9]. It is necessary to manually re-confirm whether the outbound items are consistent with the customer's requirements. Now only need to compare the information obtained by RFID with the customer's demand information, it can be out of the library, simple and convenient to operate, and improve the efficiency of warehouse operation.

(5) Warehousing visualization

Warehouse visualization is based on RFID technology. It loads an electronic tag on each item that enters and exits, and reads and collects data at each point of unloading, increasing the transparency of product flow. The signal generated by the reader is transmitted to the calculator software, and then the database is updated. The data of each cargo is recorded in the database, including the name of the goods, the time of entering the warehouse, the time of delivery, the manufacturer, and the date of manufacture. A series of information such as the warehouse, the storage price, and the description of the goods. Through the big data logistics to achieve terminal data sharing, to grasp the real-time information of the product when "where" or "where", the promotion work is more transparent and controllable, so that decision makers can make decisions, and Handle and judge various problems in a timely manner. An efficient sales system was established and sales performance naturally increased.

4.3 Challenges Facing RFID Big Data

(1) Mining challenges

For applications, the real challenge is the analysis and mining of data. The analysis system of RFID data can be used as a completely independent system from transaction processing. There is no need to save a large amount of historical data for a transaction processing system. Compressing and transferring historical data is the basis of big data applications [10]. The challenges brought by RFID data mining include: (1) Efficient hierarchical storage of RFID data has the characteristics of fast growth rate and high real-time requirements, which makes the hierarchical data storage strategy essential. (2) Efficient compression performance. Data compression is an important means to deal with massive data. The high degree of structuralization of RFID data facilitates data compression. Column storage technology has its unique advantages in this respect, but how to integrate it with other technologies is also a big challenge. (3) High performance of graph data modeling and processing. Graphs are the most effective means of describing dynamic transactions, such as logistics monitoring, biological research and other important application areas, which inevitably need to model and process graph data. The processing power of graphs is a major challenge for data mining systems. (4) Compatible with business processing systems. For mining-oriented data systems, if you use a different technology than the transaction processing system, such as noSQL technology or column storage technology, data compatibility and mutual access between the two systems is a thorny problem that must be solved.

(2) Cross-border cooperation challenges

Researching and utilizing the vast amounts of data generated by RFID enables humans to gain access to the world at a higher level. For example, the application in business allows us to discover people's buying trends and purchasing motives, and arrange inventory reasonably. The application in the biological field allows us to discover the characteristics of living things and understand the living habits of living things. The medical application allows us to Obtain information about human functions and understand the physical condition of patients; application in security monitoring allows us to detect and prevent crimes in a timely manner and maintain social stability. However, these applications all require cross-border cooperation between the application domain and the technical support field. This kind of cooperation is an important challenge for computer people and the Internet of Things.

(3) Security challenges

RFID will continue to influence the development of the supply chain in the future, although the supply chain has got rid of the shackles of cables but has also increased security risks. Some companies use RFID technology to manage the supply chain of goods, but it does not want its competitors to track the type of goods and whereabouts through the labels on the goods. Similarly, some devices with financial information associated with users use RFID tags and their user accounts should be protected. In response to these problems, the researchers proposed some encryption algorithms for the identification of the real identity of the reader by the tag, and only the relevant information is transmitted to the reader through the identity authentication. In the authentication process, the tag needs to record the ID number of the authenticated reader, and the reader also sends the ID number to the tag in the form of a broadcast. In order to ensure that the ID number of the reader itself is not intercepted by the attacker, the reader and the tag are encrypted and transmitted. Once the tag fails to pass the authentication of the reader, the tag will reject the stored information. However, such a keyed authentication will also be attacked by an intermediary who plays an attack, replay attack, and the like. Therefore, RFID technology needs to ensure the security of data through the upgrade and optimization of computer technology, which is inseparable.

4.4 Summary

Through the application of RFID technology in the logistics warehousing process, the combination of warehousing management and radio frequency identification technology can efficiently complete various operational tasks, improve warehousing management, improve operational efficiency, and improve the recognition rate of goods entering and leaving the warehouse. No need to check out the box, and identify multiple items at the same time, improve the efficiency of entering and leaving the warehouse; reduce the inventory cycle, improve the real-time data, real-time dynamic inventory status, realize the visual management of inventory items; use RF technology to improve picking and The accuracy and efficiency of the distribution process, speed up the distribution, reduce labor, reduce distribution costs; accurately grasp the material status, optimize inventory, and optimize partitions. The new technology represented by RFID is profoundly affecting the warehouse management system and even fostering a “logistics revolution”. With the continuous promotion of RFID technology and the continuous reduction of the cost of use, it will certainly promote the popularization of RFID technology in warehousing and logistics applications.

5. Conclusion

With the gradual deepening of the integration of big data industry and logistics industry, the logistics industry will undergo qualitative changes. Such qualitative changes directly penetrate all aspects of the industrial chain, such as production, storage, transportation, distribution, and sales. Big data has revolutionary significance for the future development of warehousing and logistics. In the future, IoT technology can capture the status of every resource in the warehouse, including people, equipment,

facilities, inventory, and orders. Through this dynamic state capture, bottlenecks on the production line can be instantly acquired. The data is aggregated into a central dispatching system, and the central dispatching system performs flexible and dynamic arrangements. In general, in the big data environment, logistics activities tend to be more visualized. When the decision-making layer decides a higher level of action based on the information fed back by big data logistics, it also tends to be more scientific and efficient, and the integration of logistics functions is strengthened. The level of automation of logistics information has also increased. When the accuracy, real-time and fineness of the big data information in the logistics industry are implemented and played, the benefits brought by big data logistics will inevitably exceed the objective prediction value.

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