RFID technology in A smart warehouse application study

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ABSTRACT

Warehousing as an important link in the logistics process, the application of intelligent warehousing, to ensure the accuracy of data and transmission speed of goods in all aspects of warehousing, so that warehouse managers can accurately grasp the effective data of the operation in real time, the inventory control to a reasonable interval. In this paper, through the analysis of RFID technology in A wisdom warehouse application status, from facilities and equipment to software system research, through the analysis of its application effect, found that A wisdom warehouse RFID technology application mode has a strong replicability, and in the field of wisdom warehousing has a good demonstration role, has a good promotion value. It provides a good practice case for other warehousing enterprises in building a wise warehousing system, reducing operating costs, improving operational efficiency and enhancing their refined and wise warehousing management.

Keywords: RFID technology, intelligent storage, intelligent information perception

1 INTRODUCTION

1.1 Research Background

In recent years, driven by the explosive growth of the Internet economy, the logistics industry has also seen rapid development. According to China's National Bureau of Statistics, the total cost of social logistics will be 16.7 trillion yuan in 2021, accounting for 14.6% of GDP, and the logistics industry has achieved certain results in implementing cost reduction and efficiency improvement. Warehousing as an important link in logistics, its automation, intelligence, digital level development is particularly critical.

1.2 Smart Storage

Intelligent storage is a new storage concept, which is a wisdom logistics model jointly realized through information technology, Internet of Things and electromechanical integration. This model has excellent performance in reducing operating costs, enhancing operational efficiency, and improving warehouse management capabilities. The basic principle of smart warehousing is to collect and analyze goods information in real time through sensors and other tools to provide targeted command operations, to achieve the visualization of the whole process from the storage link, to achieve remote sensing and control of goods, the cloud can form three-dimensional digital services as well as for warehouse managers to assist in decision-making, while supporting warehouse management, order management, transport management of multiple systems to run in concert. The goal of the implementation of smart warehousing is to provide process visibility, equipment intelligence and system intelligence, so that warehouse managers to grasp the whole process of the warehouse in real time, to achieve intelligent, refined management.

1.3 Current status of research at home and abroad

Jaehun Park et al. proposed an RFID-based passive SME warehouse inventory location method to effectively use multi-level racks (MSR) to manage their inventory tracking. The effectiveness and applicability of the method is illustrated and a case study is presented [1]. Yang Jingyu design a kind of intelligent warehousing system that takes the RFID technology into consideration is put forward. The system can automatically collect the data from various links such as the arrival of goods, inbound, outbound delivery, transfer and so on, and provide the warehousing ERP software with high speed and accurate supply to ensure the management can master the data in a timely and accurate manner [2]. Wang Xiaoyi researched and designed a warehouse logistics management system with RFID technology in the IoT vision, aiming to further improve the intelligence of warehouse logistics management and create more favorable conditions for the improvement of logistics management efficiency [3]. Quan Yin proposed an RFID-based logistics information security

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assurance system, the system hardware includes RFID devices, wireless collectors, routers and processors; the software is designed for the logistics information collection stage to achieve the operation of the system. The experimental results show that the logistics information loss rate can be greatly reduced [4]. Tang Zhuang through a review of the current situation and development history of RFID technology, analyzed the problems of unified standards, high costs and insufficient reliability in the RFID-based intelligent logistics industry, and proposed countermeasures such as establishing unified standards, reducing costs and strengthening security risk prevention [5].

Based on the above research, this paper selects the representative JD Logistics A wisdom warehouse in the industry, analyzes the current situation of its existing RFID technology application, composes the application of the technology in the actual operation process, discusses the adaptation of RFID technology and WMS system, and summarizes the actual application effect. Summary.

2 RFID TECHNOLOGY IN A SMART WAREHOUSE APPLICATION STATUS

2.1 A Smart Warehouse Basic Information

A smart warehouse is located in the Yubei area of South China, which was officially put into operation in December 2017, the actual area of the warehouse is about 4,600 square meters, and the effective use area is about 3,100 square meters. The total number of pallet storage is nearly 13,000, with 10,585 storage spaces; the standing warehouse covers an area of 1,400 square meters, with a height of 15.9 meters and a depth of 58 meters. The total handling capacity of the warehouse is 7,500 pallets/24 hours, with a storage capacity of about 2,000 SKU's. The RFID labeled shelves and AGV's in the warehouse are specially customized to meet the use of each standard specification pallet.

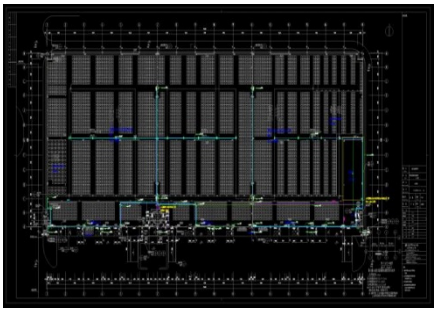

Figure 1. A smart warehouse layout CAD drawing

Figure 2. A smart warehouse AGV work scene

2.2 A Smart Warehouse Business Process

A smart warehouse is currently the core of the existing intelligent storage management system, coordinated by RFID technology with automated equipment. Warehouse operators through the RFID management system to write RFID identification code, print RFID tags, storage and analysis of RFID tag identification code data; through the intelligent storage system to the dolly, stacker cranes and other storage equipment issued operating instructions to complete access, inventory and other work. The following is the basic operation flow of the warehouse.

(1) Inbound business process

The main content of inbound acceptance: first of all, through the arrival of goods transported to the receiving station, inbound personnel based on the delivery note information, through the handheld scanning terminal, scanning goods RFID passive tags for inspection and receipt. After the goods received are put into the inspection area, the inspection is complete. After the completion of the inspection, the warehousing operator realizes the one-key warehousing on the shelves in the handheld terminal, and the system compares the goods information with the existing inventory, and intelligently recommends the best warehouse position for the warehouse manager to choose.

Then through the installation of RFID reader forklift fork to the entrance of the automated vertical storage conveyor line, to achieve a key into the warehouse shelves, the system through the goods information and the existing inventory comparison, intelligent recommendation of the best warehouse selection shelves; at the same time, the terminal scans the

shelf RFID tags, the system real-time retention of goods pictures, name specifications, arrival date, shelf life, quantity, batch number, maintenance information, suppliers, storage Location and other information. The system automatically detects the properties of goods and generates handling tasks, and then by RGV (rail shuttle trolley) transported to the entrance of the vertical storage, and finally by the stacker crane to send the incoming goods to the designated storage position, complete the storage shelves operation.

(2) Outbound business process

When leaving the warehouse, the system automatically recommends the picking path of the lower shelf warehouse according to the algorithm by matching the business order number with the electronic label scanning information, and completes the work of leaving the warehouse. High-value goods or spare parts with long production cycle use RFID card for identification when leaving the warehouse, track the goods situation, manage the goods cycle and provide data basis for analysis of operation department. Figure 6 shows the flow chart of JD Logistics A intelligent warehouse out of the warehouse.

For some of the standardized goods in the batch, the pallets with RFID markings can be sent to the conveyor line port by manual forklift, and after automatic scanning and detection to obtain the information of cargo position, etc., and drive the AGV to the entrance of the vertical storage, sent by the stacker crane to the designated outgoing cargo position, and the palletizing and outgoing storage is completed by the robot arm.

(3) In-warehouse management

The in-store management chain mainly includes inventory counting, storage area optimization and transfer management.

Inventory inventory: that is, business operators in accordance with the PDA task page guidelines, according to the designated warehouse, shelves, storage areas, storage space for goods in accordance with the required business inventory, including the initial inventory, recount, write-off and inventory profit and loss processing, etc., after the inventory is completed, the intelligent storage system to generate data, the inspection is completed before the inventory report can be generated.

Path optimization management: This link is mainly based on the warehouse functional area, storage area, storage type and shelf identification, combined with the system shelving, shelving tasks, in the warehouse area, shelves on the floor plan to identify the destination, and in each shelf to install business operation indicator, optimize the shelves, shelves path, improve the efficiency of the operator in and out of the warehouse.

Depot management: It is mainly applied to one-step delivery, inspection, receipt and shipment business on site. It completes the operation of overbanking receiving and shipping, result inquiry, PDA downloading/uploading, abnormality handling, etc.

In the task allocation link, A wisdom warehouse total control platform assigns receiving, issuing, transferring and inventory tasks to user accounts, corresponding with employee ERP accounts, to realize task allocation, query and statistics. Task allocation includes in/out task, dump task and inventory task, task confirmation includes in/out result, dump result and inventory result, query statistics includes personnel in/out workload statistics, work task hours and workload statistics by position.

2.3 A smart warehouse facilities and equipment

The equipment currently used in A smart warehouse has 12 sets of whole tray handling type AGV, 4 sets of rail shuttle trolley RGV, 8 sets of aisle type stacker cranes, the total processing capacity of the warehouse is 7,500 trays/24 hours, which can meet the storage of more than 1,700 SKUs of household electrical goods.

Table 1. A smart warehouse RFID part of the facilities and equipment information

Serial number	Hardware Name	Main Uses	Models and specifications
1	Modular racking for vertical storage	Flexible storage racking	HNCS203 8400*6200*12210 mm
2	RFID handheld terminal (large scanning gun)	Inventory, shelving, review	C72-8100
3	RFID handheld terminal (small scanning gun)	Picking and moving of goods	C71-8100
4	RFID Printer	(Fixed)	ZT411RFID
5	Tags		U8 label (100mm*30mm)
6	RFID Printer	Mobile	ZQ630
7	RFID Mobile Inventory Cart		JDX91000-A
8	RFID Reader	Inventory car use	FX9600
9	Industrial Panel PC	Inventory car use	Zebra L10 Windows 7 and above
10	Complete pallet handling type AGV	Carrying a full consignment of cargo	DDDJH-AGV-DL02

2.4 Master control platform linkage intelligent warehouse management system

A wisdom warehouse whether equipment or wisdom storage system every moment will generate massive amounts of data in real time, how these data interaction to achieve the lowest impact, wisdom storage management system (WMS5.0) through different modules between, part of the data asynchronous processing operations, the transaction will be subdivided, any set of instructions only in this module / service group, cross-module processing will be executed asynchronously. Such as picking off the shelf, inbound shelf inventory updates, these are asynchronous processing, can significantly ease the pressure between systems, while ensuring data validity and accuracy.

A wisdom warehouse total control platform through different monitoring mechanisms, real-time monitoring of each link of each system is normal, such as method monitoring, JVM (Java Virtual Machine) monitoring, URL (network protocol path), network ports, traffic monitoring, custom monitoring, etc., A wisdom warehouse in any link of system abnormalities, total control platform monitoring and warning system will issue a reminder, warehouse management personnel can timely and R & D department Collaborative processing. Figure 18 shows the total control platform of A smart warehouse.

The core of the total control platform is the warehouse data center. Its main contents include organizational structure data, warehouse master data, material master data. The relevant master data need to be imported from the logistics company staff ERP system into the intelligent storage data center, the total control system is not only the data center, but also the monitoring center, decision center and control center, can be described as the intelligent storage of the "brain", the purpose of its establishment is to ensure the realization of the goods in the warehouse "zero handling, zero error, zero loss of goods".

As the total control platform and intelligent warehouse management system to achieve data interconnection, to ensure the task status of intelligent equipment in the library, the logical area of the outgoing order volume, order processing progress, incoming order volume trends, outgoing order volume trends, etc. can be displayed in the total control platform at a glance, so that warehouse managers can clearly and clearly to provide decision-making help, significantly shorten the decision-making time while effectively enhancing the management level.

3 RFID TECHNOLOGY IN A SMART WAREHOUSE APPLICATION EFFECT ANALYSIS

3.1 Analysis of the effect of RFID technology application on business processes

3.1.1 Easy and efficient business operation

After the application of RFID technology, intelligent storage system-related business operations more convenient, reducing the manual operation links, the application can be achieved after the traditional warehouse management can not achieve a lot of business. Such as: keyword fuzzy query, One-click batch acceptance, Voice operation step prompt, Mobile convenience: the introduction of intelligent PDA and other mobile terminal equipment, while supporting intelligent path guidance equipment, to facilitate the system to automatically determine whether the normal operation of the transmission line under unmanned management conditions.

3.1.2 Accurate positioning of goods and intelligent guidance of paths

The operation process of the automated warehouse is that after the goods arrive, the total control platform will transfer the idle car according to the position and usage of the intelligent track-guided car, the stacking robot will yard the goods onto the car, the car will get the assigned storage position from the total control platform, automatically select the lane track, send the goods to the storage position, and then transport them to the designated storage position through the shelf elevator. By identifying the RFID tag, the handling vehicle moves to the designated position and waits for the next command according to the intelligent storage system command. When leaving the warehouse, the general control platform will send out instructions to the truck, and the truck will move to the corresponding position to obtain the goods according to the storage position information obtained from the general control platform, and then the goods will be carried to the outgoing storage area. For manual picking area storage, the application of RFID technology, intelligent storage system will provide picking staff path algorithm, combined with warehouse screening strategy, automatically prompt the need for shelves or shelves and recommend the optimal picking path.

3.1.3 Business process innovation and business efficiency improvement

(1) maintenance management: Registration and ledger management of goods to ensure timely pushing of maintenance tasks, generate maintenance records, and achieve full lifecycle management of maintenance.

(2) Unattended management: integrated visualization technology, through advanced information technology and perfect management means to ensure the normal operation of the warehouse when unattended to receive materials.

(3) transfer management: for materials that do not have storage on the shelves management, the system can achieve delivery, inspection, receipt, delivery, etc., to improve the efficiency of warehousing while ensuring the integrity of data information.

(4) Wave management: Pickers make appointments for picking through the system, and warehouse managers complete the picking work centrally through batch processing work orders. The picker does not have to wait and can complete the job at the scheduled time.

3.2 Analysis of the effect of RFID technology in the use of facilities and equipment

3.2.1 RFID tag application to speed up inventory turnover

A wisdom warehouse using facilities and equipment configuration RFID tags, combined with Internet of Things technology to obtain key goods details, to achieve wisdom storage system for key equipment, high-value goods automatic identification, positioning, access and other visualization management of the whole process, not only to achieve accurate positioning of goods, high efficiency, and also to accelerate the inventory turnover.

3.2.2 Real-time tracking and refinement management of facilities and equipment

After the application of RFID technology, the special tools, storage consumables, facilities and equipment used in the warehousing link are enabled with the serial number management system of one item and one code, and the intelligent warehouse management master control platform can realize real-time tracking and fine management of the apparatus through the traceability management of serial number codes to avoid the loss of goods and disorderly management.

3.3 RFID technology and intelligent storage system with the application of the effect of analysis

3.3.1 Intelligent task assignment and full process management

After receiving the customer order, the wisdom storage system will start to intelligently allocate tasks according to the task category and storage area layout after algorithm calculation, By monitoring the automatically generated task list in real time, the manager can realize the automatic tracing of operations such as in and out, inventory, and shifting.

3.3.2 Storage position visualization and operation intelligence

As the intelligent brain combined with WMS5.0, the management personnel of A smart warehouse can observe the visual display of storage position and goods on the display panel of the total control platform, and according to the dynamic changes of the inventory, drag the icon to confirm to complete the operation of warehouse adjustment, addition, merger, etc., which changes the assignment or group order task that requires frequent manual operation in the original system, and significantly reduces the manual workload and It changes the task of allocation or grouping of orders that requires frequent manual operation in the original system.

4 CONCLUSION

In summary, RFID technology combined with intelligent storage system has become the operation data analysis center of A smart warehouse, its core advantages and application effects are summarized as follows.

(1) Reduce labor cost investment

RFID technology combined with the introduction of intelligent warehouse system simplifies the entire warehouse operation process, after the internal information comparison, the number of business operators will reduced by 45%.

(2) Improvement of management operation level

Since RFID tags can store a large amount of data, they can effectively record product information, such as batch number and production time, realizing real-time product management, first-in-first-out, and accelerating turnover.

(3) Improve intelligence

By automating the collection of inventory information and realizing paperless operation, we can improve the accuracy of goods inquiry and the quality of inventory operation, and speed up the speed of goods in and out of warehouse.

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