



## INTELLIGENT LOGISTICS SYSTEM BASED ON THREE-TIER ARCHITECTURE AND RFID

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### ABSTRACT

Radio frequency identification technology (RFID) is a non-contact intelligent identification system, its main advantage lies in the wide range of recognition, information capacity, security, excellent resistance to abrasion, reusable. It can take place of the traditional bar code recognition technology, and be applied to the area of modern intelligence logistics management. This thesis introduces the working principle of the net three-tier system and RFID technology, and proposes the setting-up of the intelligent logistics system based on three-tier system and RFID technology. The thesis also studies the design and realization of the data access layer, logic layer and presentation layer for providing technical backing to the Logistics management of enterprise monitoring and decision. The experiment shows that the system can greatly improve the intelligence level of the logistics management, improve the competitiveness and economic benefits of logistics enterprises.

**Keywords:** *Three-tier Architecture, RFID Technology, Intelligent logistics, Technical Support*

### 1 INTRODUCTION

Traditional logistics management system adopted barcode recognition technology, which lead to such shortcomings as read-only, a limited number of only recognizing a bar code in a single, easy to destroy and so on. With the support of the identification of non-contact, Radio Frequency Identification (RFID) technology enjoys the following strength: small size, large storage capacity, wear-resistant, anti-jamming, penetrating distance recognition and so on. And with the advantages of high recognition accuracy, single identification supporting several identify targets, RFID greatly improves working efficiency, and can avoid the many problems of the traditional bar code technology.

In recent years, intelligent logistics planning and design technology is growing fast in many developed countries such as United States and Japan, and achieved very good results in the application. Foreign logistics companies have established its own tracking query system, to provide users with real-time tracking and tracing. For example automatic control valves for the world's largest manufacturer Fisher in the application of CLS logistics planning design and simulation software, sales increased by 70%, a 44% increase in the amount of goods shipped from the warehouse, inventory turns increased by nearly 25%, and its Fisher's satisfaction of customers has increased in

many indicators. The U.S. Air Force logistics sector has researched and developed an expert system for warehouse management and inventory control problem (Inventory Management Assistant, IMA). With this system, the rate of normal problems of improving efficiency can be raised by 8% to 10%, the rate of complex issues of improving efficiency can be raised by 15% to 18%.

One of the six key projects approved by the Ministry of Information Industry in the "Eleventh Five-Year" period, is set up based on RFID Integrated Management Information System project. The Project mainly lies in the field of trade, customs, civil aviation, railways, highways, waterways transportation, iron and steel, petrochemicals, automobiles, building materials, agriculture, finance, taxation and other areas, which promotes the application of RFID technology and RFID-based integrated management information system.

Because RFID technology can achieve the perfect combination of computer information systems to support data collection, storage, management, analysis, decision-making integrated management. This paper introduces building intelligent logistics system based on the net three-tier system and RFID technology which can better realize the information collection, processing and combination of logistics aspects of management positions in terms of speed than the simple application of RFID technology.

This has been further improved the intelligence level of the logistics management, and the efficiency of logistics management, thus can reduce management costs and the cost of production.

## 2 THE SYSTEM OF NET THREE-TIER ARCHITECTURE

### 2.1 The Principle Of Three-Tier Architecture

Based on the NET three-tier, the system can be generally divided into three tiers: the presentation layer, business logic layer and data access layer. Main features of system and business logic in a business logic layer for processing. Figure 1 represents the presentation layer, business logic layer, the relationship between the data access layer.

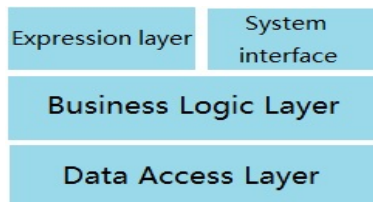


Figure 1: Three-Tier System Model

The presentation layer: It is the UI part of the system, responsible for user interaction with the system used to display input data and pass data entered by the user to the next tier---business-logic layer, when a business logic layer when the data has changed, the presentation layer would reflect the updated results. Presentation layer logic code, interface elements and system-related.

The business logic layer: Link is connected the presentation layer and the data access layer, is the core of the system as a whole. Business logic layer class library.

The data access layer: It also called the persistence layer. the main function is responsible for database access, data table, select, insert, delete, update, and the business logic layer to the data saved in the database [2].

### 2.2 The Advatages Of System Architecture

The system adopts the advanced design of multilayer network structure, in order to centralize redundant, distributed database technology to build large network databases to ensure data consistency, integrity, and security, effectively preventing and reducing damage caused by man-made or accidental destruction of data. When business logic changes, simply replace the corresponding parts of the component and other components are not affected, and meets the requirements of data management and

meet the requirements for remote client operation, stable operation. As shown in the figure 2 of Intelligent logistics system:

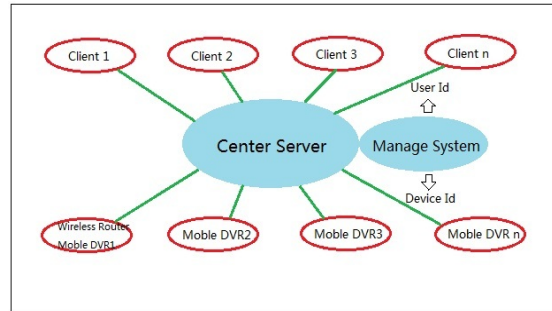


Figure 2: System Architecture Diagram

## 3 RFID TECHNOLOGY SYSTEM

### 3.1 Rfid Technology Working Principle

RFID radio frequency is a radio communication of non-contact intelligent identification technology. Its main working principle is: through the reader to the RFID tag sends a signal around, electronic tags after you receive your signals arising from the phenomenon of electromagnetic induction induced current, activates the electronic tag, in which case the tag [3] and reader communication; Readers through an antenna to send wireless signals to communicate with RFID tag, the reader receives the electronic tags after the signal, and then processed by computer systems, thus completing the electronic label recognition process.

### 3.2 The Structure Of The RFID System

Due to their work environment and the recognition of differences of RFID systems, in the application of RFID technology in concrete, specific components of a system are different, but these differences in RFID systems are based on the same principle, so RFID system typically consists of an electronic tag, reader, network, made up of three main parts.

#### 3.2.1 Electronic tag

Electronic tags are basic components of RFID system, primary storage item identification information. Electronic tags has no any supply systems of independent power, rely on the reader to provide energy. Through a reader transmitted signal, electronic tags have an induced current and is activated.

#### 3.2.2 Reader

Reader RFID systems in fact plays a role of receivers for signals, which according to different

environments and tasks, providing channels for data transmission and electronic tags. RFID reader part of the system often also include other ancillary structures, such as the power supply module, clock modules, RF modules, antenna module, and so on.

### 3.2.3 Network

RFID system also includes network systems, also named wireless network module. Network module primarily to address RFID and RF module for network communication [4], data transmission and receipt of information, mainly by radio waves to communicate.

### 3.3 Application Of RFID Technology In Intelligent Logistics Management

RFID radio frequency identification technology enables intelligent logistics management system. By wireless RF modules on electronic label for read and write operations can be achieved for goods from goods procurement, processing operations, transport, logistics jobs, warehouse jobs, sales jobs, track and manage links, even on late sales tracking services can be monitored. In the distribution chain, can be achieved through intelligent logistics system with different merchandise categories for quick sorting and storage operations, and greatly improves operational efficiency, reduces the chance of error. In transportation, intelligent logistics system can record circulation details during transport, shipment information is automatically generated to avoid trouble that artificial registration information. In the marketing chain, through intelligent logistics system can access the warehouse inventory information, timely replenishment, shelves, can also be automated commodity procurement plans, and invoicing information management system. Therefore, it can be said that RFID is the key technology for implementing intelligent logistics system, which are widely used in logistics area, mainly the achievement of information goods, goods flow of basic information, job management, integrated management information, financial information.

## 4 SYSTEM DESIGN

### 4.1 The Key Features Of The System

Intelligent logistics system is operating under windowXP or win7 system platform, IIS6.0, databases for Microsoft SQL Server 2008, Microsoft Visual Studio 2008 development tool selection, grab a variety of technical advantages, to fit in the realization of the corresponding function, meet the needs of system upgrades, making offsite data

exchange and interfaces with other systems to keep good compatibility. As shown in the figure 3 of the key features of the system:

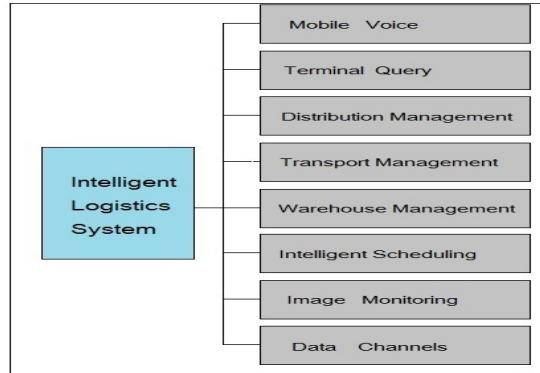


Figure 3: System Function Block Diagram

### 4.2 System Deployment

Logistics process includes several major job sectors, including goods procurement, storage of goods, packaging of goods, transport of goods, processing of goods, distribution, sales and after-sales service of goods aspect, every step is closely linked, they are complementary and indispensable. Therefore, building intelligent logistics system is on the movement of goods to be achieved in all aspects of intelligent information management. Logistics businesses to immediately grasp and control the various segments of the logistics business of resource information, product information, product information, capital flows to these four streams of information. Through putting the RFID technology into the intelligent logistics system, you can track and manage the flow of goods, thus improving work efficiency of goods flow, thereby enhancing the efficiency of the flow of information, while securing the information flow, accurate.

Logistics management from an overall point of view can be divided into three parts: warehousing, transportation, and distribution. Therefore, the use of RFID systems to achieve intelligent logistics management system, that is the key to achieving these intelligent monitoring of the distribution chain, it will realize logistics business data for information collection, storage, management, analysis and decision-making. [5]The following key links for logistics management, to design intelligent logistics system using RFID technology.

(1)Purchase link



Purchasing links is mainly to achieve the information management of procurement of goods, including vendor information, purchasing information, trade information, job information, and so on.

First of all goods classified according to product categories, and will stick electronic tags on the goods, and then using a reader writes for each commodity category commodity information, including product category code, product code, etc . Finally, through RFID registration of the storage subsystem. Because according to goods categories to label written and registered for the storage of the goods, other subsystem generates an intelligent logistics system of procurement information, commodity information, assignment information. Thus facilitating the flow of goods the next link of operational management of future jobs that do not need to rely on artificial, greatly improving the efficiency of the management of the procurement chain.

#### (2) Storage link

Storage links is mainly to manage the warehousing of goods mainly include items reported as finished goods inventory management, inventory management. Then, a RFID system for goods storage and collection management. At the same time, supply chain systems can also be receiving, picking, packing, transport and RFID sub-systems such as production planning combined achievement of intelligent logistics jobs, greatly improving working efficiency, be precise, also reducing circulation costs, savings in labour. Due to the intelligent RFID subsystem, can reduce the errors of goods goods, shipment errors, theft, loss of goods. Using the RFID intelligent logistics system could guarantee store links of management efficiency, improve the accuracy and efficiency of the job.

#### (3) Transport link

In goods transport, RFID electronic label in accordance with the prior agreement of the rules needs to be attached to the items above. Packing-shipping time to scan the RFID tag, production of goods shipping information, tracking management easy to use computers. Specifically, shipments of key locations such as the warehouse entrance, station entrance, the port entrance and so on, to identify the goods and then packing-shipping, RF system generates shipment information transmitted over the network to a centralized storage and management of computer systems. Shipping information includes basic information, delivery

address information, shipment of goods circulation information.

#### (4) Distribution link

Distribution links primarily to address operational issues of intelligent classification and sorting of goods through the RFID system to identify the electronic tags on the goods, and then sorting by category, greatly improves operational efficiency, reduces the chance of error, reducing the cost of the distribution chain. Specifically, when the goods arrived at the distribution center is equipped with electronic tags, so when reaching Distribution Center recognized by the RF system, read the tag information. First, the system will first check information and shipping information goods; if I make a mistake, the updated label information. Then transferred according to goods categories according to the specified channel. Finally, by the specified receipt channel staff reporting-as-finished. This realization of the goods distribution link of accuracy, even can grasp the flow of information goods, such as origin, transit, destination and other information. You can avoid manual sorting and distribution shortfalls, has greatly improved work efficiency.

#### (5) Market link

In the market link, since it became a list of goods for more information. At the time of sale, through the use of intelligent logistics management information system on sale (sales/distribution/sales) intelligent management of commodities. RFID subsystem is responsible for the shipment of goods management, because the inventory information has been produced in advance, so it can monitor your inventory of goods. Once in short supply, the intelligent system can prompt the job user, you can even generate a procurement plan, in order to achieve additional goods in real time. Intelligent logistics system can track your inventory and distribution information management, avoiding the criticism of labor management, greatly improve the efficiency of management, built the chance of error. While retailers, shipping information has been generated due to computer information system, monitoring and management through RFID subsystem on the validity of the goods, can also support docking and invoicing system, direct sales and billing operations using RFID system, addressing the ills of bar code billing. system deployment as shown in Figure 4:



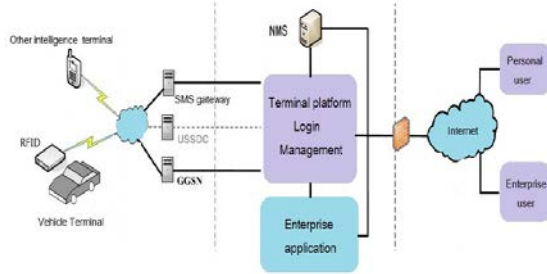


Figure 4: System Deployment Diagram

Data processing process as shown in Figure 5:

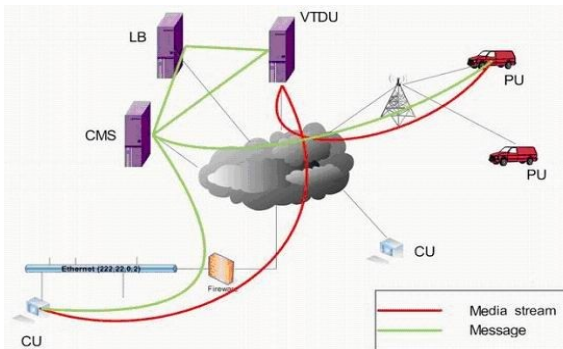


Figure 5: Data Processing Process Diagram

### 4.3 System General Framework

Overall framework for intelligent logistics system is intelligent logistics system and the mobile network +GPS+GIS. A general control center, more than one control center. Control over national alarm centre, 110 and 120 Emergency Center, as shown in Figure 6:

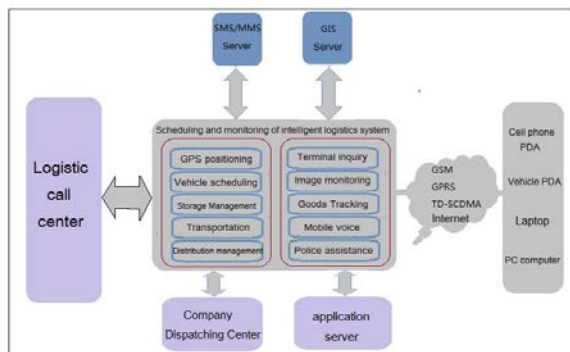


Figure 6: System General Framework Diagram

## 5 MAIN FEATURES OF THE SYSTEM

By constructing a model of intelligent logistics system based on RFID technology, you can reduce the logistics management of the dependence on human intervention, to prevent operator errors,

together with computer information systems for full monitoring and management of the flow of information on goods, which can improve logistics management efficiency.

### (1) Optimizing logistics processes

Traditional barcode technology relies on artificial jobs, bar-easy to wear, so easily lead to omissions. Using RFID technology to further optimize processes, reduce manual labor, achieve the goal of saving time reduce cost.

### (2) Improving the quality of logistics jobs

Due to the packaging of the goods are affixed with electronic tags above, it only requires the use of a radio frequency to device on all packaging for goods to be identified, then stores the inventory information to send to the computer information systems, it can solve the problem of the traditional bar code recognition technology easily to lead to errors or omissions, while ensuring the reliability and security of the information.

### (3) Reducing logistics distribution cost

Through the use of RFID automatic identification technology to realize automatic classification and sorting of goods, saves a lot of labor, and reduces the chance of error. And optimizing the logistics management process, also the system for purchase, sale and stock management for docking, significantly reduced the flow of logistics management cost.[6]

### (4) Logistics information management security and efficient

RFID technologies to support long-distance identification, and supporting multiple identification, information delivery, preparedness, rapid, the probability of error is low. Particularly in terms of logistics jobs in circulation management, can achieve data security and information management efficient.

## 6. MAJOR DIFFICULTIES IN THE SYSTEM DEVELOPMENT

Difficulties in system development mainly lies in the following aspects:

(1) The perfect combination of the c/s and b/s. This is the system's biggest problems, achieve with c/s and b/s, taking into account the network interfaces, data consistency, data rates and data security issues (System security requirements is much higher than the c/s system).



(2) Large volumes of data intelligent logistics system; larger amounts of data storage, large amounts of data interaction server will bring a great deal of pressure.

(3) Number of intelligent logistics system large, complex data tables, reasonable construction of the database, data optimization will greatly enhance the speed, the performance of the system, which is a difficulty of the system.

**6 SYSTEM TEST DATA ANALYSIS**

**7.1 Accuracy Analysis Of Logistics Process Information**

Logistics product status in real time tracking on a commodity below "JYDQ1205113" real time status tracking. Through the follow example data analysis, logistics information system data is accurate and timely.

*Table 1: Logistics Product Status In Real Time Tracking*

Time	State	Logistics node
2012.10.9 9:09:01	Leave	Qin Feng assembly plant
2012.10.9 10:01:01	arrive	Qinzhou Feida logistics Area 1
2012.10.9 10:30:01	Leave	Qinzhou Feida logistics Area 1
2012.10.9 16:34:01	arrive	Liuzhou Century logistics Area 1
2012.10.9 16:49:01	Leave	Liuzhou Century logistics Area 1
2012.10.9 17:37:01	arrive	Liuzhou Wanda Electric shopping centre

The following chart the is the condition of " Qinzhou Feida logistics Area 1" real-time monitoring of goods:

*Table 2: Real-Time Monitoring Of Goods*

No	Item number	Name	The time of arrived
15	FSXM1205003	Soccer shoes	2012.10.12 9:32:01
16	SJSM1207129	Cell phone	2012.10.12 13:01:01
17	SJSM1207155	Speaker	2012.10.14 17:13:01
18	JYDQ1203152	Water dispenser	2012.10.15 10:06:01

**7.2 Experimental Analysis Of System Efficiency**

In order to get high level intelligence and efficiency, a wide range of data number of port logistics center of goods has been collected. Intelligent systems for traditional modes of goods in

warehouses and warehouses had been analyzed by compare.

When traditional goods are transferred into warehouses, staff members need open each carton, and then scan the bar codes on the packaging each piece by the scanner, then keyin the information, and finally put the goods back into the carton. With the adoption of RFID technologies and intelligent systems, without opening the box and any scanning, staff only need to place the carton onto the transferring belt. When the cardboard boxes go through the scanner, it will automatically scan the labels, the information will be at the same time appear on your computer. Test results is shown in table 3:

*TABLE 3: The Time Comparison Between The Traditional Way And Intelligent Systems Getting Into Stores*

Quantity of cargo	The traditional way (seconds)	Intelligent RFID (seconds)
80	192	24
200	780	83
800	3392	372
1500	6649	557

Test analysis of the experimental data shows that the using of intelligent logistics system takes as less 10 times time as the traditional does with larger number of warehouse goods. The larger the number of goods, the better the intelligent systems works. Therefore, adopting intelligent system can not only avoid errors, be good at marketing calculation, but also greatly improve the speed of logistics.

**7 CONCLUSION**

Through system architecture, system deployment, software design, debugging, the design of intelligent logistics system with RFID technology has been completed based on NET three-layer structure. The realization of intelligent logistics systems can not only avoid the shortcomings of traditional logistics management technology, but optimize logistics process, cut the costs, which greatly improves the efficiency of logistics information management. Of course, multiple transaction processing power of the system could still be improved; we also need to consider the communication security, which involves the maintenance that further research is needed.



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