# Research of a Pharmaceutical Enterprise Warehouse Management System Based on RFID Technology

## Xiaohuan Xiang, Juntao Li, Xingxiang Tao

School of Information, Beijing Wuzi University, Beijing, China

### Email address

313809457@qq.com (Xiaohuan Xiang), 862974337@qq.com (Juntao Li), 260486736@qq.com (Xingxiang Tao)

**Abstract:** Under the background of a pharmaceutical company, this paper describes the problems in ex-warehousing, warehousing, inventory management process, which including low level of information, excessive label work and manual production operations, complex work processes, high working strength in employees and so on. In order to solve these problems, this paper makes a description of these issues and proposes the application of RFID technology in pharmaceutical warehouse management system, which based on the characteristics of RFID technology for material storage and automatic bulk information collection. RFID technology is widely used in logistics management and process optimization as a new type of Internet technology. Warehouse management system based on RFID technology can combine the GMP certification requirements and standards, automatically complete the input and output of information. So that it can effectively assign storage location automatically, avoid the medicine pollution problem caused by improper manual operation, improve operation efficiency, reduce error rates. The application of RFID technology in medicine warehouse management system is an exploration in domestic pharmaceutical enterprise. It is of great importance to optimize the enterprise storage management.

**Keywords:** RFID Technology, The Warehouse Management System, Automatic Bulk Information Collection

## 1. Introduction

Medicine is a special commodity. Medicine quality and facticity will be directly related to people's life safety. Countries have strict laws and regulations on the administration of the drug, present strict requirements on drug warehouse management, whether the GMP standards that pharmaceutical companies must perform, or the GSP standards that pharmaceutical distribution companies must comply with.

With the development of the pharmaceutical market, China's pharmaceutical industry will continue to maintain a fast growth trend in quite a long time in the future. In 2010, China's pharmaceutical market valued at 60 billion dollars and we predict that China's pharmaceutical market will double to 120 billion dollars by 2020. But China medicine circulation industry faces with many adverse factors, like temperature and humidity control in medicine transport process, the low information level in medicine industry, big regulatory difficulty. Most enterprises cannot strictly implement the requirements. Warehouse condition,

environment, and management hardly reach GMP and GSP requirements. Overall status in medicine warehouse is still lagged behind. In the current study of a pharmaceutical company, we can find that the enterprise has low degree of information. The track of the information, record operation and management work are all by manual operation. It forms large amount of homework, relies on a variety of labels for information description and transmission.

Due to the particularity of medicine industry, its all aspects are restrained by national legal and regulations. Requirements in the regulations are must strictly implemented. But in the enterprise warehouse, the most operations are artificial. It's hard to guarantee the implementation of regulations. We cannot ensure that the warehouse environment could reach requirements, while the increasing of employee number and complex degree of employee job also increased company funds cost and management cost. For the higher level of storage management, reduce costs and improve the information

level of enterprise storage management become a serious problem.

# 2. RFID Technology

## 2.1. Basic Composition and Classification of RFID Technology

RFID, which stands for Radio Frequency Identification, is a relatively new technology often envisioned as an enabler of the Internet of Things [1]. Compared with other technology the RFID technology offers a higher scanning speed and easier application in the automated systems [2]. RFID technology is a contactless identification technology. It consists of three parts: tag, antenna, reader. Depending on the way of energy supply, it can be divided into active RFID tag, semi-active RFID tag and passive RFID tag. RFID technology has fostered many object monitoring applications [3]. Active RFID tag carries power by itself which used to provide the energy required in passing data. This kind of RFID tag can read and write over long distances, adjust frequency according to the actual demand. Currently it is mainly used in traffic management, vehicle access control and so on. Semi-active RFID tag also carries energy supply device, but it is not supposed to transmit signal independently. It needs reader to activate its energy field to complete the data transfer, mainly used in the field of automation and control. Passive tag does not have energy source. This tag gets its own currents through electromagnetic induction with the reader. Compared with active tag and semi-active tag, the reading distance of passive tag is shorter. Because passive tag does not carry power device, it is lighter. We can design the appearance according to actual needs. And the price of passive tag is cheaper. The application field is wider than other two species type of tag, like bus card, identification card. The number of applications for RFID systems is growing rapidly [4]. We are using this kind of passive RFID tag in warehouse management to increase the efficiency of internal management. RFID is a technology which has multidimensional applications to reduce the complexity of today life. Everywhere, like access control, transportation, real-time inventory, asset management and automated payment systems etc., RFID has its enormous use [5].

According to their operating frequency, RFID tag can be divided into low-frequency (30~300kHz) RFID tag, high frequency (3~30MHz) RFID tag, ultrahigh frequency (300~968MHz) RFID tag. After a long period of time, we summarize some commonly used frequencies: low-frequency RFID are 125kHz and 134.2kHz, high frequency RFID is 13.56MHz, ultrahigh frequency RFID is 869.5MHz. Ultrahigh frequency RFID tag can be read in long distance. We can also read multiple tags at the same time efficiently. So it was often applied in the product management, custom container access management industry. The RFID technology has improved the efficiency of logistics management system and formulated appropriate logistics resources for logistics service providers [6].

## 2.2. Basic Working Principle of RFID Technology

RFID system consists of two parts, tag system and reader system. RFID tag system consists of the chip and antenna. Chip is the unique data carrier, saving tag data. It is used as a label for identification. The internal antenna is used to absorb external electromagnetic energy to provide working energy to the label. Reader system also includes two parts, external reader and reader antenna. Different with the label, most of reader antenna are outside of the reader. Reader can send and collect information between labels, and then send the decoded information to a back-end database system. Antenna is a bridge connecting reader with the label, transmitting and receiving information between the above two. When the label came into the reader's RF range, its working process is as following.
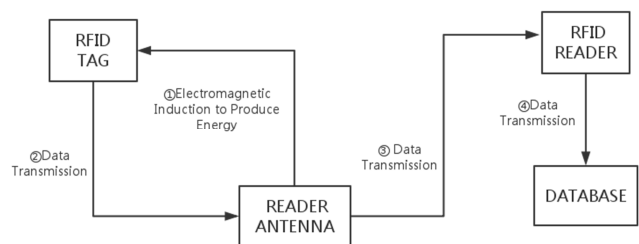


*Figure 1. RFID Working Process.*

# 3. Medical Management Standards

## 3.1. GMP Standard

GMP standard is known as good manufacturing practice standard. It is to ensure the standardization and safety in drug production and management, promulgated by the national ministry of health. Pharmaceutical companies need to strictly enforce drug manufacturing regulations. GMP regulations range from raw materials of drug production to all aspects of pharmaceutical production in the finished product, mainly involve pharmaceuticals quality management, staff qualification, facility, equipment, drug testing, production management, file management, and more. In each aspect, regulations have clear and detailed provisions. The pharmaceutical companies should strictly enforce requirements according to regulations and control every step of the process of pharmaceutical production and management, and do periodic verification. In the standards of GMP, drug production materials in the warehouse and accessories storage have strict requirements, including raw material storage temperature, humidity, classification storage standards, and materials access standards. The management system, firstly developed in industrial and transport sectors, has been recently applied also in the healthcare to ameliorate patient safety [7].

## 3.2. GSP Standard

GSP (Good Supply Practice) standard, also known as the medicine quality control regulation. It needs obey in business sale process. GSP management standard provides the storage

conditions, transport conditions, sales personnel qualification, and supply chain management for the drug in the process of operation, for example, drug procurement and recall of substandard drugs. Meanwhile, the standard also includes hardware facilities and equipment to ensure the quality of medicines. Due to the particularity of pharmaceuticals and drug traceability management for national authorities after entering the market, drug selling enterprises must strictly enforce the requirements for electronic monitoring code to ensure drug safety according to GSP regulation. Patient medication safety is an important issue in patient medication systems. In order to prevent medication errors, integrating RFID technology into automated patient medication systems is required in hospitals [8].

# 4. The Design Goal of a Pharmaceutical Enterprise Warehouse Management System Based on RFID Technology

In recent years, there has been a steady growth in the use of information systems in the logistics domain towards facilitating an agile distribution process. Based on the approach, a decision support system is designed that utilizes RFID technology for ensuring inventory accuracy [9]. Design goal means meeting the actual needs of the business functions for the different system using objects. In a medicine warehouse management system based on RFID technology, system factors need to be taken into consideration during the design process, including operational factors and national legislation factors. System objects include enterprise, administrator, business operator. We will describe the system design goal in the following angles.

## 4.1. For Business User

System has to achieve the following five objectives for business user:

At first, the medicine warehouse management system is designed to be fully relevant to national laws and regulations. Secondly, system is able to dock with the other systems within the enterprise systems. Thirdly, system has corresponding extension to meet the future development needs of enterprise. Fourthly, system complies with corporate management system. Fifthly, system can streamline current business processes, improve efficiency, easy data sharing process, and reduce management costs.

## 4.2. For Administrator

Because of the management system based on RFID technology, its main advantages are the efficiency of data collection, as well as on the efficient sharing of their data. In medicine warehouse management system, in order to the better quality control, their responsibility is more specific and strict. For administrators, pharmaceutical warehouse management system based on RFID technology aims to achieve the following four aspects in the design process:

Firstly, it is convenient for data collection, seamless docking with the warehouse management system. Secondly, system records can be more clear and unambiguous. It is beneficial to daily query. Thirdly, it can ensure the security and confidentiality of the data of the system, and a full range of management and supervision. Fourthly, staff have the access to the corresponding data, and that data can only be used within a certain range.

## 4.3. For Business Operator

For business operator, they are the ultimate users of the system. All warehouse operation project and process are done by them. During the actual operation, the biggest advantage for them is to improve work efficiency, reduce labor intensity. Pharmaceutical warehouse management system technology in the design process includes the following four aspects to achieve the goal. Firstly, relative to the job under the current situation, it can achieve simplification of process and improve efficiency. Secondly, system interface should be simple and easy to find. Thirdly, system implementation is as simple as possible, easy to operate. Fourthly, the correct system data collection can minimize repetitive task and manual operation.

# 5. The Design Principle of a Pharmaceutical Enterprise Warehouse Management System

Just as warehouse control systems has moved up from the machine level to manage picking and packing tasks, warehouse management systems are more involved in order management, planning, predictive analytics and supply chain management than ever before [10]. As the medicine warehouse management system based on RFID technology is an application system, which not only includes common design principles of general system, such as robustness, completeness, security, maintainability, and also stresses the principle of accessibility and openness. The following content will introduce the different principles.

Robustness: for complex network, it can also refer to system capacity and fault-tolerant capability. That means if some mistakes happened, the system is still able to continue working. Data and business process linked together, this puts forward higher requirements on fault tolerance of the system.

Completeness: the completeness of the system mainly targets its business processes, rules, functions, data acquisition, as well as the normative management, in order to ensure the normal operation and function realization.

Security: security is always the key point in this article, refers to the confidentiality of the data and to be used within the corresponding scope of duties. When there is alien trespass, it guarantees that the data information is not compromised and stolen. This is also an aspect of the protection of trade secrets.

Maintainability: system maintenance refers to that the management and change can be sustained. Systems need to be

able to pass their own amendment or the various elements in the system. At the same time, it can complete the management activities through the system maintenance according to the enterprise development.

Accessibility: accessibility is mainly proposed from the user's perspective. Since there are many activities related to warehouse management system in the process of designing, it should try to make the system clearly guide staff through appropriate action, reduce training costs, make it easier for system operation.

Openness: openness is the ability to dock with other systems. For warehouse management system, its main scope of work is in the warehouse. But for an enterprise, it needs warehouse management system dock with internal ERP system, complete the whole manage work.

# 6. The Overall Architecture Design of a Pharmaceutical Enterprise Warehouse Management System

Traditional system design mainly based on client/server system structure. But to achieve enterprise management requirements, now more and more management system uses the upgrade version of client/server structure. It is based on browser/server schema for system development. Based on this schema of operating system, you can achieve human-computer interaction better, use it across platform, improve system reliability and expandability. System development based on b/s structure usually consists of three layers, namely the interface layer, the business logic layer and the data access layer. This paper uses this schema model. At the same time, due to the warehouse management system is mainly used in warehouses. It need dock with other enterprise management systems, vendors and customers, so we add system interface module. The main schema is shown in the following figure:
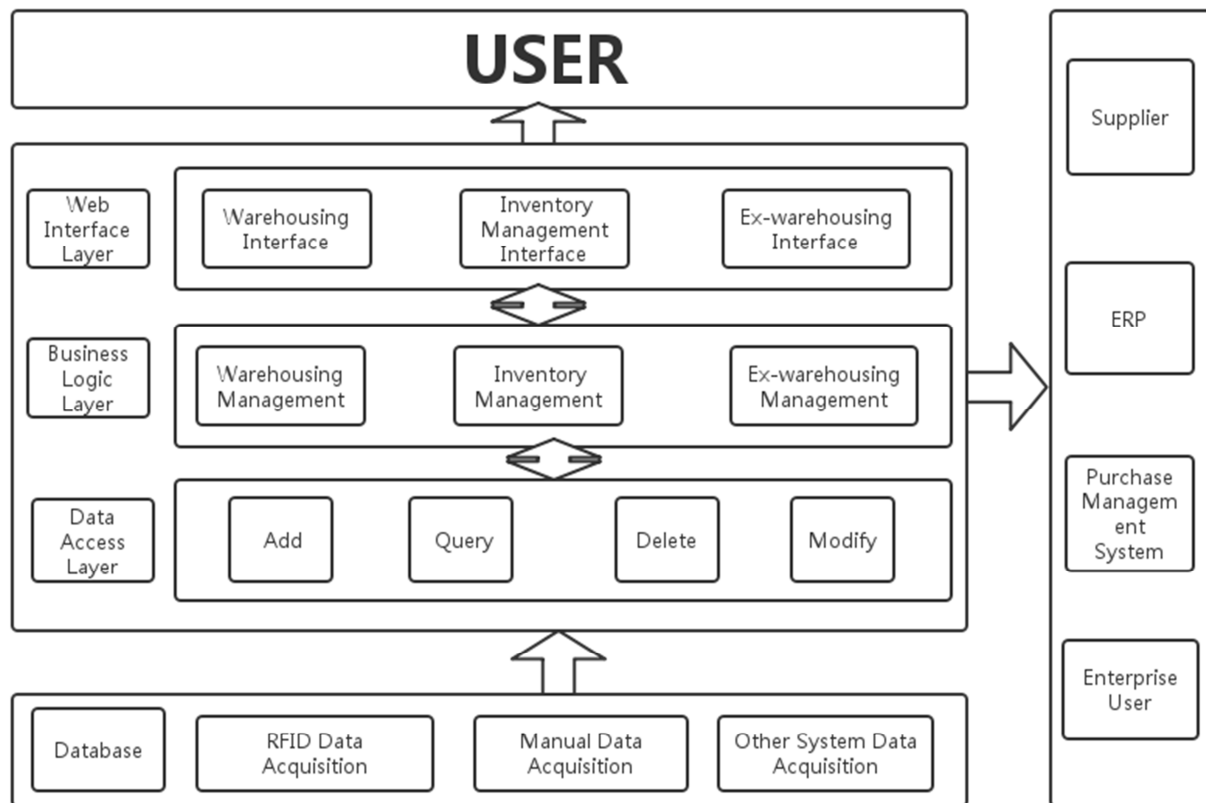


*Figure 2. System Architecture Design.*

According to the figure above, the system in this paper involved of three parts, database, warehouse management system and user. In database, its data source main including three parts, data acquisition from RFID system, staff manual type-in those data that RFID system did not take of and warehouse management system's docking system provides the last data. Warehouse management system's three-tier development model includes the data access layer, business logic layer, and the Web interface layer, which constitutes the main architecture of the system. User sends out applications for instruction via a browser server, performs daily management activities. The three-layer structure of the warehouse management system is introduced in the following paragraph.

At first, in the whole system, data access layer is the interface connecting with database. According to the

instruction in the business logic layer, it calls the corresponding data in the database, completes the operation for data itself, main including increase, query, delete and modification operation. The main body in this part is system administrator, with data access layer, completing the management of database.

Secondly, the business logic layer is mainly the orders made by system users in order to be able to complete the warehouse business management and process operating, including warehouse management, inventory management, and database management operations. System calls data in the business logic layer, analyses it according to the instructions and demand, and transfers data as a web interface to the interface layer.

Finally, the interface layer displayed data and interface to the user. Under browser/server based operating systems, user completes sending the data requirements and receiving the results through the browser according to management needs.

# 7. Conclusion

Based on the understanding of main function processes in the actual pharmaceutical warehouse management, the paper puts forward the corresponding functional requirements and integral architectural design of function's realization, and combines the implementation of all aspects with the RFID system, achieves fast data access. This paper innovatively integrates RFID technology and the current warehouse business processes, and puts appropriate medicinal management practices into the system design. In the future, we can do further practical research for medicine warehouse management system based on RFID technology, including its economic feasibility studies, pharmaceutical warehousing business process studies and operation procedure studies in the special environment. Meanwhile, we should standardize the EPC standard of materials in the pharmaceutical industry, connect with the whole supply chain, as well as in the diverse environment of pharmaceutical warehouse, and implement RFID system equipment selection, truly realize the operability of the system.

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