Design of Logistic Monitoring Management System Based on RFID Technology

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Abstract

This paper proposes RFID-based logistic monitoring management integrated system. We address three important aspects associated with the proposed system (1) developing a real-time process monitoring management with the ability to solve dynamic logistics process management problems;(2) designing a RFID collection terminal with data graphics management; (3) applying a distributed and localized reader collision avoidance algorithm to the collision detection system. In addition to rigorous analysis of performance and accuracy, we developed the proposed logistics monitoring management system based on linux platform.

1. Introduction

Enterprise logistics informatization is a key component of e-commerce. It includes transmission, storage and other activities. Its performance of consists of the commercialization of logistics information, the electronic information technology based on database and electronic code, and the effective data collection methods. The RFID technology regarded as a new data collection method will increase the speed of information collection and operation, providing a fully new collection method for logistics informatization. So the logistics informatization system based on RFID technology is the necessary requirement of logistics informatization, which will improve the collection accuracy and help to promote the development of e-commerce.

According to the features of data collection for logistic informatization, this paper gives an RFID integrated control system model based on logistic informatization, and analysis the function structure of RFID data collection. Based on this, the function modules are designed. The system has the features of anti-collision operation with task scheduling and data integrated processing, providing a referenced implementation method for the logistics informatization management.

2. The architecture of RFID control system based on logistics informatization

2.1 The architecture of RFID control system

The architecture of RFID control system based on logistics informatization is shown in Fig.1. In field device layer, the field data collection terminal based on RFID unit, supports RF identification, information query, data entry, and other functions. The data collection network composed of many such nodes, collecting the product information of different work stations. The tags' information loaded by collection work pieces, is transmitted to the work station through the filed bus controller. When a certain work process is processed, the command information is issued into RFID data format by the data transmission layer, making the RFID unit access to the tags to refresh the data information

The workers of management scheduling dispatch jobs to the workers and equipments thought the scheduling and dispatching modules. Thought the computer networks, the display system gets allocated tasks, displays the task lists, and provides the field flow information of materials. The RFID integrated control system will give full play to self-improving mechanism of JIT production mode, and improve the degree of logistics informatization.

Compared with the existing RFID integrated application modes, it has two obvious disadvantages: simple network structure and high degree of functions integrated. Those functions can be achieved in one terminal node, increasing the compatibility in kinds of application fields.

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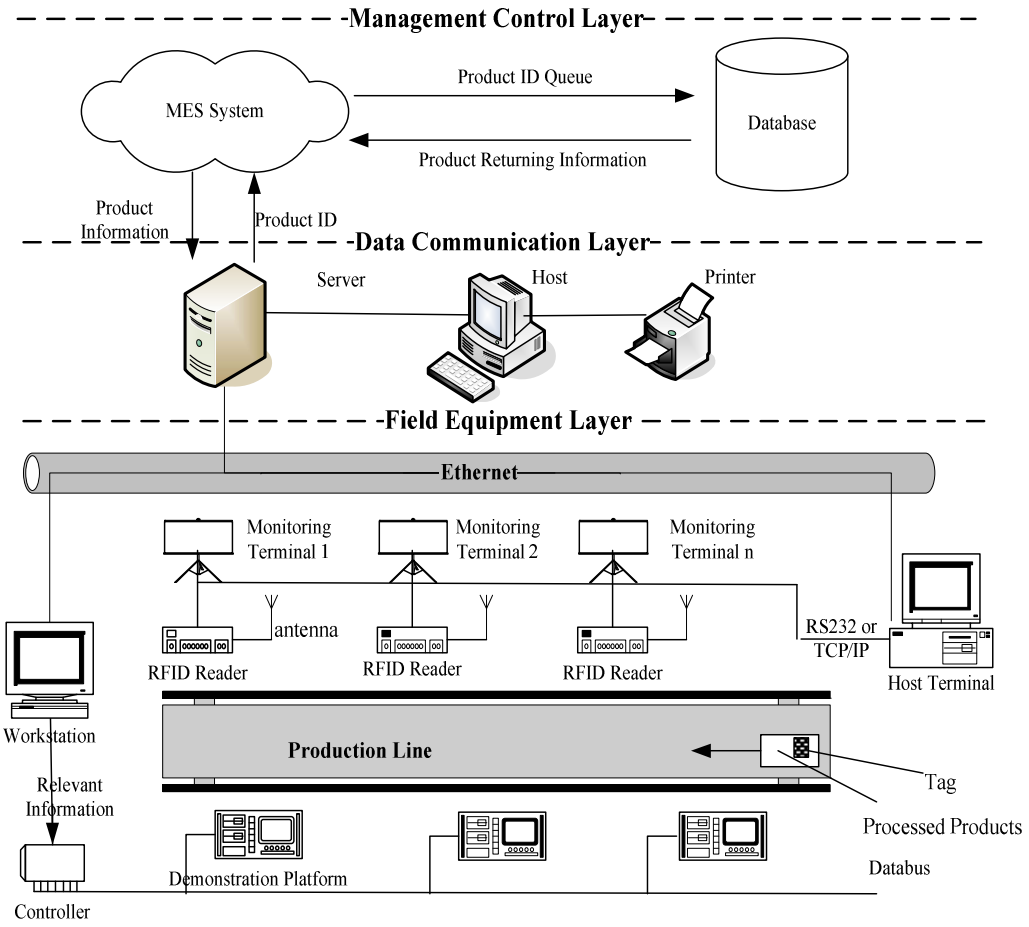

Fig.1 Architecture of RFID integrated control system based on logistics informatization

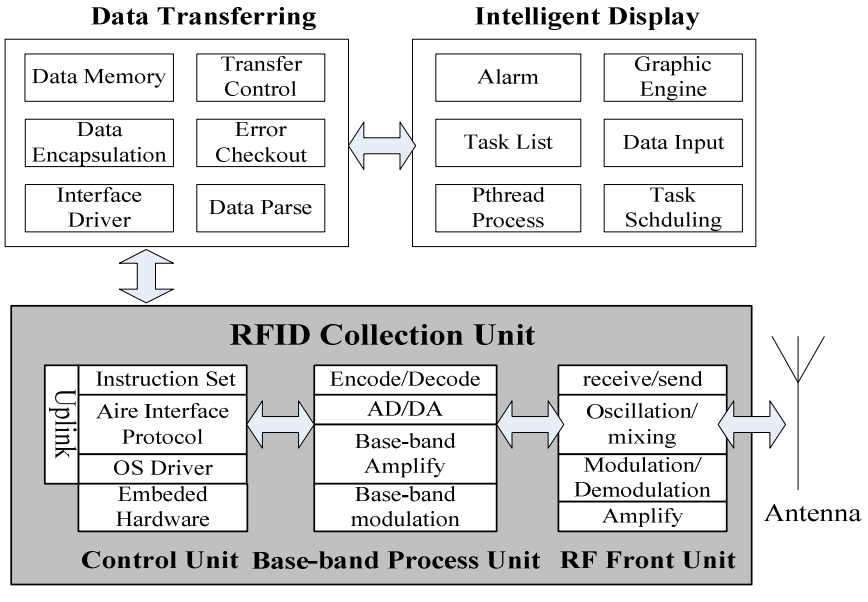

Fig.2 The principle block diagram of RFID data collection

2.2 The implementation principle of RFID collection terminal

RFID data collection unit is the key equipment of RFID control system based on logistics informatization. In the architecture mentioned in this paper, RFID data collection unit can reliably identifies the tags, process their data which is displayed on the screen. So as shown in Fig.2, the function structure of RFID collection terminal is composed of RFID collection unit, data transferring unit and intelligent display unit.

1) RFID collection unit

As an important component of RFID based system, RFID collection has a role in connecting the application system to the electronic tags. The control unit sends command to tags through the base-band process unit and RF front unit. The tag in the RF field receives the information of command, it will response according to its states [1]. The RF front unit collects the tag's information, which is sent to the control unit through base-band process unit.

2) Data transferring unit

This unit will check the data format of tags collected, providing the processing operation of RFID data. The data checked is parsed into datagram format. The data transferring unit can control the data transmitting of the controllers or nodes on the field bus, it also can store the data in the local disk.

3) Intelligent display unit

Through the intelligent display unit, the workers can query the database informatization about the scheming tasks in the MES system using the mode of downloading the production tasks. The architecture based on ARM embedded technology and MiniGUI graphic engine, has the function of field data collection, informatization display and real-time task scheduling.

2.3 The logic function of RFID collection terminal based on logistics informatization

The collection terminal mainly complete the jobs of making work piece serial number, querying the product information and inputting the equipment information , achieving the no-paper operation. Its function can divided into four parts: automatic identification, real-time display, product information input, and equipment information query.

To achieve the complex graphic interface, the Mini GUI engine is used to finish the functions of graphic displaying, information input and operation setting. The Mini GUI system provides complete muti-windows mechanism with compact structure, which is suitable as the graphic platform of the embedded linux.

3. The design of RFID collection unit hardware & software

3.1 The design of RFID collection hardware

RFID collection terminal needs a powerful processing capability to complete collection, consolidation and transfer of information, for the upper management system to provide feedback information. The embedded processing units need reasonable distribution of a variety of tasks to improve the speed and stability of the whole system.

The high costly with price lower FPGA chip used as encoding & decoding core of base-band signal, can achieve the transparent transmission between the control unit and RF front unit. The ARM micro-processor can finish the control function and communication interface. In this paper, the base-band process unit is separated from the control unit [2]. The emission power closed-loop-control and work frequency adjusting reflect the intelligence and practicality of the RFID collection terminal.

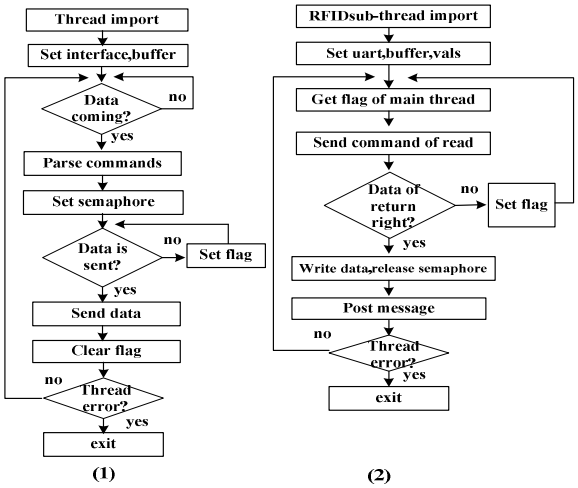

Fig.3 The flow diagram of the control software

3.2 The work flow of software

According to RFID control unit function, the basic work flow design of control unit is shown in Fig.3.

The sub-thread achieves the functions of documents uploading and data transmission. It is monitoring the requests of applications sending and the flag of RF-

driven data arriving in real time. When the request arrived, request instructions are parsed and the corresponding data is sent at the same time. When the control system receives the access request from the tags, it will send relevant command to the tags according to the EPC Gen-2 protocol [3]. The system identifies the tags using anti-collision algorithm, until only one tag returns data.

3.3 Anti-collision algorithm

In the RFID system proposed in this paper, its anti-collision algorithm uses SR algorithm, which is a kind of dynamic frame slot ALOHA algorithm [4]. As same as other ALOHA algorithm, SR algorithm's control system can dynamically adjust the slot number of each frame. But differently, SR algorithm does not need deal with all slots of each frame, which can be more flexible in adjusting the size of frame. It is superior to other ALOHA algorithm in communication number and throughput rate.

4. Application settings

The Philips's Ucode Sl3 IC used as RFID tags, includes 96-bit codes of EPC Gen2, and 128-bit user-program memory [5]. In the practical application, the codes of EPC Gen2 represents the identification field of the work pieces, the user-storage ram is divided into tow parts according to the practical use: one part is used in the identification attribute of the work pieces, another is used in the records of process informatization of the work pieces. The user-storage ram is allocated as shown Table.1.

Table.1 The allocation of tags' user-storage ram

Use	T_JOBDIS	JOBDISBOX	SEQDESC
Field	0-15	16-63	64-71

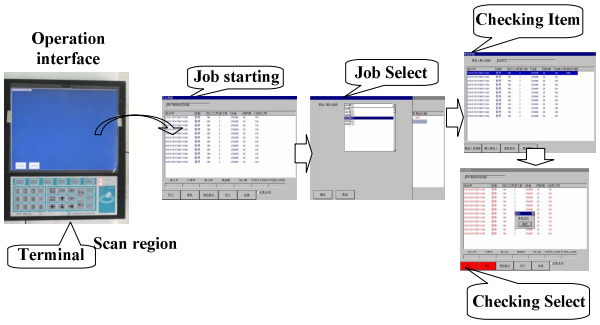

Fig.4 The operation interfaces of logistics monitoring management system

The developing and running environment of the RFID terminal software is C++ platform based on Linux system. The operation interface displays the data lists and configuration items as shown in Fig.4.

5. Conclusions

Now the research about RFID technology used in the logistic field is in the initial stage, and the advantages of RFID technology is not fully brought into play. Compared with the existing RFID applications, The RFID integrated control method based on logistics informatization has the following advantages: (1) its structure is simple, which can load more informatization. (2) it has high degree of functions integrated, which integrates RFID's control system and logistics management system, combining with the embedded Linux system and advanced graphics engine technology. The advantage of our proposed system lies not only in improving work efficiency for on-site engineers, but also in providing dynamic operation control and management to enable project participants to monitor the whole project.

6. References

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