

Research on Automatic Sorting System Based on RFID

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Abstract. Most of the logistics companies use manual sorting method to complete the sorting work. However, with the rapid development of commodity economy, there is a trend that the demands direction of development towards small volume and species. With the increased species and large quantity of commodities, the sorting task has become increasingly heavy. In this paper, RFID tags are used to replace the bar code in processing of logistics businesses. Based on the composition and working principle of the radio frequency identification system, the automatic sorting system based on RFID is designed. The experiment proved that the system can complete the sorting task about 1500 packages an hour, and have a relatively higher efficiency.

Introduction

Radio Frequency Identification is a non-contact automatic identification technology, and it makes use of radio waves to transmit identification information. It is not limited by space, for which Can quickly perform object tracking and data exchange. The distance of tag and the reader can be less than 1cm, or even more than tens or hundreds of meters[1]. In this way, it can recognize all kinds of objects in different states and achieve automated management or control. According to the different application purpose and application environment, the composition of the RFID system will be different. However, from the principle of RFID system, the system consists of RFID tags, readers and antennas generally[2][3].

Electronic label is divided into active tags, semi active tags, and passive tags. Active tags require batteries to provide energy for the communication between the tag and reader, so it's working distance is far than other, and the accuracy is relatively higher. Passive tags do not require batteries to provide energy. It convert electromagnetic from reader to obtain energy, so it's read range is shorter, and the accuracy is lower, but it's cost is also lower[4]. Semi-active tags require battery-powered only when the circuit is working. Compared with the passive tags, it provided further reading distance and accuracy. Compared with the active tag, its price is cheaper[5]. In this paper, passive RFID tags are used. The tag will sent out information by the antenna when the tag into the RF signal coverage range, the antenna on reader received signals reflect from the tag, and then transmitted to the reader through the feeder line. Finally, it will send the signal to the computer which has been demodulated and decoded.

The Advantages of System

The sorting operation is the most complicated and the largest part of the workload in distribution center. With the popularization of the bar code, many express companies have introduced bar-code technology to the auxiliary sorting[4]. Bar-code technology has played an important role in the express company. As the SF express, In the sorting operation of the SF express, they used bar code technology to improve the sorting efficiency. However, there are also inadequacies to use bar-code technology. For example, bar-code and scanner must be aligned when scanning bar-codes. This will not only increase the labor intensity of workers, but also will increase the error rate[5]. The automatic sorting system based on RFID relative to manual sorting has the following advantages:

Firstly, this system can sort continuously, regardless of weather, time, and other physical conditions of the human. The system can run efficiently, because the workers cannot work 8 hours in this labor intensity. The automatic sorting system of RFID can improved the sorting efficiency greatly in the unit time.

Secondly, this system can reduce the sorting error rate. On the basis of experimental result, it is prone to error when manual method is used because of tired. If the bar-code auxiliary sorting is used, bar codes may be wrinkled or damaged, etc. and bar-code reading method is contact reading, automatic sorting cannot be completed.

Thirdly, the purposes of using automatic sorting system are to reduce the use of workers, the labor's intensity and improve efficiency. Automatic sorting system based on RFID can minimize personnel using and reduce manpower cost.

Composed of System

Components and Function of Each Part. Automatic sorting system based on RFID consists of control device, the classification system, the delivery device and sorting crossing[6]. System configuration is shown in Figure1.

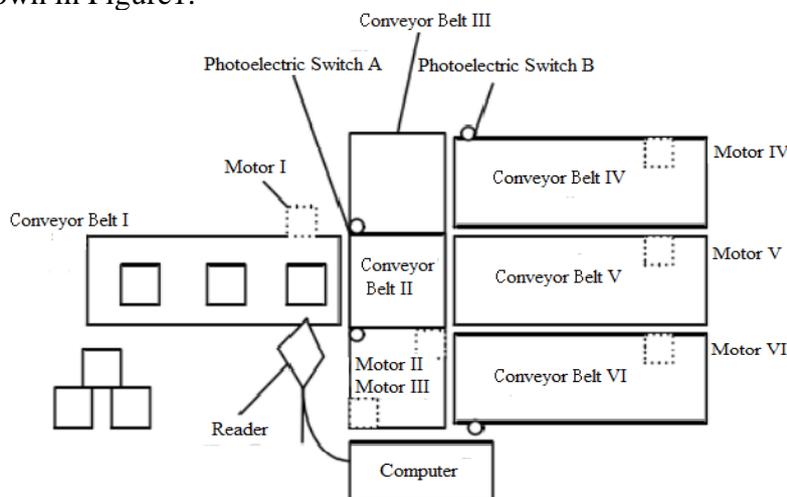


Fig1. Hardware Structure

In the practical application, sorting crossing can be more than three. This system can be used according to the actual application requirements, for example, the fourth conveyor can be used as a delivery device, to meet the application requirements.

Control device includes RFID reader, PC machines as well as micro-controller. The role of the classification system is that according to the control signal from the control module, control servo motors take the package into the sorting crossing or right place. There are many categories of classification devices, and it can be divided into delivery type, push-out, surfaced style, tilt and branch type generally. Different classification devices have different requirements for cargo volume, weight and packaging bottom surface smooth degree, in this paper, a transport-type classification system is used. Delivery device is composed of a Conveyor Belt or conveyor, the main role is to deliver the parcel to the corresponding locations for subsequent operations. The role of sorting crossing is to focus goods which have been sorted[7].

Analysis of Process. Design of the control module is the key point of this system, which is shown in Figure 2.

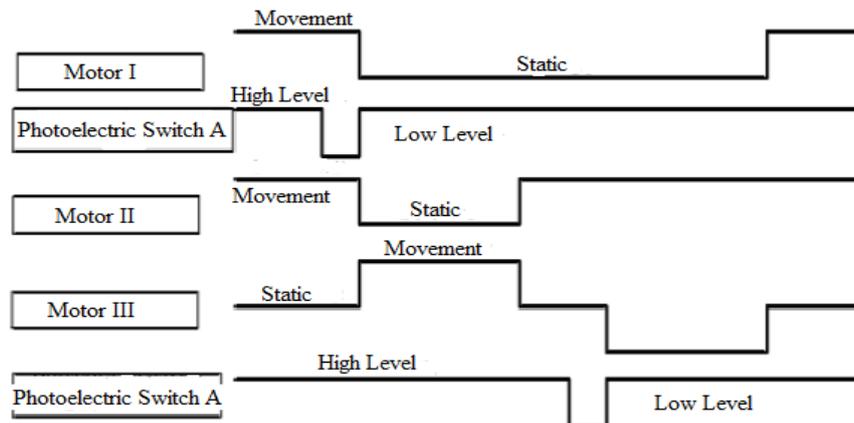


Fig2. Diagram of Timing

As shown in Figure 1 and Figure 2, the workers will put the express on first conveyor belt once the system starts running. After a certain time, goods reach the end of the belt. In this moment, the RFID reader can read the tag's data, and the computer will send a control signal to the micro-controller after process[8]. At the same time, when the object reaches the conveyor II, the micro-controller will receive a pulse signal when it passes through the photoelectric switch A. Then conveyor belt I will stop running, servo motor III will rotate according to the signal from the PC. Shipment will be transported to the designated crossing, for example, the number four crossing. Then servo motor III stops running and the motor II start to work. At this point, the shipment will arrive at conveyor IV, then the conveyor belt III return when the express pass through the photoelectric switch B. After that, motor I run again, and do the next sorting process above. Process of sorting system is shown in Figure 3.

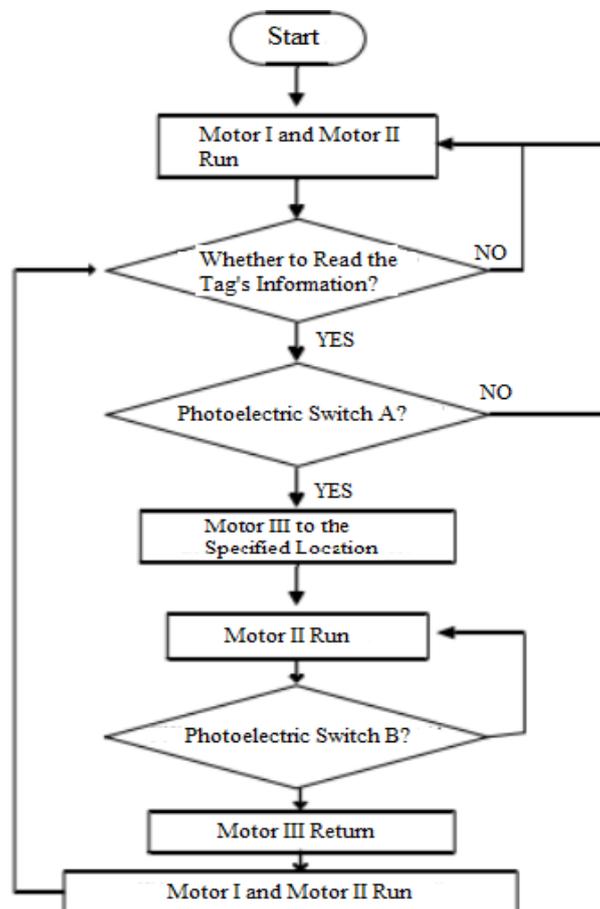


Fig3. Flow chart

Database module. Courier will write related information to the tag by the hand held terminal when he receives the information about Parcel, such as sender information, recipient information, etc.

Database and Table Design:

- 1.Package information: parcel information including number, category, weight, cost, and the time when parcel are send and received.
- 2.Recipient information: recipient information contains the parcel's number, recipient's name, the recipient's exact address and telephone number.
- 3.Statistical information: time information about the package arrived at the transfer station or outlets, for customers to query.
- 4.The administrator information: account number, password.

Data Acquisition Module.Data acquisition module mainly refers to radio frequency identification systems. The reader identifies and receives data information of tags. The computer's function is to accept tags information and send back the control signals. The reader's core chip in this paper is Austria-micro-systems company's AS3992, AS3992 chip combined with the excellent performance of the leading RF transceiver, and it integrate gain filter, PLL, mixer, voltage controlled oscillator, and the ADC-DAC etc. and it support ISO180006A_6B_6C protocol. In this module, we collect data One by one, so we read one message only at the same time. We introduce the RSSI Technology to read the tag with strongest signal.

The Control Unit.The control module makes use of two photoelectric switches and three AT89C51 micro-controllers to achieve scanning their corresponding pin level to complete the servo motor's timing control and the external interrupt port INT0, INT1 collect the sign of the photoelectric switch which is stored in the flag register. It is expected to get a interrupt signal which has low to high transition (upper edge trigger). However, the 51 series micro-controller only have two style of external interrupt which are level trigger and edge trigger style. So we use a 74LS04 invert. Signal pass through the 74LS04 invert and then deliver into the external port INT0 or INT1, the interrupt flag register will be latched interrupt request. Temporary storage will reset by hardware until the CPU response to the interrupt service routine. The diagram of control module is shown in Figure 4.

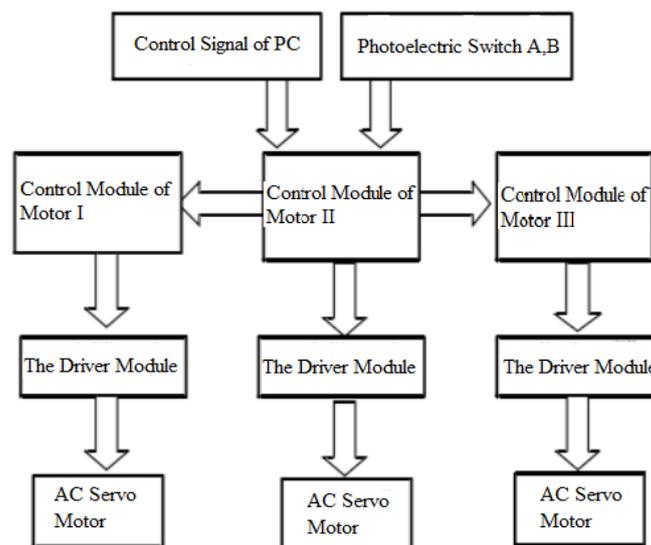


Fig4. Diagram of control module

Software Structure.On the basis of the functional integrity of the system, in the actual design process, we generally divided the system into a set of interrelated subsystems. Here is our block diagram of the system which is decomposed, On the basis of this, we design the detailed module. As shown in Figure 5, the system includes the logic module, registration module, sorting module, modification module, information query module, delete module and information input module.

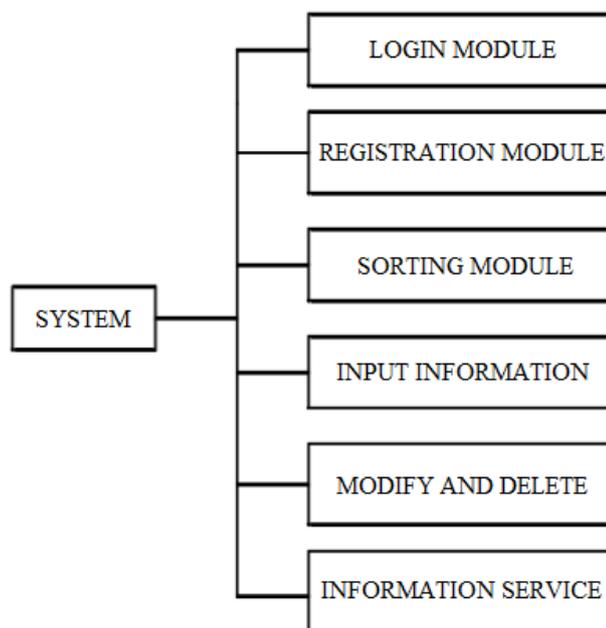


Fig5. The structure of software

Efficiency Analysis

We conducted a systematic test after the completion of the system design. The experiment proved that the system complete a sorting in average of 2 to 3 seconds according to the distance between the packages. The system can complete the sorting task about 1500 packages an hour, and have a relatively higher efficiency.

Summary

In this paper, an automatic sorting system based on RFID is designed. Firstly, the system for acquisition and managing Information is designed. Secondly, the circuit of control and circuit of driver are shown. Finally, the mechanical structure are processed and made. With the gradual improvement of the logistics environment, the automated sorting system on RFID in the field of circulation will come in handy.

Acknowledgments

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