Research on manipulator positioning control system based on RFID Technology

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Abstract: RFID technology is an automatic identification technology that has been rising in recent years. Unlike traditional bar codes and contact IC cards, RFID technology uses wireless radio frequency to conduct non-contact two-way data communication for the purpose of identifying and exchanging data. RFID has the advantages of no manual intervention and less damage to complete the identification work, and is suitable for the automation of the system. A Petri net model of four-degree-of-freedom manipulator control based on RFID single-piece production experiment system is established by applying RFID technology, and its control method is given, so that it can complete the actions of picking and transporting parts, thus realizing the scheduling of various processing tasks. Finally, the application of PLC software in manipulator servo system is explored, which provides reference for the design of PLC manipulator precise positioning and control system.

1. Introduction

With the rapid development of manipulator applications, there are more and more manipulator applications, especially in those aspects that cause harm to personnel, so the varieties of manipulator parts have begun to diversify, and the output has also increased [1]. In the face of the complex variety and huge number of manipulator parts, the traditional production management method is to use labor to manage the production of manipulator parts. The key to work efficiency lies in employees. The speed of information reading and recognition will have a certain impact on accuracy, and the final result will affect work efficiency and even the processing quality of manipulator parts [2]. RFID is becoming a reality because modern supply chains require greater efficiency, information flow and flexibility. RFID products have been applied in retail, medicine, transportation, national defense, packaged consumer goods and other industries. It is also widely used in the fields of smart transportation and personnel access control to meet the effective collection and control of vehicle and personnel information in modern management [3].RFID technology can compensate for the deficiencies of current barcodes, companies can track inventory throughout the supply chain, RFID automatic data collection does not require target objects to be within the scope of implementation, or manual scanning. RFID brings great economic benefits in some applications such as railway transportation [4]. Using RFID technology can improve system tracking, improve forecasting level and container security, and reduce the occurrence of goods shrinkage, recall and out of stock, thus saving billions of dollars in supply chain costs [5]. In this paper, based on the integration of RFID technology and manipulator, the motion control of manipulator is studied experimentally, and the positioning system of manipulator is analyzed and simulated. It provides a new idea for positioning and motion control of manipulator.

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2. RFID technology and manipulator control system

2.1. RFID technology

RFID technology is an automatic identification technology that has emerged in recent years. Different from traditional bar code systems and contact IC cards, the radio frequency identification system uses wireless radio frequency non-contact power supply and non-contact two-way data communication to achieve the purpose of identifying and exchanging data. The identification work does not require manual intervention and can work in various harsh environments. RFID technology can identify high-speed moving objects and can identify multiple tags at the same time, and the operation is quick and convenient. Compared with other identification systems, radio frequency identification system has many advantages. With the development and maturity of integrated circuit technology, radio frequency identification technology has a broader market.Radio Frequency Identification (RFID) technology is widely used in many fields such as industrial automation, commercial automation, traffic control management and so on: traffic monitoring for automobiles, trains, highway automatic toll collection system, parking lot management system, goods management, pipeline production automation, safety access inspection, warehouse management, animal management, vehicle theft prevention, and so on, even in the military.RFID applications are still emerging. Using RFID technology to realize automatic control and monitoring in the production line can improve productivity, improve production methods and save costs. RFID system is used for manipulator positioning control, and its application in manipulator greatly promotes the development of mechanization, intelligence and automation of industrial production. RFID system is usually composed of reader-writer, tag and computer communication network, as shown in Fig. 1.

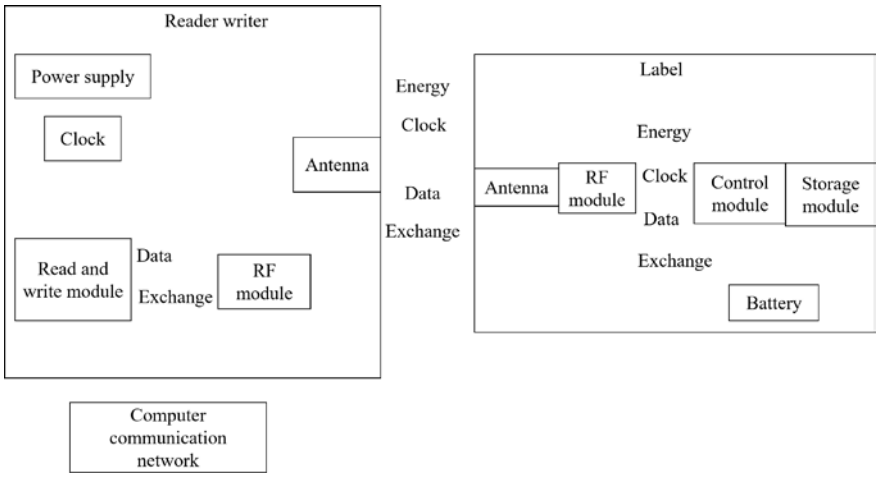

Fig.1 Structure diagram of 1RFID system

2.2. The structure of the manipulator control system

For any manipulator, the control system can be represented by the block diagram in Fig. 2, which consists of a program action commander, a coincidence circuit, a beat circuit, and a power-off memory circuit. The system is controlled in an asynchronous control mode, and the commander sends out an action command (ZL=1), and through the drive circuit, a certain part of the manipulator completes a predetermined action. The action completion signal (JFΣ=1) is issued through the coincidence circuit, the clock pulse CP is generated, and the next action command is issued. The completion signal of the previous action is used as the control method of the next action start signal, which ensures that the manipulator reliably and accurately completes the actions specified by the program.

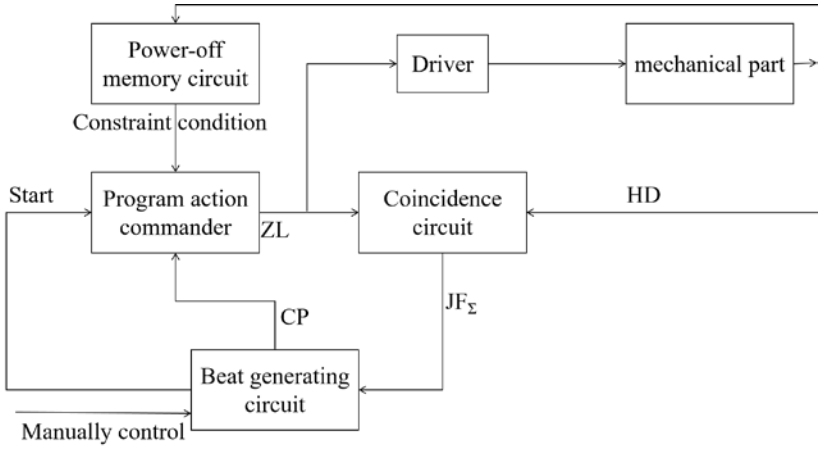

Fig.2 The structure of the manipulator control system

Due to the special needs of manipulator action, the control system shall ensure that the manipulator action state can be memorized in case of sudden power failure. When it is powered on again, this state reappears. When other conditions are met, the manipulator continues to act according to the program requirements. Like other control systems, the system can not only automatically but also manually, but also realize a cycle action in sequence [7].

3. Manipulator positioning control system based on RFID technology

The RFID reading and writing device used in this paper is TagMasterABS1500, which works at 2.45GHz, has a ring-shaped polar information field, and the reading and writing distance can reach 4 meters. And the reader can be set to make its reading and writing distance less than 4 meters as required. The communicator has 100 selectable channels. Using different channels can prevent mutual interference between adjacent communicators. The transmitting power and receiving sensitivity of the communicator can be adjusted by software instructions to achieve the best installation. The reader also has a motion detection function, which can detect moving objects such as moving manipulators, people, and even smaller moving objects, even moving objects without tags can also be detected. This function can detect the moving speed of moving objects, approach or leave the reader and other information, combined with the manipulator can detect moving obstacles and avoid obstacles. The manipulator moves according to the instructions issued by the upper computer scheduling program. The programmable controller (PLC) transmits the data collected by the terminal equipment to the upper computer. The upper computer generates scheduling instructions through the change of the state of the machine and parts in the shared memory area. Then, through the asynchronous communication between processes, the manipulator control program takes out the instructions from the shared memory area and executes these instructions in turn. A simple object handling experiment, including left-right movement, grasping and placement, is constructed to verify the effectiveness of the joint control scheme. The experimental scenario is shown in Fig. 3.

There are three main movements of the manipulator: when new parts are produced, the manipulator control program finds out an empty position from the buffer zone, and controls the manipulator to grasp the parts from the initial buffer zone to the empty buffer zone position. There are parts to be processed on the machine. At this time, the manipulator grabs a part from the position where there are parts in the buffer zone and scans it on the reader-writer beside the machine. If it is a part to be processed, put it on the machine. If it is not, put it back in the original position of the buffer zone and grab it from the next position until it finds the part to be processed. Some parts have been processed on the machine. If all processes of this part have been processed, grab the part out of the system. If not, find an empty place in the buffer area and place the part from the machine on the reader to scan and confirm the processing. Finished, and then put it in that empty spot. Finally, when the manipulator completes any of the above three actions, the status of the parts and the machine will change, and the monitoring program writes the updated status data

into the shared memory area. In order to ensure the reliability of the system, improve production efficiency and reduce the rate of defective products, the accurate positioning system adds an alarm screen design in the touch screen screen screen design. The alarm screen includes h kinds of alarm information: historical alarm table, current alarm table and alarm frequency table. The alarm information will be displayed on the man-machine screen in the way of stepping with a lantern. In the whole operation process of PLC servo control system to realize precise positioning, no matter what kind of operation interface and movement process, as long as wrong actions or operation modes such as wrong operation, wrong setting and wrong operation occur, the touch screen will display alarm information.

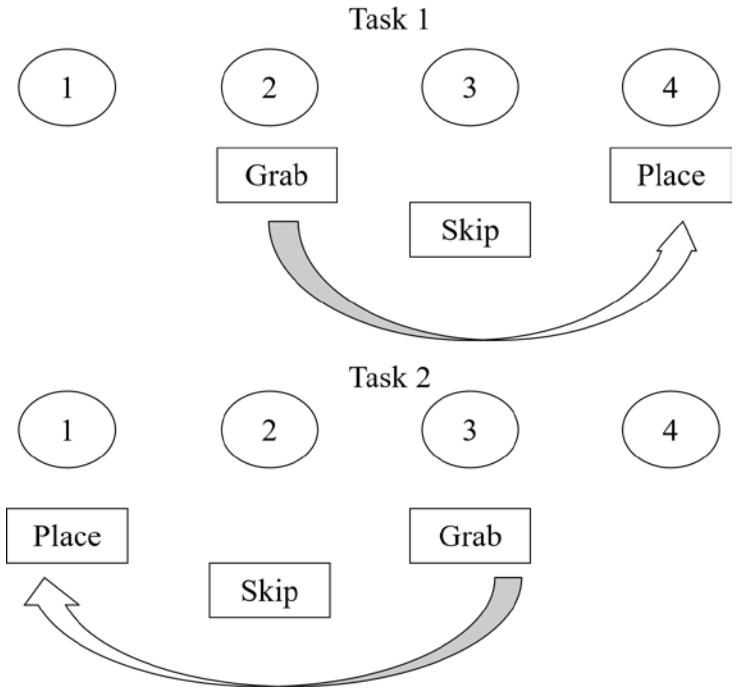

Fig.3 Example of object handling task by manipulator

4. Conclusions

This paper proposes a positioning control method for manipulators based on RFID. The development and application of RFID is one of the hot topics of current advanced science and technology, and it has received more and more attention from all walks of life. RFID technology is an identification technology that uses wireless radio frequency for non-contact two-way communication. The subject itself involves a wide range of knowledge. It needs to integrate manipulator control technology, communication and positioning technology, and each aspect is a topic worthy of in-depth study. Collecting the latest theoretical research and application results of RFID in the control and positioning system of RFID manipulator will make the manipulator system more intelligent. In summary, the application of programmable logic controller in the manipulator can improve the positioning accuracy and auto-control reliability of the manipulator. In order to do a good job in the design of the precise positioning control system for the RFID manipulator, in the design of the servo system of the manipulator, first of all, do a good job in the selection of components, and design a human-friendly human-machine interface according to the working environment and needs of the manipulator. In addition, pay more attention to the software design of the servo control system. Continuously improve the positioning accuracy and the reliability of automatic control of the RFID manipulator servo system. In the future work, fuzzy logic and support vector machine technology will be considered to further improve the classification rate of manipulator actions. At the same time, action types are added, so that the manipulator can realize more complex operation tasks. At the same time, RFID-based robot arm control system has high control precision, system chip and easy expansion. Rich on-chip resources provide guarantee for the

realization of complex algorithms and can meet different scientific research or application requirements.

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