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Design of Microbial Storage System based on PLC

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Abstract

A microbial storage system is a device for the preservation of microorganisms that is designed and operated to ensure their safety and stability. This paper introduces a microbiological storage system based on PLC. The microbiological storage system uses a robotic arm and a bidirectional fork to transport relevant petri dishes to a specified location, and completes the functions of sample collection, processing, classification, labeling, storage and management.

Keywords

PLC; Robot Arm; Microorganism.

1. Introduction

Microbial storage device is a device used to preserve and protect microbial samples, which plays a key role in biological science research, medical diagnosis, drug development and other fields. The microbial storage device can provide a low temperature environment, such as liquid nitrogen or ultra-low temperature freezing conditions, which can keep microorganisms alive and stable for a long time to ensure their long-term preservation; It helps to protect and preserve rare and endangered microbial species, as well as important microbial resources in humans and the environment, to avoid their loss and overuse. The microbial storage device provides a convenient microbial resource sharing platform for scientific research institutions, universities and industry, promotes scientific cooperation and knowledge exchange, and promotes the progress of microbial research. It helps to safely preserve and manage pathogenic microorganisms, reduces risks to the public and laboratory workers, and provides an important reference and surveillance resource for disease control and vaccine development. Microbial samples in microbial storage devices can be used to screen new drugs and bioactive substances, search for compounds with pharmacological activity and bioactivity, and provide important resources for new drug development. Microbial storage devices provide basic materials for biotechnology research and application, such as fermentation products, enzymes, metabolites, etc., and are widely used in food industry, environmental monitoring, energy production and other fields. In summary, microbial storage devices have broad prospects and application potential in microbial resource protection, scientific research, medical application and industrial production.

2. Microbial Storage Device

First, the structure of the microbial classification and identification system is designed. Through the structural analysis of the microbial classification and identification system, the hardware control system is designed. The microbial classification and identification system is divided into programmable controller module, motor drive module, RFID wireless identification module, and photoelectric sensor. module, image acquisition system and robotic arm module. The control flow chart of the microbial classification and identification system is shown in Fig. 1.

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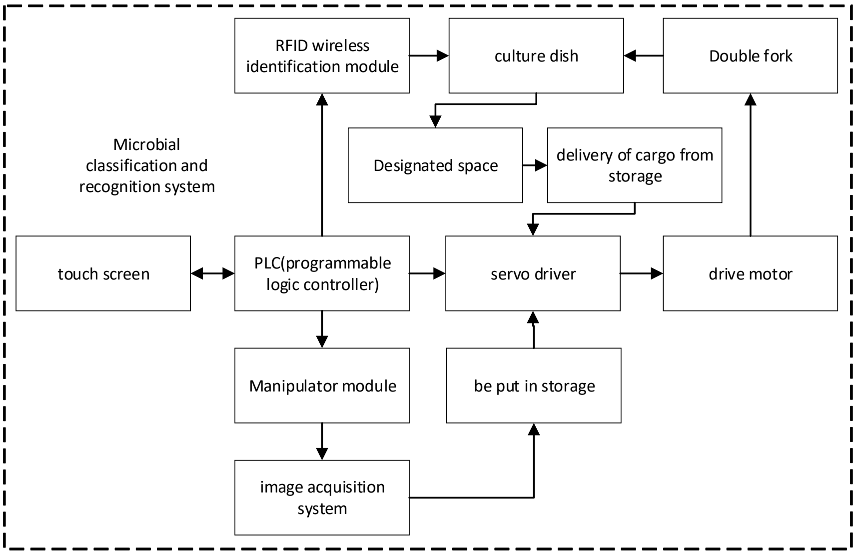

Fig. 1 System control flow chart

The structure diagram of the microbial classification and identification system is shown in Fig. 2 below. Microbial storage device system can use the PLC accurate robotic arm[1] module to grab the microbial petri dish to the corresponding location of the image acquisition system. After completing the relevant operations of microbial image collection, it will grab the microbial petri dish again and arrive at the storage location[2]. The PLC controls the two-way fork to accurately find the corresponding location. By driving the servo driver to control the motor at the relevant storage location of the petri dish, the microorganism-related classification information will be written into the petri dish or related items through the RFID wireless identification module and the petri dish will be moved to the relevant designated storage location. Through the identification operation of the photoelectric sensor-related modules, it is possible to check whether there are petri dishes or related items in the storage location, and the storage location storage information is displayed on the touch screen. Relevant staff can view and control the touch screen to carry out the microbial classification and identification system. Operation, supervision and commissioning.

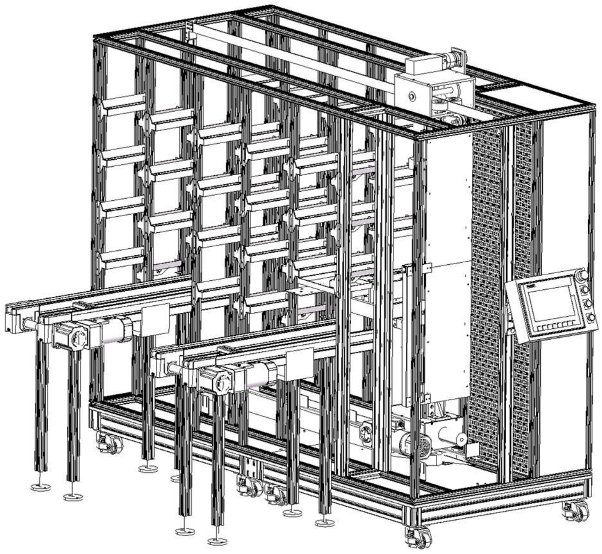

Fig. 2 Classification and recognition system structure diagram

The hardware location distribution and connections of the microbial classification and identification system are as shown in the figure.

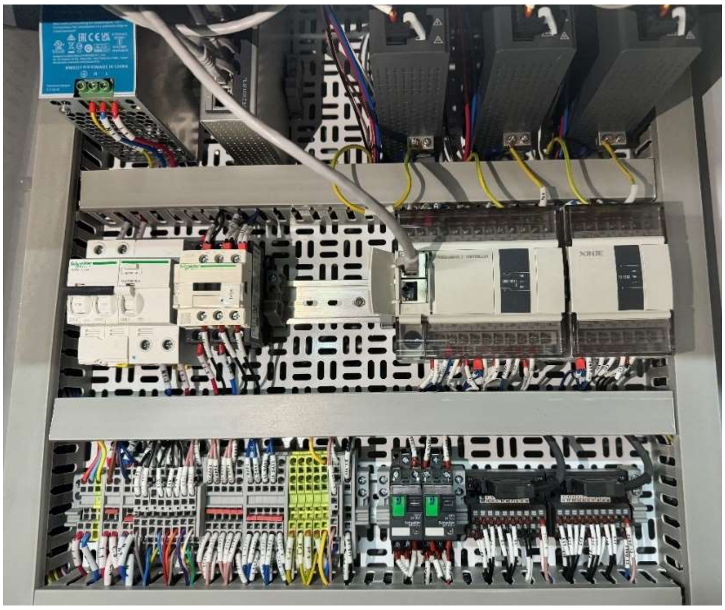

Fig. 3 Hardware distribution and its connection diagram

The RFID system is mainly composed of RFID tags and readers. RFID tags are composed of microchips and antennas, which can achieve one-way or two-way communication. Data can be read and written between the tag and the reader, as shown in Fig. 4. Tags can be attached to petri dishes and related objects to store corresponding unique identification codes and other microorganism-related species information, and use antennas to receive and send radio signal communications. The reader/writer is used to communicate with RFID tags. The reader/writer activates the surrounding RFID tags by sending wireless signals, reads the data in the tags, and transmits the read signals to the background system by connecting to the host computer, which can quickly and accurately identify Each microbiological petri dish or other related object is uniquely identified and quickly tracked, bringing convenience in inspection and storage inventory management.

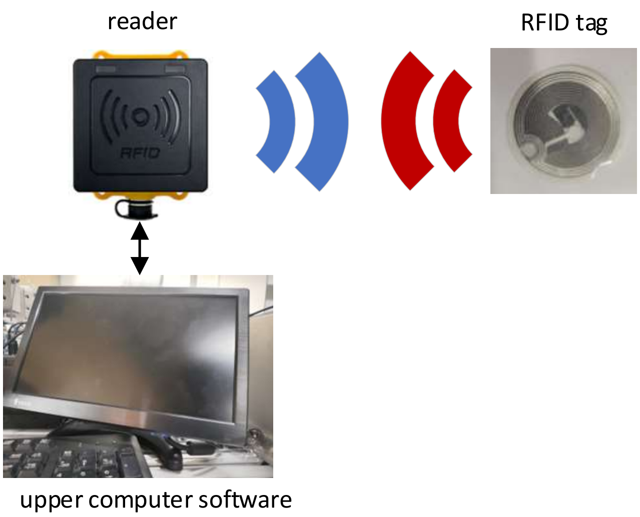

Fig. 4 RFID technology working communication diagram

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The image acquisition module is the most important module in the microbial classification and identification system that has the most important impact on subsequent image processing, and is an important part of acquiring images. The image acquisition system consists of a microscope and a microscope camera. The microscope camera converts the optical image of the microorganism into a digital signal image through the microscope, and further processes the digital image such as saving, editing, and transmission to meet the task requirements of subsequent classification and identification of microorganisms.

Fig. 5 OLYPUS DP28 digital microscope camera

The microscope camera[3] adopts OLYPUS DP28 model digital microscope camera, as shown in Fig. 5. The DP28 digital microscope camera is designed for industrial inspection, delivering up to 4k resolution with precise color accuracy and a wide field of view, and can capture clear images of microorganisms even when the platform is moving.

Fig. 6 CKN53 microscope

The microscope[4] is OLYPUS's CKX53 inverted microscope, as shown in Fig. 6. The CKX53 microscope is a compact ergonomic inverted microscope suitable for cell culture. It has higher image quality in imaging and can provide stability for various microbial observation and culture needs such as live cell observation, cell sampling and processing, image acquisition and fluorescence processing. Services, the CKX53 microscope has an anti-UV coating and a lightweight body and weight of 7 kg. It can be installed on a clean bench for UV sterilization, ensuring a pollution-free environment. In terms of placing microorganisms, the microscope with a versatile stand can be compatible with various cell culture containers, including but not limited to petri dishes, microplates, culture bottles, etc. Lifting the adapter holder expands the stage 7 mm to the left and right, allowing for greater operational flexibility by manually positioning culture vessels.

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The robotic arm[5] is responsible for placing image sampling microorganisms in the image acquisition system area. The AUBO-i5 collaborative robot was selected as Microbial storage device robotic arm module, as shown in Fig. 7 below.

Fig. 7 AUBO-i5 collaborative robot

The i5 collaborative robot is capable of automated operations with an end load of less than 5 kilograms, and does not need to install protective fences during the work process. It can work in close proximity with people, which is perfect for picking up and placing microorganisms. The arm span of the AUBO-i5 collaborative robot is 1008 mm, the working range that can be satisfied is within 886.5 mm, and the position accuracy can reach 0.02 mm. It can be stably placed in the image acquisition module area to complete subsequent image acquisition tasks.

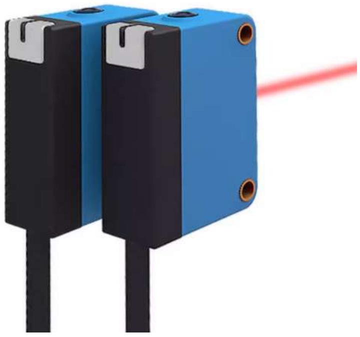

Fig. 8 Square photoelectric schematic diagram

Microbial storage device system uses square photoelectricity from Feide Automation Technology, also known as square photoresistor, model DN-16ND-100B. The working principle of Square Photoelectric is based on the characteristics of photoresistor, which consists of a transmitter and a receiver. Square Photoelectric emits infrared rays or laser beams to detect whether there is light reflected back from the receiver to detect whether the object is placed at a specified location. In Microbial storage device system, a square photoelectric is placed on the shelf to detect whether the shelf contains petri dishes or related items. The square photoelectric image is shown in Fig. 8.

3. Conclusion

Biological storage device is a kind of equipment used to preserve and maintain microbial samples, which is of great significance for microbial research and application. With the continuous progress of technology, future microbial storage devices will have higher storage density and faster access speed. This will greatly improve the efficiency and flexibility of sample management. Microbial storage devices will tend to be automated and intelligent. By introducing advanced machine learning and artificial intelligence technologies, the device can achieve automatic sample identification, classification, storage and retrieval, reducing human error and time costs. Cryopreservation technology: Cryopreservation is one of the main methods for long-term preservation of microorganisms. Future microbial storage devices will use more advanced cryogenic preservation technologies, such as ultra-low temperature freezing, freeze drying, etc., to ensure the long-term preservation and stability of microbial samples. Long-term persistence: Microbial storage devices will be designed with a greater focus on the long-term persistence of samples. The choice of materials and the design of the structure will be more durable and will be able to maintain the integrity and vitality of the sample for a long time. With the increase in microbial research data, future microbial storage devices will be integrated with data management systems to enable comprehensive management and sharing of sample information, storage conditions and research data. Overall, the microbial storage devices of the future will be more efficient, intelligent and sustainable. This will provide better support for microbiology research and applications, and promote the conservation and sustainable use of microbial resources.

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