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Research on the Application of Big Data Technology in the Design of the Control System of the Laboratory Circulation Refrigeration Equipment

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Abstract: In the era of digital economy, modern technologies such as big data and artificial intelligence have developed rapidly, and various new laboratory refrigeration equipment have been introduced, which has greatly helped the laboratory work. Therefore, based on big data technology, this paper constructs the control system of laboratory cycle refrigeration equipment, including environmental information collection module, embedded program unit, cloud service system, programmable controller and operation control elements. This laboratory cycle refrigeration equipment control system can carry out fault prediction, intelligent control and artificial intelligence for IT operations, automatically adjust the storage environment required for different reagents, improve the scientificity of laboratory temperature control, and contribute to the long-term preservation of experimental reagents. In addition, the control system of the laboratory's cycle refrigeration equipment has lower investment and energy consumption, is safer in use, has more stable performance, can achieve accurate control of the temperature zone, and improve the efficiency of the laboratory's temperature control.

Keywords: Big data technology; Control system of circulating refrigeration equipment

1. Introduction

The suitability of laboratory temperature directly affects the quality and storage time of experimental reagents. If the temperature is too high or too low, it may cause irreversible changes in the drug, thereby affecting the experimental process and results[1]. At the same time, if the laboratory temperature is not suitable, other natural factors will accelerate the destruction of the quality of the experimental reagents, causing a series of deterioration problems such as clumping, freezing, adhesion, softening, etc., weakening the effectiveness of the experimental reagents. In general, most experimental reagents need to be stored in environments below 30 ℃, while some low-temperature experimental reagents need to be stored in environments below 10 ℃, with air humidity not exceeding 70% [2]. At present, the control system design of the laboratory cycle refrigeration equipment is a key part of storing experimental reagents and conducting research. The continuous upgrading of science and technology has provided many new directions for solving the above problems, especially big data technology has become a new tool for designing the control system of the laboratory cycle refrigeration equipment. Therefore, this research actively discusses how to use big data technology to design the control system of laboratory cycle refrigeration equipment, and enhance the scientificity of laboratory temperature control.

2. Overview of control system structure of laboratory cycle refrigeration equipment

2.1 System module

Environmental information collection module. The environmental information collection module is the basic component of the control system of the laboratory cycle refrigeration equipment. It mainly monitors and collects the temperature and humidity information in the laboratory, and timely grasps the comprehensive environmental situation in the laboratory. When the temperature or humidity of the laboratory exceeds the specified value, the control system of the laboratory cycle refrigeration equipment will automatically start the refrigeration and ventilation modes, so that the laboratory environment will basically remain unchanged. The

environmental information collection module mainly includes temperature sensors, which are mainly used to detect temperature in the laboratory. Humidity sensor mainly used to detect humidity in the laboratory.

Embedded program unit. In the control system of the laboratory cycle refrigeration equipment designed by this research institute, the embedded program unit mainly processes the information collected by the environmental information collection module based on big data technology, and then transmits the results to the cloud service system. In other words, the embedded program unit first processes and analyzes the temperature and humidity information based on big data technology, and then transmits the analysis results to the cloud service system.

Cloud service system. The big data cloud platform is usually composed of data layer, business layer and logic layer, and comprehensively processes, calculates, compares and analyzes relevant temperature data[3]. Among them, the data layer is the initial information entry point of the cloud service system, which can classify the information output by embedded program units, and then transmit it to different data interfaces to perform corresponding operations such as conversion, parsing, and storage of data. The business layer provides corresponding temperature services based on various application scenarios or experimental reagent storage requirements. The business layer system mainly includes service content such as fault information, environmental data history information, temperature regulation equipment action commands, maintenance records, etc. The logic layer is mainly built by hadoop service supported by big data technology, including fault information logic processing, real-time analysis of environmental data, generation of temperature regulation equipment action commands, and logical processing of maintenance record information. The cloud service system processes and classifies environmental data through the data layer, uses big data technology to analyze the laboratory temperature, and generates the startup frequency and startup mode of refrigeration or ventilation equipment through methods such as arithmetic of equal difference and equal position, comparative analysis of historical data, etc.

2.2 System architecture and operational processes

The control system of laboratory cycle refrigeration equipment is mainly composed of environmental information collection module, embedded program unit, cloud service system, programmable controller and operation control components. In the specific operation process, the environmental information collection module of the laboratory cycle refrigeration equipment control system has temperature and humidity sensors, which can accurately detect the temperature and humidity in the laboratory. The embedded program unit of the laboratory cycle refrigeration equipment control system receives the detected environmental data, processes and analyzes the environmental data, and then transmits the final results to the cloud service system. The cloud service system of the laboratory cycle refrigeration equipment control system integrates the data processing results sent by the embedded program unit, obtains the corresponding laboratory cycle refrigeration decision, and then sends the corresponding instructions to the programmable controller. After receiving the command sent by the cloud service system, the programmable controller of the control system of the laboratory cycle refrigeration equipment sets the control parameters of the refrigerator according to the command, and starts or closes the control program of the operation control elements such as the refrigerator and blower. In this process, the environmental information collection module collects laboratory environmental data based on big data technology, generates instructions using machine learning algorithms and equipotential analysis method, and adjusts the laboratory temperature. Various laboratory environmental sensor values are transmitted to the cloud service system through 4G signals, and compared with standard values to determine if the system has malfunctioned. In case of failure, the cloud service system will send failure information to the maintenance personnel to ensure the continuous use of the circulating refrigeration equipment in the laboratory.

3. The practicability of the control system of the laboratory cycle refrigeration equipment

3.1 Fault prediction

Generally speaking, the control system of the laboratory cycle refrigeration equipment involves multiple components such as solenoid valves, pressure sensors, etc., and the risk control technology is relatively complex. Large refrigeration cycle systems are relatively large, and each link may have major failures. The traditional scheme usually uses manpower and simple technology for troubleshooting, which in a sense will consume a lot of manpower and material costs, as well as a lot of time costs, which reduces the operating efficiency of the control system of the laboratory cycle refrigeration equipment. Specifically, if key components of the circulating refrigeration system malfunction, enterprise management personnel need to contact after-sales personnel for maintenance, which cannot achieve normal use. However, when big data technology is applied to the control system of laboratory circulating refrigeration equipment, specific faults can be analyzed through big data technology analysis methods.

3.2 Intelligent control

Intelligentization is the future development direction of the control system of laboratory cycle refrigeration equipment. Therefore, relevant units study the operation law of the control system of the laboratory cycle refrigeration equipment through big data analysis method, and integrate a certain law model from it to predict the characteristic parameters of the system, thus increasing the intelligent characteristics of the system. For example, enterprise managers analyze the temperature change trend and influencing factors of the laboratory's circulating refrigeration equipment through big data, and use this as the basis for intelligent adjustment of the system, so as to improve the operating efficiency of the system. In this process, enterprise management personnel increase the specific situation of power consumption by establishing user on/off time and setting temperature. Based on this, intelligent energy-saving target values are set according to a fixed period of time. Combined with the target setting mode, operating parameters are calculated to achieve energy-saving results and reduce unnecessary resource waste.

3.3 Artificial Intelligence for IT operations

In fact, big data technology can not only enable laboratory personnel to develop the control system of circulating refrigeration equipment, but also provide sufficient support for the operation and maintenance of this system. Specifically, for the control system of circulating refrigeration equipment in large laboratories, relevant personnel use big data technology to model and analyze the data such as body comfort and weather, and then intelligently adjust the operating state of the system. Not only that, relevant monitoring personnel can also establish contact with the manufacturer's after-sales service to detect the operation status of the control system of the circulating refrigeration equipment in real time through the detection algorithm of Big data technology fault prediction. At the same time, the manufacturer's cloud service system can intelligently determine the type of fault and find a solution based on real-time uploaded operational data, improving operation and maintenance efficiency and user experience.

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