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Design Method of Intelligent Control of Central Air Conditioning through PLC

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Abstract: *The air-conditioning industry has more and more strict control requirements on the use of electrical power consumption, but the energy consumption of the existing central air-conditioning system is always high. Taking full advantage of the load uncertainty of central air conditioning, this paper designs a central air conditioning system with high automatic control function by using PLC, frequency converter and other devices. In this system, the motor is equipped with frequency converter to realize speed control, and variable air volume control and variable flow control are adopted for different loads to reduce invalid energy consumption. The software control flow and configuration monitoring interface are designed, so as to realize the variable frequency operation control of central air conditioning and finally realize the purpose of variable frequency energy saving.*

Keywords: *Central air conditioning; Control system; PLC; Frequency converter*

1. Introduction

With the development of economy, science and technology, in response to the call of the state, college students should also actively use their brains to contribute to solving social problems and promoting social development[1].

Nowadays, central air conditioning is widely used in shopping malls, office buildings and factories. The traditional control system adopts constant flow control mode, that is, no matter how the terminal load changes, the air conditioning system is running at the designed rated state, and it is not possible to scientifically adjust the refrigerant flow with the actual load change, which is a great waste of energy. Nowadays, people pay more and more attention to the comfort and energy saving of central air-conditioning[2]. However, the traditional central air-conditioning system operators and maintenance personnel often use manual control to save energy. This subjective grading adjustment is very rough, has poor real-time performance, and is greatly influenced by equipment configuration and human factors, which can no longer meet people's needs. In this environment, the control requirements of central air conditioning are analyzed, and the control logic and flow are reset. Based on this, the PLC control system of central air conditioning is designed and debugged, which is more in line with the use of shopping malls, office buildings, factories and other places[3].

In order to facilitate indoor users to control air conditioning, especially multi-line air conditioning system, a line controller is installed indoors to control the operation of indoor units. In addition, with the improvement of intelligence of air conditioning system, most air conditioning systems have voice control function[4].

At present, the voice modules that realize voice control function are mostly located in indoor machines, which are generally installed in high places, and the voice modules are far away from users. In addition, the voice module does not consider the influence of the user's indoor position change when detecting the voice control command, which leads to the low recognition rate of the voice control command and the indoor unit cannot effectively respond to the user's command[5].

Our instructors, who have rich experience and are also the teachers of corresponding research, strongly support this project. They explain algorithms, provide teaching and corresponding treatment for project members, and provide laboratories and some equipment to ensure the smooth progress of the project. At the same time, the person in charge has also won the first prize of Siemens competition, and other members also have different awards, and they have the ability and confidence to do this project well to ensure the smooth progress of the project[6]. At the same time, the person in charge has also won

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the first prize in Siemens competition, and other members also have different awards, and they have the ability and confidence to do this project well[7].

2. Project content

At present, our group is studying the design of intelligent control system for central air conditioning. The current central air-conditioning control is too rough, running in the designed rated state, rapid cooling, poor constant temperature effect, waste of electric energy, poor comfort and so on are their shortcomings. The system studied by our group adopts plc control and frequency conversion motor to achieve a more delicate, gentle and energy-saving experience. At the same time, it keeps pace with the times, improves control, enhances human-computer interaction experience, and develops towards intelligence and technology[8].

The main purpose of this project is to provide an air-conditioning instruction detection method, aiming at at at least improving the accuracy of air-conditioning recognition of voice instructions, so as to realize that air-conditioning can respond to voice instructions timely and effectively[9].

In order to achieve the above purpose, this project provides an air conditioning command detection method, which includes: obtaining the first position information of a preset user relative to an indoor unit; Determining the second position information of the preset user relative to the line control device of the indoor unit according to the first position information; Determining the detection parameters of the voice module in the line control device according to the second position information; And the voice control module detects the voice control instruction according to the detection parameters[10].

Before determining the second position information according to the first position information, the method further includes: obtaining the third position information of the line control device relative to the indoor unit; Establishing a preset corresponding relationship between the first position information and the second position information according to the third position information; And determining the second position information according to the first position information comprises inputting the first position information into a preset correspondence to determine the second position information. Inputting the first position information into a preset correspondence to determine the second position information includes: expressing the first position information as a first distance of a preset user relative to an indoor unit in a plurality of first preset directions; And converting the first distance into second distances in a plurality of second preset directions relative to the line control device based on the preset correspondence, and taking the second distances as second position information.

When the preset correspondence is a calculation relation, inputting the first position information into the preset correspondence to determine the second position information includes inputting the first position signal into a preset formula to obtain a calculation result, and taking the calculation result as the second position information.

Acquiring the first position information of a preset user relative to an indoor unit includes acquiring infrared detection information of the preset user detected by an infrared sensor arranged in an indoor unit; And determining the first position information according to the infrared detection information. The infrared detection information includes the time difference between the infrared sensor emitting infrared rays in multiple directions and receiving infrared rays reflected by a preset user, and determining the first position information according to the infrared detection information includes determining the first position information according to the time difference. The infrared detection information includes the time difference between the infrared sensor emitting infrared rays in multiple directions and receiving infrared rays reflected by the preset user, and the heat distribution information of the space where the indoor unit is located. Determining the first position information according to the infrared detection information includes: determining the position of the characteristic part of the preset user according to the recognition result of the human body in the heat distribution information; Acquiring the time difference corresponding to the position of the characteristic part; And determining the direction and/or distance of the feature part relative to the indoor unit as the first position information according to the acquired time difference. In order to reduce electromagnetic emission from a motor, it is known to electrically connect a circuit carrier having an interference suppression circuit to a terminal contact and a ground contact of the motor. The suppression device usually comprises a capacitor and an inductor, which are connected between the terminal contacts in a manner known per se. Ideally, this interference suppression circuit is as close as possible to the motor itself.

According to the prior art, it is known, for example, to weld the suppression device to the housing or

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to electrically connect it to the back iron of the motor through a rigid connection. By manufacturing at least one welding connector, but usually a plurality of welding connections are also manufactured, the assembly preparation work is increased, thereby increasing the total assembly workload.

Based on the above-mentioned prior art, the task of the present invention is to provide a motor and a method for arranging a suppression device on the motor, which simplifies manufacturing.

Determining the first position information according to the infrared detection information includes determining the position of a preset user's mouth according to the infrared detection information; And acquiring position information of the position of the mouth as first position information. Determining the detection parameters of the voice module in the line control equipment according to the second position information includes: determining the pickup characteristic parameters and the voice recognition parameters according to the second position information; Controlling the voice module to detect the voice control command according to the detection parameters includes: controlling the voice module to form a pickup beam according to the pickup characteristic parameters; Extracting a voice signal from the picked-up beam according to the voice recognition parameters; And extracting a voice control instruction from the voice signal. Extracting the voice control instruction from the voice signal further includes determining a signal strength threshold according to the second position information; Extracting intensity characteristic parameters of speech signals; When it is determined that the strength characteristic parameter is greater than or equal to the signal strength threshold, the voice control instruction extracted from the voice signal is executed; And sending a prompt message when it is determined that the strength characteristic parameter is less than the signal strength threshold.

According to the second position information, the closer the preset user is to the line control equipment, and/or the closer the preset user is in front of the line control equipment, the greater the signal strength threshold.

Before obtaining the first position information of the preset user relative to the indoor unit, the method further includes: determining that there is more than one person in the space where the indoor unit is located, and obtaining the duration of each person's stay in the space; Taking the user with the shortest duration as the preset user; Or determine that there is only one person in the space where the indoor unit is located, and take this person as the preset user. Obtaining the first position information of the preset user relative to the indoor unit includes obtaining the first position information by using a position detection device arranged in the indoor unit.

Determining the second location information according to the first location information includes determining the direction information and/or distance information of the preset user relative to the line control equipment according to the first location information, and taking at least one of the direction information and the distance information as the second location information. The second position information may be only direction information. The second position information may be only distance information. The second position information may be a combination of direction information and distance information. Determining the detection parameters of the voice module in the line control device according to the second position information includes determining the pickup characteristic parameters according to at least one of the direction information and the distance information. Determining the pickup characteristic parameters according to at least one of the direction information and the distance information includes determining the pointing direction, amplitude or phase of the pickup beam according to at least one of the direction information and the distance information, and taking the pointing direction, amplitude or phase of the pickup beam as the pickup characteristic parameters. Determining the detection parameters of the voice module in the line control device according to the second position information includes determining the voice recognition parameters according to the distance information. Determining the speech recognition parameters according to the distance information includes determining the noise reduction coefficient for speech signal processing according to the distance information, and taking the noise reduction coefficient as the speech recognition parameters. In order to achieve the above purpose, this project also provides a control device, which includes a memory, a processor and an air conditioning instruction detection program stored in the memory and executable by the processor. When the air conditioning instruction detection process is executed by the processor, the following operations of the air conditioning instruction detection method are realized: acquiring the first position information of the preset user relative to the indoor unit; Determining the second position information of the preset user relative to the line control device of the indoor unit according to the first position information; Determining the detection parameters of the voice module in the line control device according to the second position information; And the voice control module detects the voice control instruction according to the detection parameters.

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In order to achieve the above objectives, the project also provides an air conditioning system, which includes: a plurality of indoor units distributed in different spaces, wherein each indoor unit in a plurality of outdoor units is provided with an infrared sensor, and the infrared sensor is configured to detect the infrared detection information of the space where the indoor unit is located; A plurality of line control devices arranged in one-to-one correspondence with a plurality of indoor units, wherein the indoor units and the corresponding line control devices are located in the same space, and each of the plurality of line control devices comprises a voice module and a controller, wherein the voice module is configured to detect voice control instructions, and the controller communicates with the corresponding indoor units and is configured to obtain parameters set by users and control the operation of the corresponding indoor units according to the parameters set by users; And a control device communicating with a plurality of indoor units and voice modules, wherein the control device comprises a memory, a processor and an air conditioning instruction detection program stored in the memory and executable by the processor, wherein when the air conditioning instruction detection program is executed by the controller, the following operations of the air conditioning instruction detection method are realized: Determining the second position information of the preset user relative to the line control device of the indoor unit according to the first position information; Determining the detection parameters of the voice module in the line control device according to the second position information; And the voice control module detects the voice control instruction according to the detection parameters.

3. Air conditioning instruction detection method

This project provides an air conditioning command detection method. According to the method, the second position information of the preset user relative to the line control equipment is determined according to the first position information of the preset user relative to the indoor unit, the detection parameters of the voice module in the line control equipment are determined according to the second position information, and the voice module is controlled to detect the voice control instruction according to the detection parameters. Because the installation position of the line control device is closer to the preset user, the voice signal detected by the voice module in the line control device is stronger than that detected by the indoor unit. In addition, when the second position information is different, the detection parameters of the voice module are also different. Therefore, no matter where the preset user sends the voice control command, the voice module can accurately identify it, thus improving the accuracy of the air conditioner in identifying the voice command. Therefore, the air conditioner can respond to the voice instructions sent by the user in time and effectively.

4. Research methods

We use the combination of online and offline methods to investigate the defects of existing central air conditioners and the expectations of new functions of mass central air conditioners from many aspects. Then collect data and compare them in various central air-conditioning brands, find out their advantages and disadvantages, and make up for the shortcomings and improve the quality. On the basis of data statistics and classification, our group can develop and design a modern intelligent central air conditioning system and equipment that can better meet modern needs.

Step 5 be innovative

(1) The central air-conditioning system designed by our group has a small space, which has a relatively huge advantage over the existing central air-conditioning, and can reduce the volume by at least half.

(2) The air conditioner we designed has more humanized control. We plan to use touch screen to optimize the human-computer interaction control experience, and at the same time design a remote system to realize remote monitoring operation.

(3) Our group adopts the combination of plc and frequency conversion facilities to design a more accurate and energy-saving intelligent central air conditioning system.

5. Conclusion

Nowadays, people pay more and more attention to the comfort and energy saving of central air-conditioning. However, the traditional central air-conditioning system operators and maintenance

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personnel often use manual control to save energy. This subjective grading adjustment is very rough, has poor real-time performance, and is greatly influenced by equipment configuration and human factors, which can no longer meet people's needs. In this environment, the control requirements of central air conditioning are analyzed, and the control logic and control flow are reset. Based on this, the PLC control system of central air conditioning is designed and debugged. Then, the control algorithm configuration and the configuration monitoring environment on WINCC are completed by using the man-machine interaction function. The whole debugging operation results verify that the monitoring system constructed by the connection and mutual control between PLC and WINCC has perfect functions and simple operation. The system adopts Siemens PLC as the main control unit. Through PLC control, the system can adjust the flow according to the actual load, realize constant temperature control, and save a lot of energy at the same time. With the touch screen, efficient and simple temperature control and remote short-range monitoring can be realized, which is more in line with the use of shopping malls, office buildings, factories and other places.

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