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Energy Saving System of Intelligent Computer Room

Xiao Zou [1], Dongdong Li [1,*], Peng Sheng [2], YingLiu [1] and Yidu Lian [3]

[1]School of Computer and Communication, Lanzhou University of Technology, Gansu 730000, China;

[2]School of Energy and Power Engineering, Lanzhou University of Technology, Gansu 730000, China;

[3]School of Electrical Engineering and Information Engineering, Lanzhou University of Technology, Gansu 730000, China.

Abstract

This paper designs a server room based on a thermoelectric power generation device. Its structure includes the main body of the machine room, a server group set in the main body of the machine room, temperature and humidity detection devices, and electricity and storage facilities. The core thermoelectric power generation device of the entire energy-saving system includes: hot air channel, thermoelectric power generation sheet and first fresh air pipeline. The detection device refers to the setting of temperature and humidity sensors and gearboxes at the cold air duct to detect humidity, temperature and dehumidification, thereby reducing the energy consumption of the computer room system; a temperature sensor is designed at the hot air duct to detect whether the temperature exceeds the upper limit. The electrical facilities are directly connected to the thermoelectric power generation device in order to utilize the electrical energy generated by the thermoelectric power generation device. This system makes full use of the waste heat discharged by the server group to generate electric energy through the thermoelectric power generation device, and supplies the generated electric energy to the electric facilities and the electric storage equipment. While recycling resources, it achieves the goal of improving energy utilization.

Keywords

Intelligent Monitoring, Machine Room, Energy Saving, Temperature Difference Generation.

1. Background

The data center is a network of specific equipment that cooperates globally, which transmits, accelerates, displays, calculates, and stores data and information on the Internet infrastructure. In order to achieve the above-mentioned functions, the data center includes at least IT equipment and auxiliary equipment. The auxiliary equipment mainly includes ventilation and air conditioning systems and lighting devices.

Most of the capacity of the data center is not used to transmit data, but to cool the cabinet.

The current number of global data centers has exceeded 4 million, of which there are more than 500 ultra-large data centers; it is expected that in 2020, global data center power consumption will account for 5% of global power consumption; by the end of 2018, China's data center server installed 12 million units. The total power consumption of the domestic data center is as high as 61.3 billion kWh[2].

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2. Design introduction

This paper designs a server room based on a thermoelectric power generation device. Its structure includes the main body of the machine room, the server group set inside the main body of the machine room, the temperature and humidity detection device, and the electricity and storage facilities. The server group includes: a heat dissipation fan arranged in one-to-one correspondence on each server and a thermoelectric power generation device arranged inside the main body of the computer room. The core of the entire energy-saving system is the thermoelectric power generation device, which includes: hot air channel, thermoelectric power generation sheet and the first fresh air pipeline. Among them, the detection device refers to the setting of temperature and humidity sensors and gearboxes at the cold air duct to detect humidity, temperature and dehumidification, thereby reducing the energy consumption of the computer room system; design temperature sensors at the hot air duct to detect whether the temperature exceeds the upper limit. By directly connecting the electrical facilities and the thermoelectric power generation device, the utilization of the electric energy generated by the thermoelectric power generation device is improved. This system makes full use of the waste heat discharged by the server group to generate electric energy through the thermoelectric power generation device, and supplies the generated electric energy to the electric facilities and the electric storage equipment. While recycling resources, it achieves the goal of improving energy utilization. The overall design is shown in Figure 1.

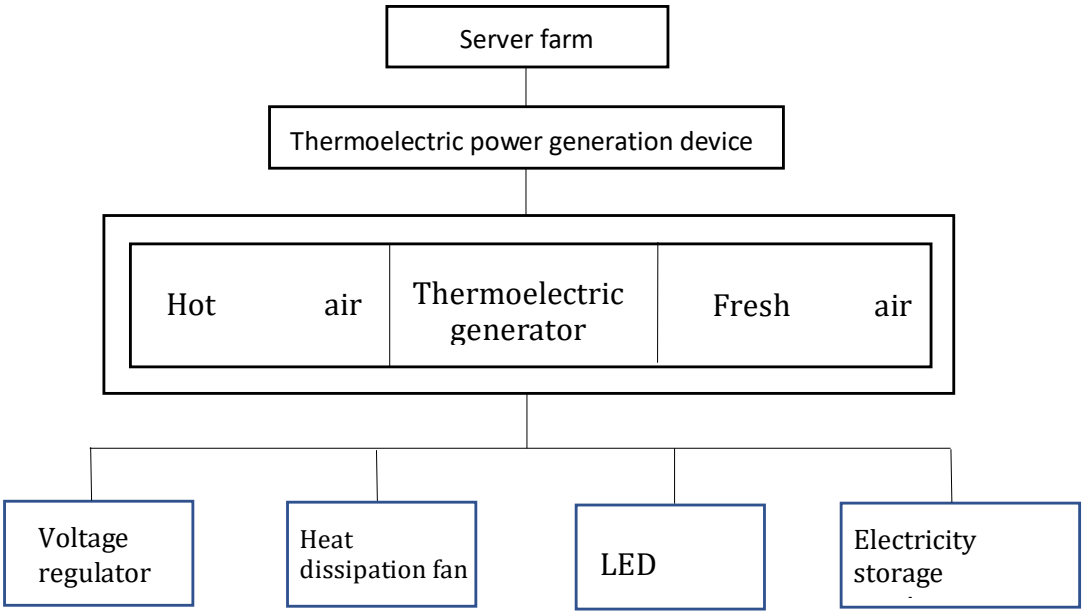

Figure 1: Overall design

3. Design plan

3.1. Thermoelectric power generation device

As shown in Figure 2, the computer room 1 is used to place cabinets 2. The number and arrangement of cabinets 2 are not limited and can be set according to specific needs. For example, multiple cabinets 2 can be arranged in a row face-to-face and/or back-to-back; hot air duct 3 is set in the ceiling of the machine room 1, and the air after cooling the cabinet 2 can enter the hot air channel 3 through the ceiling 4; the first fresh air pipeline 5 is at least partially penetrated in the hot air channel 3. The thermoelectric power generation device 6 is arranged

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between the hot air passage 3 and the fresh air pipeline 5, and uses the temperature difference between the hot air passage 3 and the fresh air pipeline 5 to generate electricity.

Combined with Figure 3, the thermoelectric power generation device 6 includes a cold end 61 and a hot end 62 arranged in the hot air passage 3, the cold end 61 is sleeved outside the first fresh air pipeline 5, and the hot end 62 is sleeved outside the cold end 61. The fresh air pipeline 5 and the cold end 61 can exchange heat, the hot air duct 3 and the hot end 62 can exchange heat, and the cold end 61 and the hot end 62 can generate electricity.

Specifically, when the air conditioning system is running refrigeration, the hot air in the hot air channel 3 flows through the hot end 62, and the heat is transferred to the hot end 62 by means of convection heat transfer, so that the surface temperature of the hot end 62 is increased. At the same time, the fresh air entering the first fresh air pipeline 5 continuously absorbs and takes away the heat from the cold end 61 during the convective heat exchange process with the cold end 61, so that the cold end 61 maintains a certain temperature difference between the hot end 62 and the cold end 61 of the thermoelectric generating unit 6; there is a temperature difference between the hot end 62 and the cold end 61 of the thermoelectric generating device 6, and the DC voltage can be generated after DC stabilization, The processing of voltage components[1], inverter elements and boost components can convert the generated DC voltage into 220 V / 380 V AC or be stored in lead-acid batteries to supply the cooling system, lighting system and some IT equipment of the data room, so as to reduce the energy consumption of the data center room.

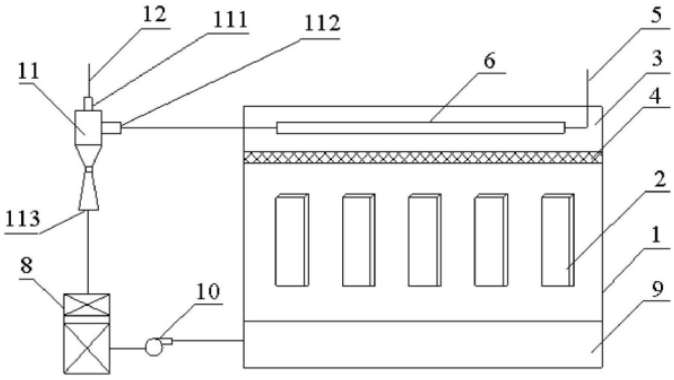

Figure 1: Computer Room Chart

1. machine rooms; 2. equipment cabinet 3.hot air passage; 4. Ceiling;5. first new air duct road; 6. thermoelectric generation module; 8. airconditioningunits; 9. coldairpassage; 10.air blower; 11. ejector compressor; 12. fresh and return air inlet duct; 111.introduction fluid inlet; 112.Induced fluid inlet; 113.fluid outlet)

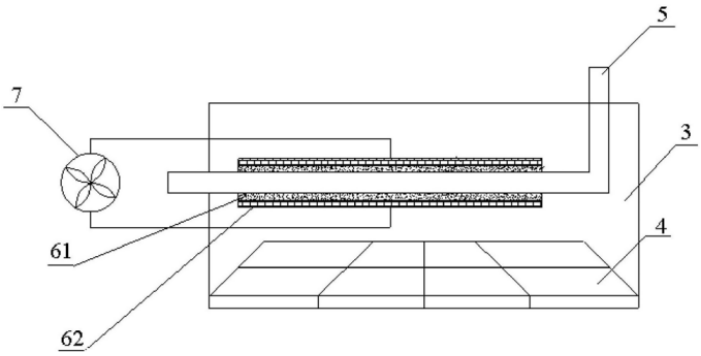

Figure 2: Design of Thermoelectric Generation

(3.hot air passage;4. Ceiling; 5.first new air duct road; 7.axial fan; 61.cold end; 62.hot end)

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3.2. Detection device

In this design, the temperature sensor adopts DS18B20, the humidity sensor adopts DHT11, the controller adopts STC15F2K61S2, the display circuit adopts LCD1602 liquid crystal display, and the alarm module adopts LED and buzzer. The overall block diagram is as shown in Figure 4.

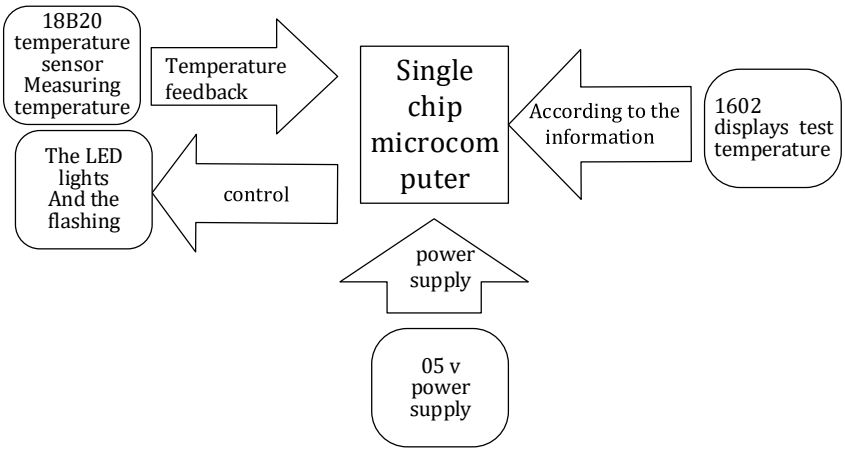

Figure 3: Overall monitoring chart

The temperature and humidity sensor and the gearbox are respectively connected to the single-chip microcomputer at the outlet of the cold air channel 9 in Figure 1. The humidity sensor monitors the air humidity and temperature at the outlet of the refrigeration pipe in real time, and transmits the signal to the single-chip microcomputer, which compares the temperature and humidity signals. If it is greater than the set humidity value, the microcontroller sends a command to the gearbox to increase the output speed of the gearbox, then the speed of the dehumidification wheel will be increased, the dehumidification effect will be improved, and the air humidity will be reduced, and vice versa, the output speed of the gearbox will be reduced. Among them, temperature, humidity and gearbox output speed can be displayed through LCD1602. In addition, the protection circuit is completed by the alarm circuit through the buzzer and LED lights. If the temperature and humidity signal exceeds the safe range, the buzzer and LED will sound and flash alarms respectively.

In Figure 1, a temperature sensor is installed at the hot air duct. The main function is to display the temperature in real time, read out and process the current temperature value measured by 18B20, and send it to the main controller for data processing and conversion into a digital signal for display.

The system software is written in C language. In the interrupt service program, the user input and the interface function of the host computer are realized; in the main program, the automatic search of the temperature sensor network and the acquisition of temperature information are realized, and the corresponding alarm function is realized according to the preset temperature upper limit. In this system, it can be programmed according to different resolution requirements, and the process can meet the high-precision design requirements.

After the temperature is measured, the temperature data is converted into a decimal temperature representation, and then the LCD 1602 is displayed on the LCD through the look-up table. The data processing here is similar to converting from binary to decimal, and then from decimal to ASCII.

First, initialize the LCD setting, write the upper limit of the alarm temperature, and compare the temperature at the same time. If the current temperature is within the set upper limit range, the LED will light up and 1602 will display the real-time temperature. If the temperature

exceeds the upper limit temperature, then The LED starts flashing, and 1602 displays the danger reminder.

3.3. Electric device

First, the thermoelectric power generation device is connected with the cooling fan. The cooling fan is used to exhaust the wind in the hot air channel 3 out of the machine room 1. The cooling fan is preferably an axial fan 7, as shown in FIG. 2. Utilizing the temperature difference between the waste heat after cooling the machine room 1 and the fresh air to generate electricity, and driving the heat dissipation fan to exhaust air through electric energy can further accelerate the cooling speed of the machine room 1, thereby forming a circulation system.

In addition, the thermoelectric power generation device can also be connected with other electricity and power storage devices. A lighting system is included, and the lighting system is an LED lighting device. It also includes an electric energy storage device, and the electric energy input port of the electric energy storage device is connected with the electric energy output port of the thermoelectric generator. The electric energy storage device is a rechargeable battery or a capacitor. It also includes a voltage stabilizer connected to the electrical energy output port of the electrical energy storage device.

4. Summary

The system we designed is installed in the server room. It uses the waste heat generated by the server and converts it into electrical energy through a thermoelectric generator. First, the thermoelectric generator is connected with a cooling fan to facilitate the cooling rate of the machine room, thereby forming a circulating system. When the generated electric energy is too much, the thermoelectric generator is connected to the LED lighting system and other low-power consumption devices to reduce the overall energy consumption; at the same time, the thermoelectric generator can be connected to the electric energy storage device to store electric energy. Be prepared for emergency.

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