The Design and Performance Analysis of a Heat Dissipation System for Computer Server

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Abstract. In view of the problem that the poor heat dissipation effect of the server influences the normal operation of internal electronic components, this paper presents a heat dissipation system solution, which includes single chip microcomputer, temperature sensor, metal net rack, cooling fan and other devices.

Keywords: server; single chip microcomputer; sensor; fan; heat dissipation system

1. Introduction

With the development of network technology, a large number of websites have entered people's life in an overwhelming way, thus bringing about a huge market demand for servers. Both the calculation and storage of massive data are inseparable from servers. These uninterrupted servers generate a lot of heat. A poor heat dissipation effect can influence the normal operation of internal electronic components in the server. At present, the solutions to the heat dissipation of servers are mainly divided into two types, that is, liquid cooling and air cooling. Although liquid cooling has no noise, high efficiency and low power consumption, etc., it is also confronted with such problems of electric conduction, corrosion, high cost and difficult maintenance. Currently, the most mainstream server is still air-cooled servers with sophisticated technology, which are characterized by low cost and easy maintenance. In this paper, a computer server with good heat dissipation performance is come up with, on the basis of air cooling mode, in the hope of solving the above problems encountered in background technology.

2. Method

2.1. Design of a Heat Dissipation System
Traditional air-cooled servers all dissipate heat by indirect contact cooling. During heat dissipation, the servers may encounter the problems of thermal contact resistance and convective heat transfer resistance. When the two are superimposed, the total thermal resistance will increase, and the heat exchange efficiency will be generally low. During the heat transfer, there is a huge temperature difference between high-temperature and low-temperature heat sources. Consequently, the convective heat transfer process of the server needs to be guided by a lower-temperature indoor heat source, and the heat dissipation process is complex. For this reason, a server heat dissipation system and its heat dissipation solution are proposed in this paper. The structure and connection of the proposed heat dissipation system are shown in Fig. 1-5. The heat dissipation devices are comprised of a server body. Inside the left and right walls of the server body, a single chip microcomputer (SCM) and a temperature sensor are fixed. In the symmetrical positions of upper and lower parts of the server body, the first metal net rack and the second metal net rack are fastened. In the symmetrical positions of the upper and lower ends of the server body, the first cooling fan and the second cooling fan are fastened. In the symmetrical positions of the left and right ends of the server body, the first support mechanism and the second support mechanism are fastened. In the symmetrical positions of the left and right ends of the server body, the first emission hole and the second emission hole are equipped. In the symmetrical positions of the upper and lower ends of the server body, a base is fastened. The output end of SCM is electrically connected with the input ends of the first cooling fan and the second cooling fan, while the input end of SCM is electrically connected with the output end of the temperature sensor. The lower end of the first metal gasket fixed onto the first cooling fan is abutted with the server body, and the first screw is mounted on the first metal gasket. The first screw goes through the first metal gasket from top to bottom and is fastened to the server body. The upper end of the second metal gasket fixed onto the second cooling fan is abutted with the server body, and the second screw is mounted on the second metal gasket. The second screw goes through the second metal gasket from bottom to top and is fastened to the server body. The first support mechanism comprises the first mounting plate, the third screw, the first support rod, the first base plate and the first rubber pad, and the third screw goes through the first mounting plate and is fastened to the server body. The first mounting plate is connected with the first base plate through the first support rod, and the lower end of the first base plate is bonded to the first rubber pad. The second support mechanism comprises the second mounting plate, the fourth screw, the second support rod, the second base plate and the second rubber pad, and the fourth screw goes through the second mounting plate and is fastened to the server body. The second mounting plate is connected with the second base plate through the second support rod, and the lower end of the second base plate is bonded to the second rubber pad [1-3].

Fig 1. The Structure of the Heat Dissipation System
Fig 2. The Connection between the First Cooling Fan and the Server Body

Fig 3. The Connection between the Second Cooling Fan and the Server Body

Fig 4. The Structure of the First Support Mechanism
Fig 5. The Structure of the Second Support Mechanism

The reference numerals in the figures are: 1. server body; 2. SCM; 3. temperature sensor; 4. the first cooling fan; 5. the second cooling fan; 6. the first metal net rack; 7. the second metal net rack; 8. the first support mechanism; 9. the second support mechanism; 10. the first emission hole; 11. the second emission hole; 12. base; 13. the first metal gasket; 14. the first screw; 15. the second metal gasket; 16. the second screw; 17. the first mounting plate; 18. the third screw; 19. the first support rod; 20. the first base plate; 21. the first rub pad; 22. the second mounting plate; 23. the fourth screw; 24. the second support rod; 25. the second base plate; 26. the second rub pad.

2.2. Specific Implementation

Inside the left and right walls of the server body 1, SCM 2 and temperature sensor 3 are fixed. The model of SCM 2 is STC89C52 and the model of temperature sensor 3 is DS18B20. The temperature sensor 3 is a sensor that is capable of sensing temperature and converting it into an outputable signal, so as to test the temperature inside the server body 1 and dissipate heat automatically. In the symmetrical positions of upper and lower parts of the server body 1, the first metal net rack 6 and the second metal net rack 7 are fastened, so that the first metal net rack 6 can help the first cooling fan 4 draw air from the outside world into the server body 1. While the second metal net rack 7 can help exhaust hot air out of the server body 1. In the symmetrical positions of the upper and lower ends of the server body 1, the first cooling fan 4 and the second cooling fan 5 are fastened. The operation of the first cooling fan 4 can send air from the outside world into the server body 1, while the operation of the second cooling fan 5 can exhaust hot air out of the server body 1, which can improve the exchange efficiency of internal and external air and facilitate the dissipation of heat. In the symmetrical positions of the left and right ends of the server body 1, the first support mechanism 8 and the second support mechanism 9 are fastened. The first support mechanism 8 and the second support mechanism 9 can increase the contact area between the server body 1 and the ground, so that it won’t be easy for the server body 1 to topple. In the symmetrical positions of the left and right ends of the server body 1, the first emission hole 10 and the second emission hole 11 are equipped. The first emission hole 10 and the second emission hole 11 can help hot air in the server body 1 emit from the left and right ends. In the symmetrical positions of the left and right parts of the lower end of server body 1, base 12 is fastened, which serves as a support, so that the server body 1 has a certain height and heat can be dissipated. The output end of SCM 2 is electrically connected with the input ends of the first cooling fan 4 and the second cooling fan 5. SCM 2 can automatically control the power switches of the first cooling fan 4 and the second cooling fan 5 and dissipate heat automatically. The input end of SCM 2 is electrically connected with the output end of temperature sensor 3, and temperature sensor 3 can transmit the temperature signals it senses to SCM 2. A normal temperature range can be preset on SCM 2, so that SCM 2 can automatically control the first cooling fan 4 and the second cooling fan 5. The lower end of the first metal gasket fixed onto the first cooling fan 4 is abutted with the server body 1. The first metal gasket 13 can increase the contact area, so that the first
screw 14 can be fastened. The first screw 14 is mounted on the first metal gasket 13. The first screw 14 goes through the first metal gasket 13 from top to bottom and is fastened to the server body 1. The first screw 14 can be aligned with the first metal gasket 13, screwed down, go through the first metal gasket 13 from top to bottom and be fastened to the server body 1, so that the first cooling fan 4 can be installed and removed. The upper end of the second metal gasket 15 fixed to the second cooling fan 5 is abutted with the server body 1. The second metal gasket 15 can increase the contact area, so that the second screw 16 can be fastened. The second screw 16 is mounted on the second metal gasket 15. The second screw 16 goes through the second metal gasket 15 from bottom to top and is fastened to the server body 1. The second screw 16 can be aligned with the second metal gasket 15, screwed down, go through the second metal gasket 15 from bottom to top and be fastened to the server body 1, so that the second metal gasket 15 can be installed and removed. The first support mechanism 8 comprises the first mounting plate 17, the third screw 18, the first support rod 19, the first base plate 20 and the first rubber pad 21, and the third screw 18 goes through the first mounting plate 17 and is fastened to the server body 1. The first mounting plate 17 plays an ancillary role by increasing the contact area, so that the third screw 18 can be fastened. The first mounting plate 17 is connected with the first base plate 20 through the first support rod 19. The first support rod 19 is used to connect the first mounting plate 17 and the first base plate 20 and serves as a support. And the lower end of the first base plate 20 is bonded to the first rubber pad 21. The first rubber pad 21 is made of rubber and has certain elasticity. The elasticity of the first rubber pad 21 can prevent the first base plate 20 from being worn by friction with the ground. The second support mechanism 9 comprises the second mounting plate 22, the fourth screw 23, the second support rod 24, the second base plate 25 and the second rubber pad 26, and the fourth screw 23 goes through the second mounting plate 22 and is fastened to the server body 1. The second mounting plate 22 plays an ancillary role by increasing the contact area, so that the fourth screw 23 can be fastened. The second mounting plate 22 is connected with the second base plate 25 through the second support rod 24, and the second support rod 24 is used to connect the second mounting plate 22 and the second base plate 25 and serves as a support. The lower end of the second base plate 25 is bonded to the second rubber pad 26. The second rubber pad 26 is made of rubber and has certain elasticity. The elasticity of the second rubber pad 26 can prevent the second base plate 25 from being worn by friction with the ground [4-6].

3. Experiment
The block diagram of the principle of heat dissipation of the server is shown in Fig. 6. To begin with, the power is turned on. During use, first of all, the first mounting plate 17 is aligned with the left end of the server body 1. The third screw 18 is screwed down, goes through the first mounting plate 17 and is fastened to the server body 1. Then the second mounting plate 22 is aligned with the right end of the server body 1. The fourth screw 23 is screwed down, goes through the second mounting plate 22 and is fastened to the server body 1. In this way, the first support mechanism 8 and the second support mechanism 9 can be mounted, and the stability is excellent. After that, the first metal gasket 13 on the first cooling fan 4 is aligned with the upper end of the server body 1. The first screw 14 is screwed down, goes through the first metal gasket 13 from top to bottom and is fastened to the server body 1. Later, the second metal gasket 15 on the second cooling fan 5 is aligned with the lower end of the server body 1. The second screw 16 is screwed down, goes through the second metal gasket 15 from bottom to top and is fastened to the server body 1. The temperature sensor 3 can sense the temperature in the server body 1, convert it into an outputable signal and then transmit it to SCM 2. A normal temperature range is preset on SCM 2. When the temperature sensed by the temperature sensor 3 is higher than the preset temperature, SCM 2 will turn on the power of the first cooling fan 4 and the second cooling fan 5 automatically. The operations of the first cooling fan 4 and the second cooling fan 5 will accelerate the air flow inside and outside the server body 1, for ease of heat dissipation. The heat can also be emitted from the first emission hole 10 and the second emission hole 11.
Fig 6. Block Diagram of the Principle of Heat Dissipation of the Server

4. Results

By setting a SCM, temperature sensor, the first cooling fan, the second cooling fan, the first emission hole and the second emission hole, the proposed system solves the problem that the server has a poor heat dissipation effect and high temperature affects the normal operation of internal electronic components. Inside the left and right walls of the server body, a SCM and a temperature sensor are fixed. And in the symmetrical positions of the upper and lower ends of the server body, the first cooling fan and the second cooling fan are fastened. The temperature sensor can sense the temperature inside the server body, convert it into an outputable signal and then transmit it to SCM 2. The temperature can be preset on SCM. When the temperature is too high, SCM will turn on the power of the first cooling fan and the second cooling fan automatically. The first cooling fan and the second cooling fan will rotate in the same direction. The first cooling fan draws air from the outside world into the server body, while the second cooling fan exhausts air out of the server body and accelerates the air flow speed, so that hot air can be emitted from the upper end of the server body. In the symmetrical positions of the left and right ends of the server body, the first emission hole and the second emission hole are equipped. The first emission hole and the second emission hole can help hot air emit from the left and right ends of the server body and the heat dissipation effect is good [7-9].

5. Conclusion

The heat dissipation system designed in this paper can solve the convective heat transfer of server through temperature sensor, cooling fan and other equipment, without the guidance of an indoor low-temperature heat source. By setting the first support mechanism and the second support mechanism, it solves the problem that the server has poor anti-toppling performance and topples easily when hit by heavy objects or earthquakes, thus strongly supporting the heat dissipation performance of the server. In the symmetrical positions of the left and right ends of the server body, the first support mechanism and the second support mechanism are fastened. First of all, the third screw fastens the first mounting plate to the left end of the server body, so that the first support mechanism can support the left end of the server body. And then, the fourth screw fastens the second mounting plate to the right end of the server body, so that the second support mechanism can support the right end of the server body. The first support mechanism and the second support mechanism can increase the contact area between the server body and the ground, effectively protecting the server from toppling over when hit by heavy objects or earthquakes. The solid structural design allows hot air to be emitted from the periphery of the server body and the server achieves a satisfactory cooling effect [10].

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