The Design and Implementation of a Noise Reduction System for a Microcomputer Cooling Fan

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Abstract. In view of the noise caused by the CPU inside the mainframe box, and the cooling fan of power unit, this paper comes up with a noise reduction device, comprising a polyurethane sound-insulating cotton layer, a wood-wool sound-absorbing board, a temperature detector and a cooling fan, etc. and illustrates its implementation method.

Keywords: cooling fan, mainframe box, rectangular frame, noise reduction system

1. Introduction

The cooling fan inside the mainframe box of microcomputer is used to dissipate heat from CPU, power supply and other equipment, and it is also the main source of noise. The outer frame of the axial fan of CPU radiator is connected with cooling fins. During the operation, the axial fan can generate certain noise. The noise from the vibration of power supply is caused by the looseness or unbalance of blades on the fan bearing. Too large bearings and gaps are also the leading causes of noise. How to denoise the cooling fan and obtain a low-noise solution for the whole system is a goal that people have always been pursuing. When people work in a noisy environment for a long term, their mood will be affected, and their work efficiency will also be lowered. With this consideration in mind, it is necessary to perfect the existing technology. To attain this goal, this paper puts forward a new technical solution for the microcomputer noise reduction system, including a noise reduction device and its implementation method.

2. Method

2.1. Design of a Noise Reduction Device

The noise reduction device comprises a mainframe box and a rectangular frame. On the rear side of the mainframe box, a mounting rack is fastened through the first screw. A cooling fan is fixed onto the mounting rack through the second screw. A rectangular frame is inlaid at a position
corresponding to the cooling fan on the rear side in the mainframe box. A separator is fastened between the upper and lower walls inside the rectangular frame. The first rotary shaft connects the right side of the separator and the right wall of the rectangular frame and rotates uniformly. There are four first rotary shafts, all of which are fitted with louvers. The left end of the first rotary shaft runs through the separator and is fitted with the first bevel gear. Inside the rectangular frame, the second rotary shaft connects the upper and lower walls on the left side of the separator and rotates. The second bevel gear matching the second rotary shaft is fastened to a position corresponding to the first bevel gear on the second rotary shaft. The middle of the second rotary shaft is fitted with a dial disc. Heat sinks are inlaid on the left and right sides of the mainframe box. The heat sink is evenly spaced by strip holes. Cooling fins that tilt down are fastened to the exterior of the heat sink, above the strip holes. The mainframe box comprises a substrate, a polyurethane sound-insulating cotton layer and a wood-wool sound-absorbing board. Inside the substrate, a wood-wool sound-absorbing board is fastened. A polyurethane sound-insulating cotton layer is placed between the substrate and the wood-wool sound-absorbing board. The side of the dial disc is all engraved with anti-skid treads. At a position corresponding to the dial disc on the front side of the rectangular frame, a rectangular hole mated with it is set. Between the mounting rack and the mainframe box, the first screw is sheathed in the first gasket. Between the mounting rack and the mounting frame of the cooling fan, the second screw is sheathed in the second gasket. A temperature detector is fastened to the top inside the mainframe box[1–3].

2.2. Specific Implementation

As shown in Fig. 1-4. On the rear side in mainframe box 1, the mounting rack 3 is fastened through the first screw 4. The cooling fan 2 is mounted on the mounting rack 3 through the second screw 13. The cooling fan 2 can be fixed inside the mainframe box 1 through the mounting rack 3, so that the heat can be discharged from the mainframe box 1 and the ambient temperature can be lowered when the host works. The rectangular frame 5 is inlaid at a position corresponding to the cooling fan 2 on the rear side in mainframe box 1. The separator 6 is fastened between the upper and lower walls inside the rectangular frame 5. The first rotary shaft 7 connects the right side of the separator 6 and the right wall of the rectangular frame 5 and rotates uniformly. There are four first rotary shafts 7, all of which are fitted with louvers 8. By fitting louvers 8 to the first rotary shaft 7, and enabling the louvers 8 to rotate along with the first rotary shaft 7, we may adjust the tilt angle of louvers 8 and the gap between louvers 8 and further adjust the contact area between the louvers 8 and airflow. When the cooling fan 2 rotates, we level louvers 8, in order to diminish their contact surface with the airflow and reduce the resistance louvers 8 are subject to. By doing so, we can prevent the louvers 8 from producing noise when they are affected by the airflow, during the use of the cooling fan 2. The left end of the first rotary shaft 7 runs through the separator 6 and is fitted with the first bevel gear 9. Inside the rectangular frame 5, the second rotary shaft 10 connects the upper and lower walls on the left side of the separator 6 and rotates. The second bevel gear 11 matching the second rotary shaft is fastened to a position corresponding to the first bevel gear 9 on the second rotary shaft 10. The middle of the second rotary shaft 10 is fitted with the dial disc 12. By turning the dial disc 12, we can let the second bevel gear 11 on the second rotary shaft 10 drive the first bevel gear 9 to revolve, so as to adjust the tilt angle of the louvers 8. Heat sinks 17 are inlaid on the left and right sides of the mainframe box 1. The heat sink 17 is evenly spaced by strip holes 18. Cooling fins 19 that tilt down are fastened to the exterior of the heat sink 17, above the strip holes 18. By setting the heat sink 17 and the cooling fins 19, we can accelerate the heat dissipation of the host and minimize the use of the cooling fan 2, so as to reduce noise when the host is used. The mainframe box 1 comprises a substrate 21, a polyurethane sound-insulating cotton layer 22 and a wood-wool sound-absorbing board 23. Inside the substrate 21, a wood-wool sound-absorbing board 23 is fastened. A polyurethane sound-insulating cotton layer 22 is placed between the substrate 21 and the wood-wool sound-absorbing board 23. By setting the wood-wool sound-absorbing board 23, we can absorb noise generated by the use of the cooling fan 2. By setting the polyurethane sound-insulating cotton
layer 22, we can prevent noise from coming out of the mainframe box 1. The side of the dial disc 12 is all engraved with anti-skid treads. At a position corresponding to the dial disc 12 on the front side of the rectangular frame 5, a rectangular hole 20 mated with it is set, so that the front edge of the dial disc 12 can protrude from the front side of the rectangular frame 5 and the dial disc 12 can be dialed more easily. Between the mounting rack 3 and the mainframe box 1, the first screw 4 is sheathed in the first gasket 14. Between the mounting rack 3 and the mounting frame of the cooling fan 2, the second screw 13 is sheathed in the second gasket 15. By sheathing the first screw 4 in the first gasket 14 and sheathing the second screw 13 in the second gasket 15, we make sure that the vibration produced during the use of the cooling fan 2 won’t be transmitted to the mainframe box 1 through the mounting rack 3, thus avoiding noise. The temperature detector 16 is fastened to the top inside the mainframe box 1. By setting the temperature detector 16, we can detect the temperature in the mainframe box 1 in real time. When the temperature in the mainframe box 1 is low, heat can be dissipated through the heat sink 17 and the cooling fins 19, so as to minimize the use of cooling fan 2. While when the temperature in the mainframe box 1 is too high, the cooling fan 2 can be turned on to dissipate heat rapidly [4–6].

![Fig 1. Side View of the Interior of the Mainframe Box](image-url)
Fig 2. Front View of the Mainframe Box

Fig 3. Installation of the Louvers

Fig 4. Composition of the Mainframe Box

The reference numerals in the figures are: 1. mainframe box; 2. cooling fan; 3. mounting rack; 4. the first screw; 5. rectangular frame; 6. separator; 7. the first rotary shaft; 8. louvers; 9. the first bevel gear; 10. the second rotary shaft; 11. the second bevel gear; 12. dial disc; 13. the second screw; 14. the first gasket; 15. the second gasket; 16. temperature detector; 17. heat sink; 18. strip holes; 19. cooling fins; 20. rectangular hole; 21. substrate; 22. polyurethane sound-insulating cotton layer; 23. wood-wool sound-absorbing board.
3. Experiment

The cooling fan 2 can be fixed inside the mainframe box 1 through the mounting rack 3, so that the heat can be discharged from the mainframe box 1 and the ambient temperature can be lowered when the host works. The rectangular frame 5 is inlaid at a position corresponding to the cooling fan 2 on the rear side in mainframe box 1. The separator 6 is fastened between the upper and lower walls inside the rectangular frame 5. The first rotary shaft 7 connects the right side of the separator 6 and the right wall of the rectangular frame 5 and rotates uniformly. There are four first rotary shafts 7, all of which are fitted with louvers 8. By turning the dial disc 12, we can let the second bevel gear 11 on the second rotary shaft 10 drive the first bevel gear 9 to revolve, so that the tilt angle of louvers 8 and the gap between louvers 8 can be adjusted, and further the contact area between the louvers 8 and airflow can be adjusted. When the cooling fan 2 rotates, we level louvers 8, in order to diminish their contact surface with the airflow and reduce the resistance louvers 8 are subject to. By doing so, we can prevent the louvers 8 from producing noise when they are affected by the airflow, during the use of the cooling fan 2. Heat sinks 17 are inlaid on the left and right sides of the mainframe box 1. The heat sink 17 is evenly spaced by strip holes 18. Cooling fins 19 that tilt down are fastened to the exterior of the heat sink 17, above the strip holes 18. By setting the heat sink 17 and the cooling fins 19, we can accelerate the heat dissipation of the host and minimize the use of the cooling fan 2, so as to reduce noise when the host is used. By sheathing the first screw 4 in the first gasket 14 and sheathing the second screw 13 in the second gasket 15, we make sure that the vibration produced during the use of the cooling fan 2 won’t be transmitted to the mainframe box 1 through the mounting rack 3, thus avoiding noise [7–9].

4. Results

Compared with the existing technologies, the proposed microcomputer noise reduction system can fix the cooling fan inside the mainframe box, discharge heat from the mainframe box, and lower the ambient temperature when the host works. A rectangular frame is inlaid at a position corresponding to the cooling fan on the rear side in the mainframe box. A separator is fastened between the upper and lower walls inside the rectangular frame. The first rotary shaft connects the right side of the separator and the right wall of the rectangular frame and rotates uniformly. There are four first rotary shafts, all of which are fitted with louvers. By turning the dial disc, we can let the second bevel gear on the second rotary shaft drive the first bevel gear to revolve, so that the tilt angle of the louvers and the gap between louvers can be adjusted, and further the contact area between the louvers and airflow can be adjusted. When the cooling fan rotates, we level louvers, in order to diminish their contact surface with the airflow and reduce the resistance louvers are subject to. By doing so, we can prevent the louvers from producing noise when they are affected by the airflow, during the use of the cooling fan. Heat sinks are inlaid on the left and right sides of the mainframe box. The heat sink is evenly spaced by strip holes. Cooling fins that tilt down are fastened to the exterior of the heat sink, above the strip holes. By setting the heat sink and the cooling fins, we can accelerate the heat dissipation of the host and minimize the use of the cooling fan, so as to reduce noise when the host is used. By sheathing the first screw in the first gasket and sheathing the second screw in the second gasket, we make sure that the vibration produced during the use of the cooling fan won’t be transmitted to the mainframe box through the mounting rack, thereby avoiding noise.

5. Conclusion

The microcomputer noise reduction system proposed in this paper comprises a polyurethane sound-insulating cotton layer, a wood-wool sound-absorbing board, a temperature detector and a cooling fan, etc. By setting adjustable louvers, we can level louvers when the cooling fan is in use, to diminish their contact surface with airflow, reduce the resistance louvers are subject to and prevent the louvers from producing noise when they are affected by the airflow [10].
References

[1] Thomas.Carolus, Marc.Schneider,Hauke.Reese.Axial flow fan broad-band noise and prediction. Journal of Sound and Vibration 2007, 300: 50-70.

[2] T.Fukano, Y.kodama, Y.Senoo. Noise Generated by Low Pressure Axial Flow fans III:Effects of Rotational Frequency,Blade Thickness and Outer Blade Profile. Journal of Sound and Vibration 1978, 56(2): 261-277.

[3] Yasutoshi.Senoo, Yoshio.Kodama.Noise Generated by low pressure axial flow fans. Bulletin of the Japan Society of Mechanical Engineers 39: P1900-1910, 1973.

[4] Neise.W. Fan Noise-Generation Mechanism and Control methods. Proceedings of the 1988 International Congress on Noise Control Engineering (INTER-NOISE’88),France:1988.767-776.

[5] H.K.Versteeg, W.Malalasekera. An Introduction to Computational Fluid Dynamics: The Finite Volume Method. Wiley, New York, 1995.

[6] S.F.Wu, S.G.Su. Noise Radiation from Engine Cooling Fans. Journal of Sound and Vibration 1998, 216 (1) : 107-132.

[7] ECMA073-2003. Measurement of Airborne Noise Emitted by Information Technology and Telecommunications Equipment. Annex D, 2003.

[8] T.Fukano, Y.kodama, Y.Senoo. Noise Generated by Low Pressure Axial Flow fans I :Modeling of the Turbulent Noise. Journal of Sound and Vibration 1977, 50(1): 63-74.

[9] T.Fukano, Y.kodama, Y.Senoo. Noise Generated by Low Pressure Axial Flow fans II:Effects of number of Blades, Chord length and Camber of Blade. Journal of Sound and Vibration 1977, 50(1): 75-88.

[10] M.B.Abbott, D.R.Basco.Computational Fluid Dynamics-An Introduction for Engineers. Longman Scientific&Technical, Harlow, England, 1989.

[11] S.V.Patanker, D.B.Spalding. A Calculation procedure for heat,mass and momentum transfer in three-dimensional parabolic flows. Int J Heat Mass Transfer, 15: 1787-1806, 1972.