Research on the Fabrication Method of a Data Processing Device for VR Virtual Scene Creation

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Abstract: In VR virtual scenes, users can deeply experience created virtual environments using VR tools. Data processing equipment is one of the key factors in realizing certain scene effects, but it suffers from problems such as insufficient computer protection and poor shock resistance. This invention proposes a data processing tool specifically designed for VR virtual scenes. It can be connected to a display screen, with both sides protected by protective components. A heat dissipation system is also used to ensure that the temperature is compliant. In addition, a clamping component is added to ensure the stability of the host and prevent displacement. It is also equipped with multiple shock absorbers, four hydraulic columns, and four hydraulic housings, which can effectively reduce vibration and protect the host when the bottom of the host vibrates, and can also improve heat dissipation performance to enhance equipment stability.

Keywords: Component Assembly; Vibration Damping Device; Heat Dissipation Structure; Vibration Damping Efficiency

1. Introduction

VR virtual scene creation leverages virtual reality technology to construct simulated environments. It employs computer graphics, animation, sound, and other multimedia elements to mimic or create fictional realities. By wearing a VR headset, users can immerse themselves in these virtual worlds, enabling widespread applications in gaming, education, training, and entertainment. This technology offers more immersive and interactive experiences, allowing "virtual" creations to generate significant "real-world" value [1]. Building virtual VR scenes is a core task in VR technology applications, demanding high-performance data processing tools as they directly impact user experience. Advancements in VR technology have led to increased processing speed and graphics performance in devices, but they also result in higher heat generation within computer hosts. Therefore, designing efficient cooling systems is crucial to ensure long-term stable operation of VR equipment and prevent overheating-induced lags or crashes. Additionally, when users perform head rotations, body movements, and other actions while using VR devices, the computer host may experience instability and shaking. The use of vibration damping devices can reduce this shaking, improve stability, and provide a more comfortable user experience.

2. Overview of Technological Development and Research Motivation

2.1 Evaluation of Existing Technologies

There are significant shortcomings in the computer host technology in China. Host protection is limited to one side of the casing, leaving it vulnerable to impacts from multiple directions, increasing the risk of damage and affecting normal operation. The lack of cushioning at the bottom of the host, especially when placed near vibration sources, can cause damage to core components such as hard drives, leading to read/write errors, internal loosening, and system failures. [2] These issues weaken the host's stability and reliability, shortening its lifespan. It is imperative to address host protection and cushioning to improve computer host technology, ensuring stable and reliable operation, extending service life, meeting user demands for high-performance computing environments, and driving the continuous advancement of

computer technology.

2.2 Driving Factors for Research

The continuous advancement of virtual reality (VR) production technology has made optimizing the user's immersive experience a core objective. However, the inadequate protection and lack of bottom-level shock resistance of current computer hosts hinder the development of VR scene production technology. Effective host protection can ensure stable operation, reduce the risk of collision failures, guarantee the continuity and reliability of VR application scenarios, and strengthen the protection of the host and internal data processing equipment through bottom-level shock absorption [3], preventing data loss and device damage. This is crucial for high-quality rendering of virtual environments. Therefore, a data processing device specifically designed for VR virtual reality has been developed to enhance computer host protection and shock absorption, providing more stable and reliable hardware support for VR scene construction. The unique design allows users to better experience virtual reality technology, accelerating the innovation of scene creation technology and enhancing its potential applications in education, entertainment, research, and other fields.

3. Current Challenges in Host Device Technology

Existing computer host protection is inadequate. The current design, with protective casings on only two sides, leaves the host vulnerable to damage from everyday handling, accidental impacts, and collisions in office environments. This can lead to damage to internal critical components, resulting in decreased performance, data loss, and even system crashes. The absence of vibration damping at the bottom of the host exacerbates the problem, as hard drives are sensitive to vibrations and can experience read/write errors and damage. Additionally, internal components may become loose, affecting normal operation and computational performance. In industrial environments with higher vibration levels, these issues are even more pronounced. To improve device performance, it is necessary to address these technical challenges through continuous innovation and design optimization, enhancing protection and vibration damping to provide users with a stable, reliable, and efficient computing environment.

4. Analysis of Product Device Technology Scheme

4.1 3D Structure of the Device

A modular design allows the device components to be divided into relatively independent modules based on their function and structure [4]. The data processing device presented in this invention can be connected to a display for VR virtual scene creation. Two protective components shield the left and right sides of the data processing unit. A heat dissipation device dissipates heat from the host to prevent overheating. A clamping component secures the host in place to prevent displacement. Multiple vibration damping components, four hydraulic columns, and hydraulic housings reduce vibrations when the bottom of the host is subjected to shocks. This design provides comprehensive protection for both sides of the host, bottom-level vibration damping, improved heat dissipation, and mechanical fixation, enhancing the overall performance and stability of the host. The 3D structure of the device is illustrated in Figure 1.

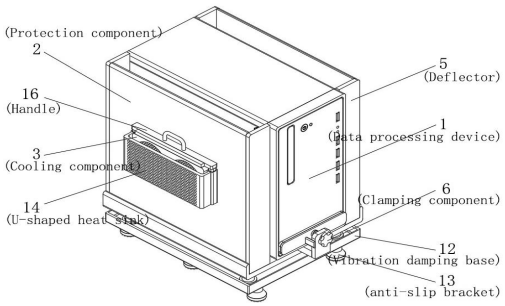

Figure 1. 3D Structural Diagram of the Device

4.2 Data Processing Device

Three limit modules are installed on both the left and right sides of the bottom of the device host. These modules use assembly-type limit blocks that are connected to sliding rods, enabling the protective plates to move in an ideal manner. The limit modules are tightly connected to the host, forming a stable support structure [5]. The channels within the limit modules match the sliding rods, which are connected to the protective plates. Multiple sliding rods and limit modules define the boundaries of the protective plates, allowing

them to move left and right, enhancing reliability and stability. The position of the protective plates can be adjusted to suit different scenarios, providing flexibility and improving efficiency. This design enhances the performance and stability of the device, providing users with a better experience and higher efficiency in practical applications. The systematic and efficient movement of the protective plates is a key feature of this design. The 3D structure of the data processing device is shown in Figure 2.

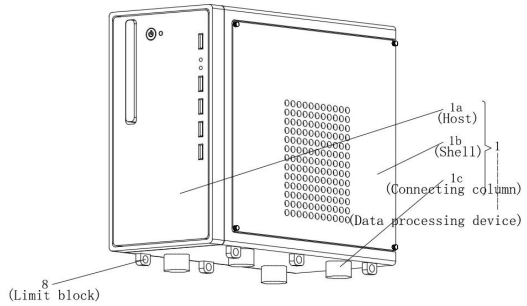

Figure 2. 3D Structural Diagram of Data Processing Device

4.3 Local Structure

Each hydraulic column is tightly connected to a hydraulic housing filled with hydraulic oil. The compressibility of the hydraulic oil allows it to absorb and release energy, reducing the vibration amplitude transmitted to the base plate and the host [6]. In terms of device operation, this design can effectively handle various irregular vibrations, ensuring the stability of core components and minimizing the negative impact of vibrations.

The four hydraulic columns placed at different angles enhance the vibration damping performance and durability of the device. The hydraulic housings provide a sealed and leak proof environment. The vibration-damping base serves as the core support, connecting to the lower vibration damping measures to enhance performance and increase frictional force for fixation. It is connected to vibration damping springs for added effectiveness, working in conjunction with the hydraulic columns to reduce damage to the host. In industrial environments, the hydraulic column assembly can mitigate the adverse effects of mechanical vibrations, improving comfort and safety, and ensuring that high-precision equipment is not affected by vibrations, thereby guaranteeing high-quality and stable product performance. A detailed 3D diagram of the local structure is shown in Figure 3.

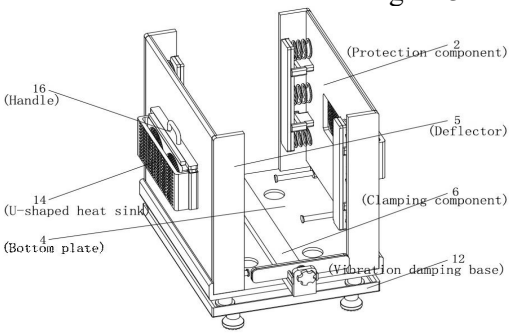

Figure 3. 3D Schematic Diagram of Detailed Perspective View of Local Structure

4.4 Protection Components

The limit blocks on both the left and right sides of the host bottom work in conjunction with the sliding rods. The top of the left sliding rod is connected to the bottom of the protective plate. These components restrict the protective plate's movement to the left and right, ensuring precise and stable motion, preventing wobbling or deviation. The sliding rods move within the limit blocks, providing a clear track for the protective plate, resulting in smoother movement, reduced friction, and improved fluidity [7]. Additionally, adjusting the position of the limit blocks or replacing the sliding rods can alter the movement range and direction of the protective plate, enhancing flexibility and adaptability to meet personalized user needs. This makes the movement of the protective plate more efficient and suitable for various usage scenarios. The 3D structure of the protection components is shown in Figure 4.

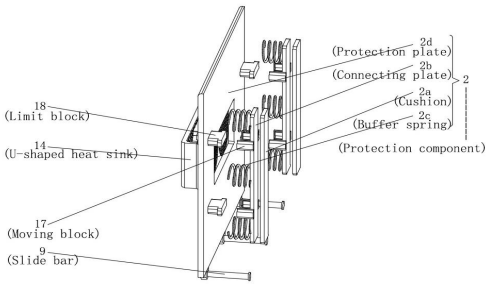

Figure 4. 3D Structural Diagram of the Protection Components

4.5 Clamping Components

The clamping components include a support plate, a fixed plate, and a screw.

The support plate connects to the base plate to provide a stable support. The screw is threaded into the fixed plate, controlling the movement of the clamping plate. The first protective pad

is located at the rear end of the clamping plate, and the second protective pad is located at the front top of the support plate. The host is placed on the support plate, and rotating the screw moves the clamping plate backward to tightly secure the host, preventing vibration-induced displacement. The protective pads increase friction and clamping force, preventing damage to the host. The adjustable components allow for adaptation to different operating environments. The 3D structure of the clamping components is shown in Figure 5.

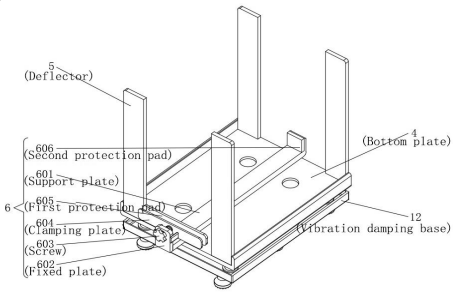

Figure 5. 3D Structural Diagram of the Clamping Components

4.6 Heat Dissipation Components

The framework of the heat dissipation components is designed based on the interference phased array structure. Two fans are installed front and back within the framework, rapidly expelling the heat inside the chassis through the left outer box, creating an ideal temperature environment and ensuring stable computer operation [8].

Two dust filters on both sides of the device form a double purification filtration system, blocking dust and impurities, reducing internal wear and tear, and extending the service life. The connecting column and the first magnet provide convenience and flexibility to the heat dissipation component. The first magnet is fixed to the left side of the protective plate, and the connecting column connects the framework to the first magnet, enabling easy assembly, disassembly, and stable operation. The cooling system adopts a duct design [9]. The fan, located at the air inlet, cooperates with the heat sink. Four dust filters create the main cooling channels, and the rectangular straight-through air duct ensures smooth airflow, reducing resistance and energy loss. The wind baffles seal the gaps on both sides of the air duct to prevent airflow short circuits, creating a "high-speed channel" for airflow, enhancing heat dissipation performance and maintaining equipment stability. The 3D structure of the heat dissipation components is shown in Figure 6.

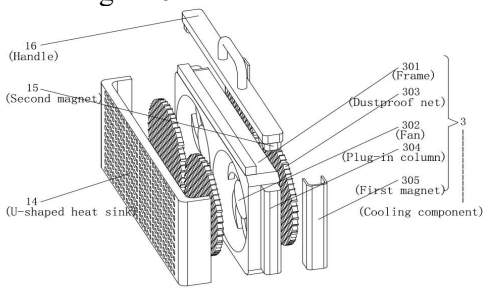

Figure 6. 3D Structure Diagram of Heat Dissipation Components

4.7 Vibration Damping Components

The vibration damping components consist of a control block, vibration damping springs, and a disc. The control block is located at the upper end of the vibration damping component and is connected to the base plate to transmit vibration signals and regulate vibration dimpling. The disc is located at the bottom of the control block, providing a stable support. The vibration damping springs are located in the center and connect the upper and lower parts. During the operation of the host, the vibrations at the bottom compress the springs, converting mechanical energy into storable energy. When the vibrations decrease or cease, the springs rebound, releasing their elastic potential energy and effectively absorbing and reducing the vibration energy of the host [10]. In practical applications, high-performance vibration damping components ensure the stable and reliable operation of the host, reducing potential failures and damage, and providing a comfortable operating experience. Through the combined work of these three components, the vibration of the lower part of the device is significantly reduced, providing support for efficient and stable operation of the equipment. The structure of the vibration damping components is shown in Figure 7.

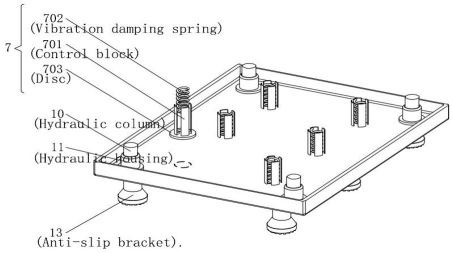

Figure 7. Structural Diagram of Vibration Damping Components

5. Usage Verification and Performance Evaluation

A series of usage studies were conducted to verify the actual effectiveness of this technology.

In terms of heat dissipation, after activating the dual-fan cooling unit, the temperature of the critical components of the host can be effectively reduced and maintained at a suitable level. The double filtration function of the four dust nets is excellent, resisting dust and ensuring a clean internal environment.

In the simulation of the host's swaying motion, the clamping components, with the cooperation of the clamping and supporting plates, ensure that the host remains stable and does not deviate.

When vibrations act on the base plate, the anti-vibration springs deform to reduce the risk of vibrations being transmitted to the bottom of the host, demonstrating excellent performance.

In the base plate movement protection test, the limit modules and sliding rods work together to enable the protective base plate to slide accurately left and right.

In that detection of the seismic and anti-skid capability of the bottom plate, the hydraulic columns effectively reduce impact forces, and the anti-slip brackets exhibit excellent anti-slip characteristics.

During the fixing and protection of the frame and fan, the U-shaped heat sink provides effective protection, and the combination of the first magnet, second magnet, and handle securely fixes the frame and fan to the left side of the protective plate.

Through practical application verification, each function of this invention meets expectations and performs excellently in terms of heat dissipation, fixation, vibration damping, control of protective plate movement, system stability, and protection, significantly enhancing the overall performance and stability of the host.

6. Conclusion

This invention discloses a data processing device used for creating virtual VR scenes. Through theoretical analysis and optimization of the host components in terms of heat dissipation and vibration damping, the experimental results align with the theoretical analysis, proving its correctness. This device not only achieves high performance but also ensures user comfort and safety, effectively solving the problems of computer host heat dissipation and vibration, and providing a good user experience. It has broad application prospects in the field of virtual VR scene creation and other related fields.

Acknowledgments

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References

[1] Yi Tao. Let the "Virtual" Create More "Real" Value. Qingdao Daily, 2024-3-25(001).

[2] Qiu Zhizhen, Gu Xiaolin, Chen Fuqiang. Rotating Slider Mechanism and Its Motion Analysis. Journal of Anhui University of Technology, 2001, (04): 283-285+289.

[3] Chen Xuekai, Ling Naiyang, Wang Lin, et al. Design of an Experimental Device for Automatic Control of Axial Temperature Distribution of Rotary Cylinders // Chinese Nuclear Society. Report on the Progress of Nuclear Science and Technology in China (Volume 7) - Proceedings of the 2021 Annual Academic Conference of the Chinese Nuclear Society, Volume 4 (Isotope Separation Volume). Institute of Chemical Engineering and Physics of Nuclear Industry, 2021:5. DOI:10.26914/c.cnkihy.2021.036646.

[4] Ling Siqing. Research on the Assembly of Mechanical Components in CNC Machine Tool Manufacturing. Modern Manufacturing Technology and Equipment, 2023(07):85-87.DOI:10.16107/j.cnki.mmte.2023.0420.

[5] Qu Sibang, Li Huamin. Research and Application of the Limiting Block for the Working Device of Loaders. Construction Machinery & Maintenance, 2016, (12):72-73.

[6] Feng Bin. Research on the Effective Bulk Modulus and Measurement Device of Hydraulic Oil. Zhejiang University, 2011.

[7] Qiu Zhizhen, Gu Xiaolin, Chen Fuqiang. Rotating Slider Mechanism and Its Motion Analysis. Journal of Anhui University of

Technology, 2001, (04): 283-285+289.
[8] Li Tao, Li Yanlong, Xu Ran, Huang Peng, Wang Zhixiang. Design of a Heat Dissipation Structure for a T Component. Mechanical Engineering & Automation, 2023(03):109-110+112.
[9] Yuan Zhen, Cheng Haifeng, Yu Xianwei. Heat Dissipation Design of a High-power Solid-state Synthetic Power Amplifier Component. Machine Design and Manufacturing Engineering, 2023(04):121-124.
[10] Huang Shiming, Wu Guolin, Wu Shuiquan, Yang Pengfei, Wu Weiqiang. Design and Vibration Damping Efficiency Analysis of the Vibration Damping Device Based on a Universal Testing Machine. Mechanical Engineering & Automation, 2024(03):97-98.

