Design Research on Auxiliary Equipment for VR Virtual Interactive Scene Creation

Xiangyu Zhang, Jingmiao Shi, Peng Zhou, Qian Wang*, Wenjing Cao, Jiaming Hu, Xiao Liu, Weiqun Lu

Guangzhou Railway Vocational and Technical College, Guangzhou, Guangdong, China

**Corresponding Author.*

Abstract: This paper introduces an auxiliary device specifically designed for VR virtual interactive scene creation. This auxiliary device aims to solve the cumbersome problem of manually adjusting the angle of existing monitor stands. This design ensures that the monitor maintains a comfortable angle for the user during operation, offering numerous advantages and positive effects. Through a detailed explanation of the design principles, function implementation, and performance testing of the device, the potential application of this auxiliary device in VR scene creation is demonstrated. By analyzing and improving existing technologies, a new solution is proposed to enhance the convenience and efficiency of monitor angle adjustment.

Keywords: **VR Virtual Interactive Scene; Auxiliary Equipment; Monitor Stand; Automatic Adjustment**

1. Introduction

With the rapid development of urban rail transit, subways are widely used. To improve the professional skills of subway drivers and their ability to respond to emergencies, virtual reality (VR) technology [1] has become an important training tool. However, existing VR interactive scene training systems use monitor stands that require manual adjustment. Drivers need to constantly adjust the height and angle of the monitor during training to accommodate different postures and visual requirements [2]. This repeated adjustment not only increases operational complexity but may also distract the driver, affecting training outcomes. Therefore, achieving automatic adjustment of monitor stands to provide a comfortable and stable visual experience [3] is a current problem awaiting resolution. This paper aims to explore an automatically adjustable monitor stand design based on an intelligent control system to improve training quality and reduce fatigue and discomfort. We are committed to designing auxiliary equipment to realize intelligent and convenient monitor adjustment, ensuring optimal visual effects and comfort, and endowing it with multifunctional capabilities to promote development in this field.

2. Research Objectives

In the current field of VR virtual interactive scene creation, with the development of artificial intelligence and smart hardware [4], the monitor serves as a crucial information display tool. We aim to provide an auxiliary device for VR virtual interactive scene creation that can conveniently adjust the height and angle of the monitor, solving the problem of frequent manual adjustments required with existing stands when users change their sitting posture. This device also offers installation and cable management functions, ensuring that the monitor maintains the optimal viewing angle during use, thereby enhancing overall work efficiency and comfort. By integrating advanced mechanical structures and intelligent control systems, this device aims to address the inconvenience of monitor adjustment, chaotic cable management, and insufficient stability in the current VR virtual interactive scene creation process. It also plays a positive role in the promotion and application of intelligent control technology [5].

3. Current Situation and Existing Problems

3.1 Current Situation Analysis

With the continuous development of VR technology, VR virtual interactive scene creation has become an important field, especially in the simulation of scenes in rail

transit. The use of monitors is particularly critical. However, traditional monitor stands mostly use manual adjustment methods [6], which require users to make repetitive and cumbersome adjustments when their sitting posture changes. This not only affects work efficiency but may also cause discomfort, limiting the fluency and accuracy of VR virtual interactive scene creation. Therefore, there is a need for a monitor stand that can automatically adjust, is easy to use, has good stability, and includes cable management functions to improve the efficiency and quality of VR virtual interactive scene creation while ensuring the health and comfort of the users.

3.2 Existing Problems

With the development of VR technology, the complexity and detail of scenes have increased, leading to higher performance requirements for monitors. To improve efficiency, creators need to handle multiple tasks simultaneously, requiring more flexible and expandable auxiliary equipment. Additionally, with the widespread adoption of VR, more non-professionals are participating, raising expectations for the usability and operability of the equipment. Therefore, designing VR virtual interactive scene creation auxiliary equipment that meets the needs of professionals while being accessible to non-professionals is a significant current challenge.

4. Auxiliary Equipment for VR Virtual Interactive Scene Creation

The auxiliary equipment for VR virtual interactive scene creation includes components such as a stand, lifting mechanism, scanner, controller, clamping mechanism, adjustment mechanism, and cable management mechanism. The stand consists of a base and a pillar, the lifting mechanism adjusts the height of the monitor, the scanner monitors the user's posture, and the controller processes the data and adjusts the monitor's angle using the lifting and adjustment mechanisms. The clamping mechanism secures the monitor, the adjustment mechanism adjusts the angle, and the cable management mechanism organizes the cables. Additionally, the device further optimizes monitor stability with features such as a spring-loaded clamp and push plate inside the clamping blocks. It adheres to ergonomic principles to reduce user burden and uses intelligent control technology to precisely adjust the monitor height, meeting personalized needs and promoting relevant application development.

(1) Design and Structure of the Auxiliary Equipment for VR Virtual Interactive Scene Creation

The design structure mainly includes the stand, lifting mechanism, scanner, controller, clamping mechanism, adjustment mechanism, and cable management mechanism. The design principles and functions of each part are introduced in detail below, as shown in Figure 1, Figure 2, Figure 3, and Figure 4.

Stand: The stand includes a base and a pillar. The base has a stable structure capable of bearing weight and resisting environmental impacts. The pillar is connected to the base to provide vertical support, with an adjustable support platform at the top. The lifting mechanism, which includes a motor, threaded rod, lifting block, and support platform, is key to adjusting the monitor's height. The motor drives the threaded rod to rotate, moving the lifting block up and down, thereby fine-tuning the height of the support platform and the connected monitor.

Scanner: To monitor the user's posture changes in real-time and adjust the monitor's position and angle accordingly, the auxiliary equipment is equipped with a scanner [7]. The scanner is installed at the top of the stand and can scan key parts of the user's body, such as the head and shoulders, to obtain posture data.

Controller: The controller is the core component for receiving and processing data from the scanner. It receives data from the scanner and automatically adjusts the monitor's position and angle based on preset algorithms. The controller can also receive manual input signals from the user for manual adjustments when necessary.

Clamping Mechanism: The clamping mechanism secures the monitor on the stand to prevent movement or detachment during adjustments. It consists of two clamping sleeves, two clamping blocks, two clamping springs, and a clamping rod. The clamping sleeves are fixed to the back of the stand, with clamping blocks sliding inside the sleeves. The clamping springs connect the clamping blocks to the clamping rod, allowing the monitor to be fixed or released by adjusting the position

of the clamping rod.

Adjustment Mechanism: The adjustment mechanism adjusts the monitor's angle and includes components such as a sliding rod, slider, and cylinder [8]. The sliding rod is fixed to the stand, with the slider connected to the sliding rod and the cylinder attached to the sliding rod and connected to the clamping rod. By operating the sliding rod, the cylinder's extension and retraction can be controlled, causing the clamping rod and monitor to rotate to a certain angle.

Cable Management Mechanism: To facilitate the organization of monitor cables, the cable management mechanism includes a cable trough, a first cable board, and a second cable board. The cable trough is fixed to the back of the stand, with the first cable board sliding inside the trough and the second cable board sliding inside the first cable board. Cables are placed in the trough, and the first and second cable boards block and organize them, preventing tangling.

Spring-loaded Clamp and Push Plate: Enhance monitor stability.

Fixing Block, Fixing Rod, and Fixing Spring: Ensure the stable connection between the second cable board and the cable trough.

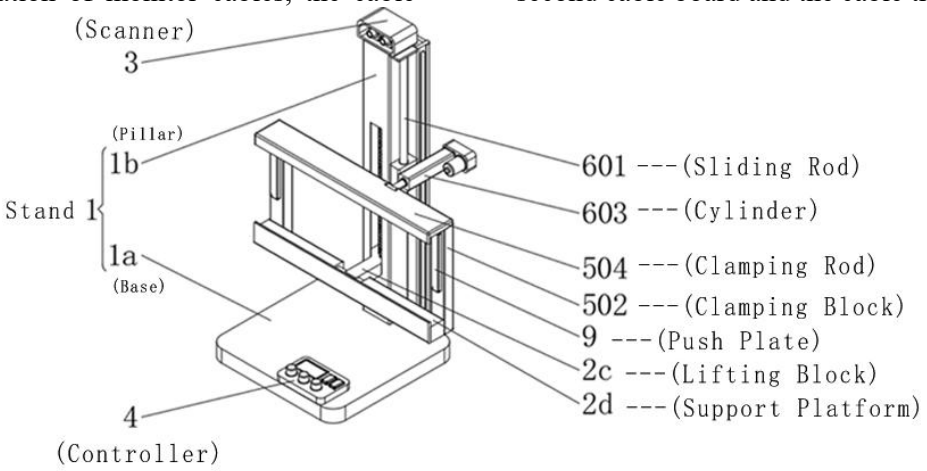

Figure 1. Refined Perspective Front View of Local Structure

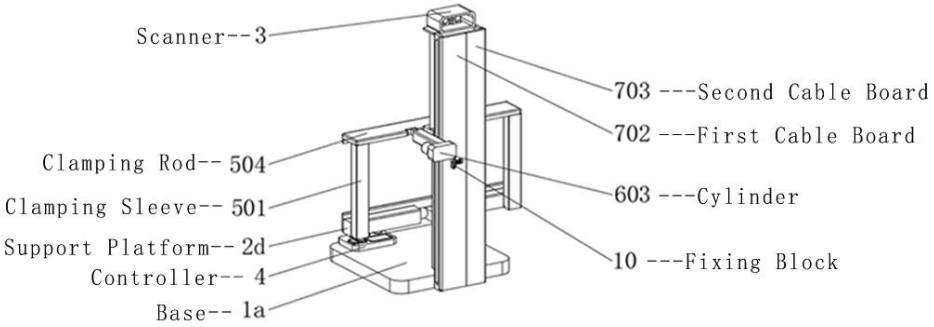

Figure 2. Refined Perspective Rear View of Local Structure

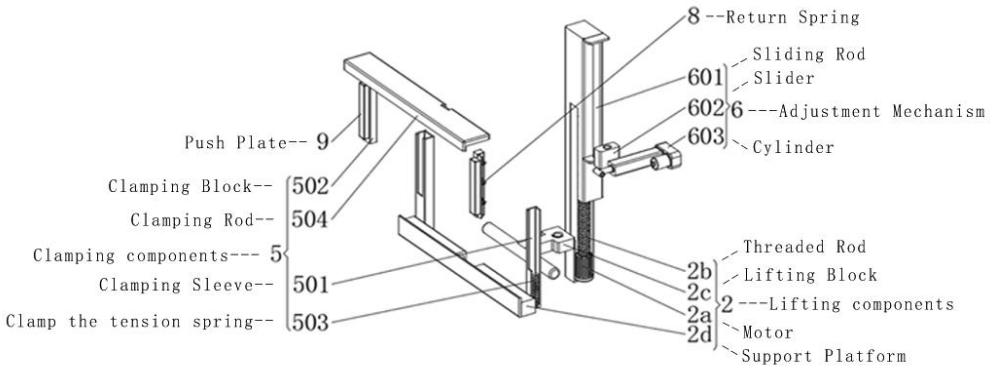

Figure 3. Exploded View of Local Structure

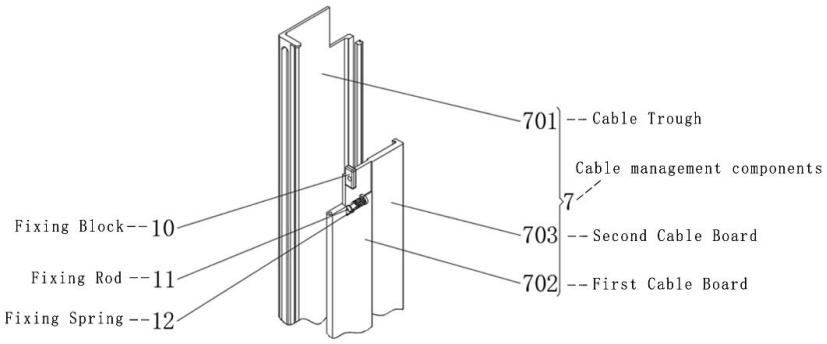

Figure 4. Cable Board Fixing Diagram

(2) Innovative Design

The design of the auxiliary equipment for VR virtual interactive scene creation incorporates several innovations: it utilizes an automated adjustment mechanism driven by a motor to precisely adjust the monitor's height, avoiding the cumbersome and inaccurate manual adjustments; it integrates a scanner and controller to achieve intelligent tracking, which can monitor changes in the user's posture and line of sight in real-time to automatically adjust the monitor's angle and position, enhancing work efficiency and comfort; it optimizes the stand structure and adds clamping mechanisms to improve stability, preventing monitor shaking that could cause visual fatigue and potential damage; it includes a cable management component to prevent cable entanglement and improve the tidiness of the work environment; it is highly extensible, considering the compatibility with different monitors, and its modular design of the stand and clamping mechanism can adapt to various application scenarios. By reducing manual steps through automation and intelligent adjustment functions, it shortens the work cycle and improves production efficiency.

5. Application Cases

(1) Application Scenarios:

We apply this auxiliary equipment to VR virtual interactive scene creation in subway and light rail transportation design and operation, utilizing VR technology for immersive driving environment simulation and interactive training. VR technology is also used to create immersive architectural models, allowing designers and clients to better experience and evaluate design proposals; it creates various educational scenes, such as historical events and scientific experiments, providing students with more vivid and intuitive learning experiences. Additionally, in VR education or training environments, teachers or instructors can automatically adjust the monitor's angle based on the students' positions to better present the teaching content.

(2) Application Effects:

By using this auxiliary equipment in application scenarios, the automated adjustment function and intelligent tracking system [9,10] greatly reduce the time and effort spent by users adjusting the monitor's position and angle, allowing them to focus more on scene creation. In collaborative scene creation, the convenience and stability of this auxiliary equipment facilitate communication and collaboration among team members; it reduces physical strain on users, decreases eye fatigue, and increases comfort and satisfaction; the application of intelligent control technology inspires more innovative ideas on how to use VR technology to improve work efficiency and quality of life.

6. Development Plan

In future development, we will focus on technological innovation, deepening intelligent tracking technology to achieve precise posture and line of sight recognition. We will actively collaborate with hardware manufacturers, software developers, and content creators to design diverse monitor stands to meet different user needs, increase marketing efforts, and enhance product visibility. We will also continuously optimize user experience, focusing on comfort and convenience, establishing a user feedback mechanism, and constantly improving products and services to promote the widespread application and development of monitor stands in VR virtual

interactive scene creation.

7. Conclusion

This paper primarily discusses the design and research of auxiliary equipment for VR virtual interactive scene creation, aiming to solve the problem of frequent monitor angle adjustments required when users change their sitting posture during VR virtual interactive scene creation. By analyzing and improving existing technologies, a new solution is proposed to enhance the convenience and efficiency of monitor angle adjustments.

Acknowledgments

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References

[1] Ren Xiaocheng, Qiu Chunting. Research on 3D Interactive Scene Virtual Reality Modeling and Simulation. Computer Simulation, 2024, 41(01): 217-221.

[2] Du Wentao, Gao Yuan, An Ping, Tian Xinyu, He Junqin, Fang Ziwang. Design of Intelligent Monitor Stand Based on Human Sitting Posture Recognition. Electronic Production, 2019, (17): 3-6.

[3] Yu Junhui, Yu Yongjie, Wang Chunli. Design and Research of a Mobile Monitor Stand for Preventing Cervical Spondylosis. Electronic World, 2019, (13): 192-193.

[4] Dili Airem·Tuerdiyusuf, Guo Bin, Fu Yonglong. Design of Adjustable Monitor Stand Based on STM32. Computer Knowledge and Technology, 2024, 20(05): 103-106.

[5] Chen Ruwei. Design of Automatic Adjustment Transmission Mechanism for Face Camera. China Machinery, 2023, (26): 10-13.

[6] Wu Muyun, Luo Kai, Ni Minghui, Qin Fuhong, Li Yanlin. Design of Automatic Adjustable Monitor Stand System Based on MTCNN. Electronic Components and Information Technology, 2020, 4(09): 53-54+68.

[7] Zhang Xu, Mao Qingzhou, Shi Chunlin, Shi Yixuan. A Fast Establishment Method for the Mapping Relationship between 3D Scanner Point Clouds and Panoramic Images. Journal of Zhejiang University (Engineering Edition), 1-11.

[8] Fang Jicai, Ren Haipeng, Sun Yu. Research on an Adjustable Height Monitor Stand. Wireless Interconnection Technology, 2016, (22): 55-56.

[9] Miao Chengjia. Analysis of the Application of AI Wearable Equipment and Visual Target Tracking Technology in Sports. Sports Equipment and Technology, 2024, (07): 162-164.

[10] Shan Wei. Research on Human Posture Recognition Algorithm Based on Deep Learning. Heilongjiang Science, 2024, 15(10): 91-93.

