Research on the Simulation Training System of Substation Primary Equipment Inspection Based on Computer VR Technology

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Abstract. At present, most of the substation primary equipment inspection simulation training system still has many shortcomings, such as the high cost of the simulation system, the simulation effect is not intuitive enough, the simulation scene is not realistic enough and so on. Based on this, this paper first analyses the concept and function of computer VR simulation tech, then studies the characteristics of substation patrol simulation training system under VR tech, and finally gives the construction strategy and process of substation primary equipment patrol simulation training system based on computer VR tech.

Keywords: Mongolian Music, Timbre Library, Computer Sampling

1. Introduction
With the iterative progress and maturity of computer tech, it has obtained extensive and in-depth research and popularization in many fields, especially the utilization of computer tech represented by VR in substation primary equipment inspection simulation training system, which greatly promotes the improvement of substation simulation training level [1]. On the other hand, as an important component of the power system, substation automation and informatization have an important impact on the stability, reliability and maintainability of the whole power system. The operation of substation primary equipment will have a significant effect on the whole system, so it is necessary to carry out scientific training and operation drill for operation and maintenance personnel. Most of the training of substation primary equipment in power system is carried out draw support from computer simulation tech and means, so as to ensure the authenticity and safety of the training process.

At present, most of the substation primary equipment inspection simulation training system still has many shortcomings, such as the high cost of the simulation system, the simulation effect is not intuitive enough, the simulation scene is not realistic enough and so on. In view of these practical deficiencies and problems, computer VR tech with its typical utilization advantages in interactivity, intuition and experience, has gradually obtained more in-depth research and utilization in the substation primary equipment inspection simulation training system. VR tech can generate a 3D dynamic scene of substation equipment inspection, so that the relevant trainees can get an immersive training experience, so that they can effectively learn various operation and maintenance operations in the simulated training environment.
In addition, the existing substation primary equipment inspection simulation training mode mainly consists of several components as shown in Figure 1 below. These training modes have obvious shortcomings, mainly reflected in the simulation scene is not realistic enough; it is difficult to give the trainees enough sense of experience and substitution, resulting in the low efficiency of training [2]. Draw support from computer VR tech, the patrol mode of substation can be effectively simulated, so as to greatly mobilize the participation and experience of trainees in the process of training. With the continuous maturity of computer VR tech, the visual quality, audio quality and interactive interface in the simulation training system have been greatly improved and optimized, so its utilization potential and space are further expanded.

![Simulation board Model Tour Q & A tour Image Tour](image)

**Figure 1.** Current simulation training mode of substation primary equipment inspection

In a word, draw support from computer VR tech to carry out the simulation training of substation primary equipment inspection, while improving the immersion experience of simulation training, it can ensure the safety and operability of the training process. By modeling the process of substation primary equipment inspection, a virtual simulation scene is built, which can carry out the training of substation primary equipment inspection simulation without affecting the normal operation of the power system [3]. In the process of training, we can also collect the training feedback of trainees by virtue of the interaction of VR system, so as to carry out further optimization iteration, and achieve the purpose of improving the equipment operation level, mastering the equipment knowledge and improving the working ability of trainees. Therefore, it is of great practical value to study the simulation training of substation primary equipment inspection based on computer VR tech.

2. **The concept and function of computer VR simulation tech**

2.1. *The concept of computer VR simulation tech*

Computer VR simulation tech is to build a simulated training scene draw support from computer system. Through the 3D information virtual environment composed of VR simulation, it can truly simulate the process of a substation equipment inspection, including related equipment and equipment operation environment [4]. Draw support from VR simulation, the training environment can enable trainees to interact with computer VR environment system organically, thus breaking the constraints of space-time and other objective conditions, and ensuring the training effect and experience without affecting the normal operation of real equipment and system. In addition, the immersion, interactivity, illusion and fidelity of computer VR simulation tech make its utilization in substation primary equipment inspection simulation training have good applicability.

2.2. *The value of computer VR simulation training system construction*

First of all, draw support from computer VR tech to build a substation equipment patrol simulation training system can improve the equipment operation skills of trainees [5]. The use of 3D mode can truly simulate the scene of equipment use and operation, so as to organically simulate various possible real scenes, and improve the practical operation skills and standardized operation level of substation operators. Secondly, the utilization of this tech in the simulation training of substation primary
equipment inspection can effectively save the cost of training [6]. Due to the traditional training mode has higher restrictions and requirements on training equipment, venues and funds, which leads to a lot of training process is difficult to effectively carry out, and the utilization of VR tech can effectively avoid the shortcomings and problems in the traditional training mode. In addition, the simulation training system based on VR tech can reduce the risk in practical operation and establish the crisis awareness of the trainers.

3. Characteristics of substation patrol simulation training system based on VR tech

3.1. Architecture of VR simulation training system

The construction of substation primary equipment inspection simulation training system based on computer VR tech can be flexibly deployed in local area or commercial secret network according to the actual needs and conditions of substation [7]. The training can achieve all the training processes of learning, practice and testing, so that the trainees can effectively master the relevant practical operation knowledge. The architecture of VR simulation training system is shown in Figure 2. The VR simulation training system architecture is suitable for the daily simulation training and skill assessment of substation front-line operators and emergency disposal personnel.

In addition, the virtual instrument which can reflect the real substation law is established by using computer VR tech for demonstration operation, which can partly replace the practice process which is difficult to carry out in the current substation equipment inspection, or which is time-consuming, laborious and capital consuming, and carry out virtual experiment and virtual operation drill on the computer.

3.2. Function of VR simulation training system in substation

First of all, draw support from computer VR tech simulation training system, it can dynamically simulate the 3D simulation scene of a substation equipment inspection [8]. Through the dynamic simulation function, such as the relevant models and the behavior data of trainees, the scene and environment changes in a substation equipment inspection can be more truly simulated and presented, and the dynamic, visual and interactive simulation of the operation scene can be realized. Secondly, the system should also have the function of safe operation demonstration. Through real video shooting and 3D motion simulation, the system can intuitively show the correct operation method in the process of an equipment inspection, and make an intuitive demonstration.

In addition, the system should be able to truly restore the operation scene, and show the whole process of a real equipment inspection through simulation [9]. Finally, the system should also be able to carry out warning education, free training simulation, so that the trainees can learn and train independently in the process simulation of a substation equipment inspection. Draw support from this module, the 3D simulation scene Library of learning, practice and test is open to trainees. Trainees can freely choose the scene and accident type for learning and training by logging in this module.
3.3. Characteristics of VR simulation training system

First of all, the substation patrol simulation training system based on VR tech has the characteristics of real 3D visualization scene simulation [10]. According to the real scene of a substation equipment inspection, a 3D scene model is built to simulate the environment in the inspection process realistically, which can not only make the trainees master the inspection knowledge effectively, but also make them familiar with the difficulties and key points in the inspection and learn the key points. Secondly, the training simulation system based on VR tech has the characteristics of integration of learning, training and height measurement. The integrated module platform enables trainees to gradually improve their activities from theoretical learning to practical operation and patrol real scene drills. In addition, the system platform also covers a wealth of teaching resources, including basic knowledge, case analysis and practice drills, and runs multiple training at the same time, making the training process more flexible, more targeted and scalable.

4. Construction of substation primary equipment inspection simulation training system

4.1. The key tech of VR based simulation training system for primary equipment inspection

The key technologies of substation primary equipment inspection simulation training system based on computer VR tech include 3D virtual simulation, dynamic simulation tech, visual human-computer interaction, multi person networking interaction tech, personnel dynamic position tracking tech and multi person online real-time communication tech, as shown in Figure 3 below. In addition, the hardware environment of the system includes the deployment of LAN and cloud server. In order to make the simulation training system closer to the practical environment, we need to fully consider the actual needs of the patrol operators, carry out humanized design, promote the friendliness of interactive experience, so that the trainees can easily enter the VR simulation training system, and complete the patrol training in it.

4.2. Implementation of VR tour simulation training system

First of all, in the simulation environment construction level of substation primary equipment inspection, we need to build the natural environment, substation equipment and related format files in the inspection process. Secondly, in the implementation level of virtual inspector, we need to build a virtual inspector and import virtual inspector into the system. In addition, in the implementation level of VR simulation tour of substation primary equipment, through the optimization of system equipment and system speed, the scene roaming and tour are completed. Finally, in the realization of the setting and detection of dangerous areas and dangerous equipment, the bounding box tech is used to set the dangerous areas in the inspection process, and the collision detection algorithm based on bounding box is used to realize the detection of dangerous areas.
5. Conclusion
In summary, with the continuous maturity of computer VR tech, the visual quality, audio quality and interactive interface of simulation training system based on VR tech have been greatly improved and optimized, thus greatly mobilizing the participation and experience of trainees in the training process. Through the analysis of the concept and function of computer VR simulation tech, this paper studies the value of computer VR simulation training system construction. Through the research on the characteristics of substation patrol simulation training system based on VR tech, the function of substation VR simulation training system is analyzed. Based on the analysis of the construction of the simulation training system for substation primary equipment inspection based on computer VR tech, the key tech and implementation of VR inspection simulation training system are studied.

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