Simulation Application of VR Technology in Communication Network

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Abstract. With the further improvement of the level of informatization, the three-dimensional visualization technology of coal mine safety production has always been a hot issue of current research, among which virtual reality technology is the key technology to achieve three-dimensional visualization. This research mainly discusses the simulation application of VR technology in communication network. First of all, the exchange of data in communication is done in the form of data packets. The data packet transmitted between processes is in binary format, and the content of the data packet is composed of a data header and data content. Then determine the location of the roadway, equipment, and cable to be constructed, and design the object model in 3DS Max. Finally, in order to realize the docking and integration of the digital platform of the whole mine, VIR tools are used to develop the virtual scene platform. In the open-phase fault simulation experiment, the voltage and current parameters of the fault phase are all zero, and the diagnosis result is greater than 0.8. This research improves the management efficiency of power supply and distribution network through real-time communication of mine grid data and integrated display and control of virtual scenes.

Keywords: VR Technology; Communication Network; Mine Power Grid Data; Phase Failure Simulation

1. Introduction
The use of virtual reality technology can integrate the system information of mine geology, mining engineering, ventilation, transportation, power supply, drainage and other systems into a comprehensive automation platform, which is a major development trend. The virtual reality platform can comprehensively take over all kinds of information about coal mine safety production, reflect the real situation of the mine, and effectively share and comprehensively use the respective information systems.

Virtual reality technology has been developed vigorously at home and abroad. My country is also gradually attaching importance to virtual reality technology and has achieved certain results, but there is still a certain gap with developed countries [1-2]. In recent years, with the proposal of the technical
upgrading and transformation goal of coal mine safety monitoring system, the development of coal mine monitoring system has become the development goal of coal mine monitoring system by building a fully digital mine with diversified integration and information sharing, and realizing safety monitoring system data analysis and comprehensive utilization [3-4]. In response to this goal, the coal mine power supply and distribution network monitoring system must require a more convenient data access and sharing platform, improve the compatibility and expandability of the system, and achieve multi-protocol and multi-platform docking [5-6]. In this case, the development cycle of the system will appear to be relatively long, and the cost will naturally rise. It is more important to adopt a generalized open platform. The development of a unified standard makes it easy to achieve system division and integration [7-8]. At present, the communication protocol of the series of products provided by the supplier of coal mine power supply and distribution network monitoring system is not open, the compatibility with third-party equipment is relatively poor, and the cost is relatively high. Therefore, it is aimed at the open architecture coal mine power supply and distribution network monitoring system The research and design of it are more important [9-10].

Based on the analysis of the environment and mature technology of the coal mine’s deep mine power supply and distribution system, this study uses a three-tier network structure model of equipment layer, monitoring layer, and comprehensive information management layer to design a coal mine power supply and distribution network monitoring system network platform to achieve Integration and docking with coal mine comprehensive automation information platform.

2. VR Technology Simulation Application

2.1. VR Technology

The "immersion" state realized by virtual reality technology is because the user has the consciousness or illusion of the existence of virtual objects in the same computer environment as the actual objects.

(1) The amount of data is small, and the network bandwidth is less occupied. In order to solve the problem of less model data, geometric modeling methods can be used to construct virtual models and optimize the models. At the same time, by combining object-oriented technologies, the inheritance and reuse of virtual scenes can be strengthened.

(2) Complete real-time roaming of virtual scenes. The server publicly sends documents to the WEB, the user downloads the documents, creates a scene locally through the browser, browses and roams in it. In this process, the scene presentation and the virtual model are separated. This facilitates real-time rendering, and the user can also control the virtual model while downloading the virtual model in real time.

2.2. Communication Network

Data transmission of smart terminals. The calculation method for data transmission is as follows.

\[ \Pr[C] \geq \left( 1 - \frac{q_{pk}}{q_{Hi}} \right) \left( 1 - \frac{q_{au}}{2^t} \right) \left( 1 - \frac{q_{mi}(q_{Hi} + q_{It})}{2^t} \right) \varepsilon \]

(1)

Where \( \Pr[C] \) is the total amount of data transmission for data transmission.

\[ W_{i,j} = \exp \left( \frac{\alpha_i D_{HO}-x}{1+\sqrt{x}} \right) \]

(2)

\[ E_c = \frac{1}{L} \sqrt{\sum_{i=0}^{t-1} [y(k-i)-y_m(k-i)]^2 + y_m(k-i)} \]

(3)
$W_{\theta}$ represents the final delayed power.

2.3. Coal Mine Power Supply and Distribution Network Monitoring
At this stage, most coal mine power supply and distribution network monitoring systems use traditional host computer monitoring systems. They only stay at the level of two-dimensional monitoring. What you see is only the power supply and distribution situation of the circuit schematic. The length and equipment location information cannot be grasped, and the interaction with other systems is poor, and they often exist independently of other systems. The power supply and distribution network monitoring system realized by virtual reality technology can realize three-dimensional visualization display, can more comprehensively understand the real operation situation of coal mine, and its comprehensive information processing ability is greatly enhanced.

3. VR Technology Simulation Experiment

3.1. Calculation Program Communication Protocol
The exchange of data in communication is done in the form of data packets. The data packet transmitted between processes is in binary format, and the content of the data packet is composed of two parts: the data header and the data content.

3.2. Build a 3D Model
Determine the location of the roadway, equipment, and cable to be constructed, and design the object model in 3DS Max.

3.3. Realization of Virtual Scene
The 3D visualization platform is mainly based on the development of the VIR tools platform, which can be used as the expansion and extension of the 2D monitoring platform. The main purpose is to realize the docking and integration of the digital platform of the whole mine. First use the VIR tools Max Exporter plug-in in the 3DS Max 3D design software to export the designed coal mine power supply and distribution network virtual reality 3D model to a file in .nmo format, and then import the exported file into the VIR tools platform for scene roaming and data interaction. The design of other functions realizes the driving of the scene. Monitoring real-time data is shown in Table 1.

| Insulation resistance | Power factor | Reactive power | Active power | Zero sequence voltage | Zero sequence current |
|-----------------------|--------------|----------------|--------------|-----------------------|-----------------------|
| 6.50                  | 0.87         | 0.93           | 2.25         | 3.00                  | 0.00                  |

4. VR Technology Simulation Analysis

4.1. Single-Phase Grounding Short-Circuit Fault Simulation Analysis
In the virtual reality scene, the detailed functions of the 3D model surface are expanded, and the richer the surface details, the higher the performance. However, the richer the detailed functions of the surface, the more system resources the model occupies. Therefore, in order to provide theoretical support for model mapping, theoretical research on texture mapping is needed. In virtual reality scenes, in order to make the three-dimensional model of the object more realistic, the detailed functions of the object model surface are usually very complicated, the number of model grids is greatly increased, the system delay of most operating resources and other machines related to the same phenomenon occur. With texture mapping technology, a detailed image with object characteristics can
be mapped to the surface of the object, so the object has the detailed characteristics of the image. Table 2 shows the dynamic changes of the data of single-phase grounding short-circuit fault simulation and diagnosis. When using VR technology to simulate a single-phase grounding short-circuit fault, from the field data, the numerical changes of the faulted phase and the non-faulted phase are consistent with the characteristic analysis results. Judging from the diagnosis results, the diagnosis results of the fault phase and the "G" phase are both greater than 0.8, and the diagnosis results of the non-fault phase are both less than 0.1, indicating that the diagnosis results are consistent with the actual fault type, and also the diagnosis of the fault diagnosis subsystem the correctness of the results. The diagnosis result is judged and processed through the script language, and the processing result is displayed in the fault column. Among them, "None" means that no fault has occurred, and "AG", "BG", and "CG" respectively indicate that phase A, phase B and phase C have a single-phase grounding short-circuit fault.

Table 2. Dynamic changes of data for single-phase grounding short-circuit fault simulation and diagnosis

| Time | Diagnostic data | Malfunction |
|------|-----------------|-------------|
|      | A   | B   | C   | G   |            |
| 10:10 | 0.04 | 0.08 | 0.05 | 0.03 | No         |
| 10:23 | 0.93 | 0.06 | 0.03 | 0.89 | G          |
| 10:40 | 0.03 | 0.89 | 0.07 | 0.91 | BG         |
| 10:55 | 0.06 | 0.04 | 0.86 | 0.93 | CG         |

4.2. Phase Failure Simulation Analysis

For the simulation process of open-phase fault, firstly select the corresponding open-phase fault type in the upper computer server man-machine interface, and send the fault command to the lower computer PLC controller through the enable button. The PLC controller of the lower computer will make logical judgment and processing of the fault command to drive the corresponding relay action to complete the simulation of the phase failure. When a phase failure occurs, the data storage server will store the field data. The fault diagnosis subsystem will read the latest set of data from the data storage server for diagnosis, and write the diagnosis results to the data storage server. At the same time, the upper computer server man-machine interface will also display the fault diagnosis results in real time. And through the script language to judge the diagnosis results, display the type of failure.

Figure 1 shows the dynamic changes of the data of the open-phase fault simulation and diagnosis. The field data column records the real-time data collected from the field. The data in the diagnosis result column indicates the reliability of the failure of each phase. Here, the diagnosis result is greater than 0.8 to indicate that the phase has failed, and less than 0.2 indicates that the phase has not failed. As a basis to judge whether a phase has a fault. From the data displayed on the man-machine interface, when no fault occurs, the data of each phase are normal, and the diagnosis results are all less than 0.2, indicating that the diagnosis results are consistent with the actual situation. When a phase failure occurs, the voltage and current parameters of the faulty phase are all zero, the diagnosis result is greater than 0.8, and the diagnosis results of the non-fault phase are all less than 0.1, indicating that the diagnosis result is consistent with the actual situation, and it also illustrates the fault diagnosis subsystem the correctness of the diagnosis result. In order to judge the fault type more intuitively through the diagnosis result, a scripting language is used to judge and process the diagnosis result, and the processing result (fault type) is displayed in the fault column, where “none” means no fault has occurred, "A", "B", "C" respectively indicate that the phase is broken.
4.3. Simulation Analysis of Short Circuit Fault between Two Phases
Figure 2 shows the dynamic changes of the data for the simulation and diagnosis of short-circuit faults between two phases. When simulating a short-circuit fault between two phases, from the field data, the changes of the voltage and current values of each phase are consistent with the characteristic analysis results. From the data of the diagnosis results, the diagnosis output value of the fault diagnosis subsystem for the fault phase is greater than 0.8, and the diagnosis output value for the non-fault phase is less than 0.1, indicating that the diagnosis result is consistent with the actual fault type, and it also illustrates the fault. The correctness of the diagnosis result of the diagnosis subsystem. The diagnosis result is judged and processed through the script language, and the processing result is displayed in the fault column. Among them, "AB", "AC", and "BC" indicate short circuit faults between AB phases, AC phases and BC phases, respectively. In this study, a preliminary research analysis and application of the application of virtual reality technology in the power supply and distribution network monitoring system have been done, and the three-dimensional visual display of the power supply and distribution network in the coal mine’s deep shaft has been realized, which is a good example of virtual reality technology in the safe production of coal mine the foundation is laid for wide application. Through further research on the power supply and distribution monitoring system based on virtual reality technology, comprehensive utilization can also be realized in the fields of simulation training, comprehensive planning of power supply and distribution network, line equipment inspection, etc., to achieve multiple and reusable use.
5. Conclusion
The power communication network monitoring and management system is a complex and huge project, which needs to be strengthened and improved. The use of communication networks for data transmission is ubiquitous in today's information society, and it is also a fast and convenient way to communicate between users.

The Internet is developing towards an integrated network consisting of wired networks, base stations and wireless mobile networks. However, compared with the formed wired network, the probability of system errors in the wireless communication network has increased compared with the wired network. It is convenient for users and also has reliability and security issues. Brings certain challenges.

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