Monitoring Technology of Power System Operation State Based on Stereo Sensing

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Abstract. In recent years, the development of computer technology, automation control technology and communication technology has provided new hardware and software support for the implementation of distribution network operation monitoring. In the daily production of the oil field, the reliability and stability of the power supply are the key links to ensure the completion of the production tasks of the oil field. This paper studies the problem of scene depth reconstruction in panoramic technology. On this basis, the panoramic depth map is combined with the panoramic image, and the three-dimensional panoramic characteristics are reconstructed from the visual and environmental aspects of the stereo perception model suitable for its performance. This paper develops an oilfield distribution network operation monitoring system based on stereo perception, and develops corresponding system management software. This paper first determines the mathematical model of the distribution network line loss calculation, and introduces the principle of GPRS technology to formulate a specific network plan for distribution network operation monitoring. Finally, based on the terminal data collection method of CDD-IDT / GPRS, the development of terminal system management software is finally completed. Field test results show that the stereoscopic perception-based oil field distribution network operation monitoring system developed in this paper has high accuracy of accident prediction, strong real-time performance, stable and reliable operation, and the average transmission time of each data in the stereoscopic perception based monitoring network transmission is 1.88 seconds, which can be displayed immediately after pre-loading.

Keywords: Three-dimensional Perception Model, Oil Field Distribution Network, Operation Monitoring, GPRS Monitoring Technology

1. Introduction
In recent years, in order to effectively improve the safety and economic operation of the power distribution system, various oil production plants in the oil field have done a lot of work in line transformation and management measures, and have made progress in reducing accident rates and reducing network losses. Certain results, but due to the limitation of information management methods, on the whole, there is still a big gap compared with the local power system\textsuperscript{[1-2]}. In order to fundamentally solve the current situation that the distribution system operation management information is small, management methods and methods lag behind, improve the reliability and economy of the distribution network operation, and thereby improve the economic benefits of oil and gas production in the oil field, the use of information technology The distribution network performs real-time monitoring and production management\textsuperscript{[3-4]}.

Stereoscopic technology is a virtual reality technology developed based on IBNR, which includes a series of technologies such as the acquisition of panoramic images, panoramic imaging of image processing and so on\textsuperscript{[5-6]}. With the development of the Internet, network transferability will be more and more valued, and it has become the driving force for the development of new technologies. The use of pictures as a carrier of stereoscopic perception technology also conforms to the characteristics of network transmission. Motivation\textsuperscript{[7-8]}

This paper develops the operation evaluation index system of the oil field distribution network and develops corresponding calculation software. Develop an online monitoring device for the operating status of the oil field power grid. The oil field distribution network operation monitoring system developed in this paper includes a set of main station equipment, sub-station equipment, portable equipment, and intelligent high-voltage measurement equipment. Since its operation, the system has operated normally and the equipment has operated stably\textsuperscript{[9]}. At the same time, the software system of "Operation Monitoring Technology of Oil Field Power Grid Based on Stereo Sensing" has a friendly human-machine interface and strong maneuverability. It is a reliable real-time monitoring software for oil field distribution network\textsuperscript{[10]}. This study intends to combine the three-dimensional perception technology to study the three-dimensional panorama technology suitable for network propagation. Taking the panorama feature, three-dimensional sensory mode and network communication application characteristics as the starting point, the computer vision related theory is used to study the reconstruction of the virtual environment in three-dimensional panorama Real-time monitoring of oil field distribution network as an information source aims to introduce a three-dimensional perception model and establish a three-dimensional panoramic representation of the three-dimensional perception model to enable real-time monitoring of oil field distribution network to achieve more sensory information transmission, while providing relevant spatial analysis The development of applications (spatial positioning, feature picking) laid the foundation.

2. Proposed Method

2.1. Overall Design of Oil Field Distribution Network Operation Monitoring System Based on Stereo Perception

As a basic component of distribution network automation technology, the distribution monitoring operation system based on stereo perception has accumulated many years of operating experience abroad. Based on the characteristics of the oil distribution network based on stereo perception, this paper has developed a set of Perceived hardware system and software system for oilfield distribution network
operation monitoring.

(1) Stereo vision model

The core of visual recovery is to provide different images for both eyes, which is equivalent to positioning two visual bodies in the actual environment. The traditional internal beam model, that is, the model where the visual body is perpendicular to the scene depth plane of the line of sight, the visual body. When rotating, the projection surface is not parallel to the depth of the scene in the direction of the line of sight, and then the model will generate vertical parallax, and its perceived depth will increase from the center to both sides in a quadratic hyperbola, resulting in deformation. In order to ensure the consistency of the projection surface and the progressive depth of perception, an off-axis model that translates the two viewing volumes around the shooting axis can be used.

(2) Visual presentation

In the close-range model, the horizontal displacement of all pixels in the rectangular projection is calculated for binocular stereoscopic display, and the polarized red and blue color separation method is used for stereoscopic display. After loading the depth map, the system operates on each pixel in the source 3D panorama:

1) Obtain the corresponding pixel depth from the panoramic depth map.

2) The original pixel of the panoramic image is divided by its R (red) color channel, and the pixel point is relocated as the left eye display position \( p_1(x - \frac{t_{sf}}{2}, y) \).

3) The original pixels are removed from the G (green) and B (blue) color channels, and relocated to the pixel point as the right eye position \( p_1(x - \frac{t_{sf}}{2}, y) \).

4) Mix the A and B pixels into C, which is the pixel value of the final rendered pixel.

(3) Node load calculation

The length of the specified time period determines the accuracy of the system. According to the management model of the oilfield distribution network based on stereo perception, this article takes one hour as a prescribed period and the sampling interval is minutes.

1) Hourly load power at the feeder exit:

\[
P_{st} = K_{st}P_s \quad (1)
\]

\[
Q_{st} = K_{st}Q_s \quad (2)
\]

\[
K_{st} = V_{st}I_{st}/\sum_{t=1}^{24}V_{st}I_{st} \quad (3)
\]

In the formula, \( K_{st} \)--the power distribution coefficient at the t-th minute at the exit of the feeder;

\( P_s, \ Q_s \)--feeder outlet active and reactive power in a specified period of time;

The active power and reactive power at the t minute of the specified period at the exit of \( P_{st} \) and
3. Experiments

3.1. Software Operating Platform

In order to ensure the stability of the system and the ease of management, as well as the upgrade and expansion of the system, we have selected the Chinese version of NT 4.0 server as the server operating system. NT is a 32-bit multi-tasking, multi-threaded operating system, which supports multiple processors and supports multiple protocols (TCP/IP, IPX, etc.). In order to strengthen the fault tolerance of the system, the system adopts dual machine backup and cluster technology. For the confidentiality and security of network data, it supports inexpensive disks with fault tolerance and redundant array RAID, and has overall C2 level security protection measures.

3.2. Online Monitoring of Distribution Line Production and Operation Information

(1) Data collection. The system will collect the following real-time data:

1) Analog quantity: active power P, reactive power Q, current I, voltage U, power factor, etc. at the beginning, middle and branch of the distribution line;

2) Digital quantity: position of line and section switch, protection action number, communication channel fault signal, fault location indicator signal, device main power failure signal, etc.;

3) Protection information: state quantity of switch protection, protection setting value, self-diagnosis information of protection equipment, fault location information, etc.;

4) Event Sequence Record (SOE): It can be logged into the historical database, and the tools provided by the system can be used for convenient classification retrieval and printing.

4. Discussion

4.1. Monitoring Image Analysis Based on Stereo Perception

In the research of this paper, the stereoscopic visual presentation adopts the color cast method when viewing the grid monitoring image. The picture is a stereoscopic display image; it reflects the change of the global brightness of the power grid operation monitoring picture during the day; the stereo effect is determined by subjective experiments. Table 1 statistics the load cost of the system in terms of storage space, display time and network transmission. At the same time, subjective experiments show that the
stereo effect conforms to the natural hearing situation, and the environment change has a strong immersion. The experimental results are shown in Table 1 below.

**Table 1.** Description of system load in storage space, network transmission

|                | Node1 | Node2 | Node3 | Node4 |
|----------------|-------|-------|-------|-------|
| SubFigure      | 4     | 5     | 9     | 6     |
| Processing time(ms) | 231   | 235   | 209   | 224   |
| Storage (Megabyte)  | 1.31  | 1.16  | 1.02  | 0.89  |
| Web translate time(s) | 1.33  | 1.14  | 1.01  | 0.97  |

As shown in Table 1 above, real-time load detection indicates that the imaging processing time of the system is only related to the texture complexity of the scene. In terms of storage space requirements, statistical data can be seen that the storage cost under the condition of a certain resolution of the panoramic depth map of the power grid operation monitoring. The original is related to the texture complexity of the scene. This is mainly because the texture complexity affects the interpolation process. Generally speaking, the more complex the surface texture, the more interpolation is performed at its depth, resulting in a larger storage space. In terms of network transmission, the average transmission time of each data is 1.88 seconds, which can be displayed instantly after being preloaded.

4.2. Monitoring Results and Benefit Analysis

In order to verify the accuracy and reliability of the forecast content of the “Operation Monitoring System for Oilfield Distribution Networks Based on Stereo Sensing” designed in this paper, this operation monitoring system has been used for a long-term test research based on the field, and a lot of field test monitoring has been obtained data. Through comparative analysis, it is known that the forecast of the system is timely and rapid, the forecast content is true and reliable, and the expected effect of the experiment is achieved.

During the field test, the “Operation Monitoring System for Oilfield Distribution Network Based on Stereoscopic Awareness” reported a total of seven times of “Excess Electricity Loss”, including “Brick Factory”, “Glass Fiber Factory”, “Steel Plant”, etc. Differently, the load of “insulation material factory” is in the middle. After careful investigation by the relevant responsible departments, one of them was caused by the local farmers' "woven belt factory" using electricity across the meter, which should be investigated and dealt with immediately. The plant's average daily load is 200 kilowatts, and the monthly electricity consumption is 180,000 kilowatt-hours based on the daily operation time of 20 hours, which is equivalent to nearly 100,000 yuan in electricity costs. The data monitoring report and accident report are shown in Figure 1 below.
As shown in Figure 1 above, the “Operation Monitoring System for Oilfield Distribution Networks Based on Stereo Sensing” also reported a total of “Over Harmonic Content Exceeding Standards” during the field test, the most serious of which was the “High Voltage Electric Dehydration” equipment. The "total voltage harmonic content" is reached, and the other is the "boiler room circulating water pump soft start equipment", and the "total voltage harmonic content" is reached. In this case, the voltage and current can hardly see any sinusoidal waveform. The field test results of the "Operation Monitoring System for Oil Field Distribution Network Based on Stereoscopic Perception" show that the economic and technical indicators of its actual operation have met the established requirements of the subject, and three of the technical indicators are higher than the established requirements of the subject and reached the design of the subject. expected result.

It can be seen from the above analysis that the “Oilfield Distribution Network Operation Monitoring System” studied and designed in this paper can provide a realistic and credible basis for the early warning and timely treatment of various types of accidents in the oilfield distribution network, creating a large-scale blackout to avoid large-scale accidents. In order to ensure the safe and smooth progress of the daily production tasks of the oil field, it provides a reliable guarantee for the energy conservation and efficiency of the oil field and safe production, and has considerable social and economic effects.

5. Conclusion

The site involved in this system research is only one (accurately half) distribution line, a monitoring point, it should be said that it is a very small case, especially for some outdoor equipment due to the consideration of meteorological conditions Because of the single environment and short running time, an accurate conclusion may not be formed for a while. Problems such as these need to be resolved on the basis of the system's continuous operation for a long time. In this paper, the parallel camera model is used for scene depth acquisition. In practice, there may be other imaging conditions that need to be considered. In addition, the operational complexity of the depth information acquisition involved in the research is still relatively high, and future research will further consider higher integration Depth
measurement method. In terms of the reconstruction of the stereo perception model, this article is limited to the types of vision and environment, and further research on the development of other multi-dimensional stereo perception needs to be continued. In this paper, the definition of stereo perception is compared through subjective test experiments, which lacks reliability and is limited to the depth of research. This study only considers the three-dimensional panoramic application in the offline acquisition state. Real-time processing capabilities will also be one of the future research directions.

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