Research on Key Technologies of Training System of Transformer Capacity Testing Based on MR

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Keywords: Transformer capacity testing, Training system, MR

Abstract: Power system is a complex integrated system. It is of great scientific significance to apply mixed reality technology into power safety production and management. In view of the special complexity of transformer capacity testing, this paper studies the key theories and technologies of mixed reality system for transformer capacity testing and develops the training software for transformer capacity testing based on mixed reality. This paper describes the design of interactive capacity testing training in detail, including the sensory design of switching circuits, the design of inductance sensing and the design of interface to provide some references for the relevant researchers.

1. Introduction

Transformer capacity testing process is often very complex, which requires very high requirements for operators [1]. Overhaul personnel often face thousands of equipment testing personnel, in the process of operation, even skilled maintenance personnel often need to rely on readily read manuals to guide operations, often easy to miss inspection. This way relies too much on the personal skills and experience of maintenance personnel, and there are many inconveniences in operation, resulting in low efficiency and difficult to ensure the quality of operation. Therefore, there is an urgent need for an intelligent operation system solution, which can intuitively guide on-site operation and turn human's active access into passive reception. It not only alleviates the adverse effects of individual capacity limitation on operation and service, but also maximizes the protection and enhances the full play of individual capacity through technical means. In order to improve the operational efficiency of transformer capacity testing, the tracking registration technology based on Mixed reality technology and somatosensory human-computer interaction technology are emphatically studied. Therefore, the application of Mixed reality technology to the power industry has become an inevitable trend in the future. But at present, the research of Mixed reality technology in power industry is in its infancy. Based on the training requirement of Mixed reality technology in power safety production, this paper will study the key theory and technology of Mixed reality system [2].

2. Basic Concept of Mixed Reality

Mixed reality technology is a kind of visual technology that seamlessly integrates the virtual information generated by computer with the real environment and presents it uniformly in the display device. It can present the virtual object or other information generated by computer graphics technology in the observation and display of the scene as real objects, so as to achieve "false and true", which can provide additional virtual information and not be like virtual. Virtual Reality technology, like VR technology, completely replaces reality. It retains the intuitive and transparent observation of the real environment, and ensures that the newly added virtual objects and the real environment maintain a high degree of consistency in posture, illumination and so on. It brings people a new visual experience. It is an information enhancement of the original real scene. It is a research hotspot in recent years. The transformer capacity testing system based on MR technology can not only superimpose virtual 3D reality enhancement information about components on the real operation

  DOI: 10.25236/iwmecs.2019.086

scene, such as component model, technical information, etc., but also provide visual and intelligent operation guidance for operators. Then the operator is prompted step by step with mixed information, such as what tools to use, where to locate and how to operate. The real-time transmission and reconstruction technology of MR data and the fast modeling technology based on depth camera are introduced. A real-time service system for transformer capacity testing is developed by applying MR technology to realize the visual guidance of transformer capacity testing. MR can help senior executives in the construction industry communicate to workers which parts of the equipment are not working or which jobs have not yet been done through virtual signals. Through their headphones, staff can view technical charts and find the same solution [3].

3. System Features of Transformer Capacity Testing Based on MR

Although the process steps of transformer capacity test are complex, the operation of each step is not very difficult, mainly in accordance with the sequence of operations, and pay strict attention to safety operation specifications. Transformer capacity test is a very common type of power maintenance operation in actual operation and production. It has the characteristics of strong universality and great safety responsibility. Therefore, in this system, process standardization and safety operation specification are the key contents of system design. In order to do homework, we need to have a good understanding of the basic working principle and related technical parameters of the equipment. Therefore, in the system, theoretical knowledge learning is the basic content, using text, pictures, video and other ways to learn theoretical knowledge. In order to improve the active learning ability of trainees, the structure recognition function module is designed in the system. Through the three-dimensional superposition of virtual three-dimensional model and real equipment, each component and structure of transformer is introduced and analyzed in detail. In mixed reality system, interaction design and optical field technology are the most important. Because there is no mouse and keyboard, the input operation of the system will be totally different from that of traditional software system. Under completely different circumstances, how to ensure the operator to operate quickly and skillfully is a great test for interaction design [4]. In the industry, the auxiliary handle is often used to input part of the operation, but in this system, because the operator also needs to manually pull the drop switch and use the electroscope stick, so the handle can no longer be used.

4. Design of Interactive Capacity Testing Training

4.1 Sensory Design of Switching Circuits.

Switching circuit sensing in the project is realized by switching quantity acquisition. Switching quantity refers to the acquisition and output of discontinuous signals, including remote signal acquisition and remote-control output. It has two states: 1 and 0, which are the switching properties of digital circuits. Electricity refers to the switching on and off of circuits or the switching on and off of contacts. "On" and "off" are the most basic and typical functions of electrical appliances. General switching device realizes the output of switching quantity through internal relay. Power supply specifications: 9 ~ 27VDC. Digital Quantity Interface Form: Dry Contact. DI acquisition frequency: 1KHz. Wire: RVV 2*0.5. The switch of low-voltage main circuit breaker is connected with ID1 interface of switching quantity acquisition module. The three upper terminals of transformer high voltage input end are connected with ID2, DI3 and ID4 interfaces of switch acquisition module in turn. The three lower terminals of transformer high voltage transmission line are connected with GND interface of switch acquisition module in turn. High voltage terminals A, B and C are connected with GND interface of switch acquisition module in turn. Low-voltage terminals A, B, C and O are connected to GND interface of switch acquisition module in turn. The test rod is connected with the ID5 interface of the switch acquisition module. The discharging rod is connected with the ID6 interface of the switch acquisition module.

Figure 1. Figure of transformer circuit installation

4.2 Design of Inductance Sensing.

In this project, the metal parts of transformer are tested by the electroscope rod. The upper part of the electroscope is a metal ball. It is connected with the metal rod. The metal rod passes through the rubber stopper. Two very thin metal foils are hung at the bottom of the metal rod and packaged in a glass bottle. When checking, contact the object with metal ball (metal plate), if the object is charged, a part of the charge will be transferred to two pieces of metal foil. Because of the same charge, the metal foil will open because it repels each other. The more charges it carries, the larger the angle of opening. If the object is not charged, the metal foil will not move. When an object is known to be charged, it is necessary to identify the type of charge it carries. Just contact the charged body with the metal ball first to make the metal foil open. Then, contact the metal sphere of the electroscope with a known number of positive objects. If the angle of opening of the metal foil is larger, the charge of the charged body is positive. On the contrary, if the angle of opening of the metal foil decreases or closes first and then opens, the charge of the charged body is negative. The above facts mean that when charged body increases the same charge again, the magnitude of charge increases; when charged body increases the different charge again, the magnitude of charge decreases. Therefore, positive and negative charges are usually expressed as positive and negative respectively. For example. The algebraic sum of positive and negative charges is zero, which shows that the external electric effects cancel each other out. At this time, they are electrically neutral. This phenomenon is called discharge or neutralization.

4.3 Design of Interface.

By classifying different requirements of interface design and the influence of interface design elements on user behavior, the importance of user in interface design is studied. Interactivity has become the goal of network interface design. In order to make the design meet the usability requirements, it is necessary to have a comprehensive understanding of user characteristics and diversified requirements. This requires finding the right way to record and implement diverse user requirements. Interface is the medium through which people interact with objects. In other words, interface is the new face that designers give to objects. Adhering to the principle of GUI design, the interface is intuitive and transparent to users: users can see the corresponding functions of the interface at a glance after contacting the system. User interface is the window of human-computer

interaction in the operating system. The interface design is based on the physical characteristics of the device screen. According to the number of colors and image formats supported by the device, the physical characteristics of the device can be maximized. In order to reduce the user's memory burden and the beauty of the interface, the consistency of the interface is maintained in the interface, which includes standard controls and the same information representation methods, such as font, label style, color, terminology, display error information and so on. The interface style is relatively uniform, and the specific interface can be adjusted reasonably according to the usability and practicability of the specific operation, so as to coordinate and unify the regions and give priority to them properly. Ensure that users can operate functions conveniently and quickly, and reduce the burden of memory. The color and style of the interface are unified, including the style of icons and buttons and the visual effect under different operating conditions.

5. Gesture Recognition

In computer science, gesture recognition is an issue of recognizing human gestures through mathematical algorithms. Gesture recognition can come from the movement of various parts of the human body, but generally refers to the movement of the face and hands. Users can use simple gestures to control or interact with devices so that computers can understand human behavior. The key technologies are gesture segmentation, gesture analysis and gesture recognition. Gesture recognition is a topic in computer science and language technology. The purpose is to recognize human gestures through mathematical algorithms. Gestures can be derived from any body movement or state, but usually from the face or hand. Current focus in the field includes emotion recognition from face and gesture recognition. Users can use simple gestures to control or interact with devices without touching them. Recognition of posture, gait and human behavior is also the subject of gesture recognition technology. Gesture recognition can be seen as a way for computers to understand human language, thus building a bridge between robots and humans that is richer than the original text user interface. Gesture recognition enables people to communicate with machines and interact naturally without any mechanical equipment. Using the concept of gesture recognition, the finger can be pointed to the computer screen so that the cursor will move accordingly. Whether the gesture is static or dynamic, the recognition order first needs to detect and segment the gesture of the image acquisition hand, and then carry out static or dynamic gesture recognition.

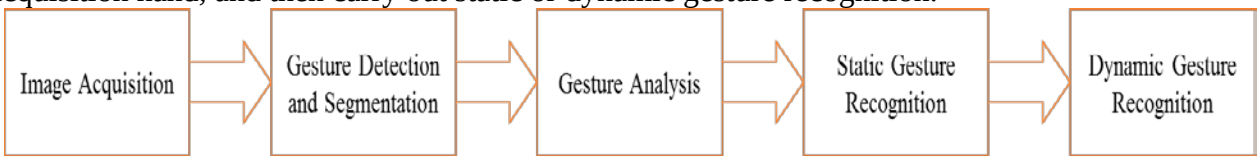

Figure 2. Process of gesture recognition

Gesture recognition is the process of classifying trajectories (or points) in the model parameter space into a subset of the space, which includes static gesture recognition and dynamic gesture recognition. Dynamic gesture recognition can ultimately be transformed into static gesture recognition. From the technical realization of gesture recognition, the common methods of gesture recognition are template matching method, neural network method and hidden Markov model method. The template matching method regards gesture action as a sequence composed of static gesture images, and then compares the sequence of gesture template to be recognized with the known sequence of gesture template, so as to recognize gesture. Hidden Markov Model (HMM) is a statistical model. The system modeled by HMM has double stochastic processes, which include state transition and output of observations. The stochastic process of state transition is implicit, which is represented by the stochastic process of observation sequence. Gesture recognition is an important part of human-computer interaction, and its research and development affect the naturalness and flexibility of human-computer interaction. At present, most researchers focus their attention on the final recognition of gestures. They usually simplify the background of gestures and use the algorithm to segment gestures in a single background. Then they use common recognition methods to analyze the meanings of gestures. However, in practical applications, gestures are usually in complex

environments. There are many complex background factors in over-darkness, such as different gesture distance from acquisition equipment. These problems have not been solved before, and will be difficult to solve in the future. Therefore, researchers need to solve the current problems in a specific environment, and then through the combination of various methods to achieve gesture recognition suitable for different complex environments, thereby contributing to the research of gesture recognition and future human-computer interaction.

6. Conclusion

Transformer capacity testing is of great significance in practical production, and has high requirements for safe operation standards. In this system, the gesture operation commonly used in MR technology is used as the basic interaction mode. How people respond to the operation of the actual equipment in the MR software is the difficulty of the whole system. It is very difficult to realize it by using the technology of MR image recognition, and it is not feasible. Therefore, we make simple modification of the equipment to achieve the purpose of converting physical space operation into digital signal.

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