Application of Image Processing Technology in Substation Patrol Inspection

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Abstract. Electricity plays an important role in the development of national economy, and substation is the core of the whole power grid, which plays an important role in dispatching power supply. In the past, substation management mainly relied on human resources to monitor and inspect the substation on duty, which caused a lot of waste of electric power technicians. With the development of automation technology and network technology, a new substation management mode emerged as the times require, that is, the application of image processing technology in substation inspection. This kind of substation inspection involves image and voice compression technology, computer technology, multimedia network technology, so it is a relatively complex large-scale system. Image processing technology makes it possible to patrol unattended substations. In view of space, this paper mainly introduces the application of image processing technology in substation patrol.

1. Introduction
The overhaul branch of Jiangxi Electric Power Company is an intensive management unit for 520 and 230 kilovolt transmission and transformation in Nanchang. It is mainly responsible for the operation and management of 520 and 230 kilovolt transmission and transformation primary and secondary equipment, maintenance, overhaul, technical transformation, defect treatment, emergency repair and technical management of accidents, and regular management of secondary equipment. School (trial) inspection; Responsible for the treatment of major defects and emergency repair of power transmission and transformation equipment in Jiangxi power grid. At present, the overhaul branch of Nanchang Electric Power Company has 7 550 KV substations and series compensation stations. At the same time, it has to take over 43 substations of 230 KV in Jiangxi Power Grid, and this number is constantly refreshing [1-2]. These substations play a vital role in the transmission and distribution of the entire Jiangxi power grid. Patrol inspection of each substation is one of the main tasks to ensure the normal operation of substation equipment.

With the progress of science and technology and the deepening and development of power system reform, the degree of automation of power system has been greatly improved. The electrical signals of substation equipment can be obtained through monitoring control and data acquisition system, insulation detection of high voltage equipment, relay protection and other devices, thus realizing the remote monitoring of substation main equipment. Control, namely "four remote" (telemetry, tele-communication, remote control, tele-adjustment) function [3].
Even though most substations have realized the function of "four remotes" and are on duty for fewer people or unattended substations, to a certain extent, there are still a series of problems caused by unattended on-site timely monitoring and patrol, even leaving hidden dangers for safe operation. The first kind of problem is the heating and overheating caused by the leakage of busbar connection points, terminals and vacuum switches, and minimal leakage of lightning arresters, thus losing the opportunity of timely detection; the second kind is the anti-theft and defensive rescue; the third kind is the lack of timely understanding of the main transformer, switch oil level and the external condition of equipment; the fourth kind is the problem. It is impossible to inspect the equipment condition in time after strong wind, heavy snow and thunderstorm. Due to the lack of timely understanding of the substation situation, the opportunity to prioritize treatment is lost. Therefore, patrol inspection plays an extremely important role in ensuring the normal production and safe operation of substations. Traditional patrol tasks need to run patrol personnel to each substation every day or regularly, collect a large number of operation data, and do a lot of routine patrol work. In this way, it brings some difficulties to the daily maintenance and inspection of substations, especially the daily operation and maintenance. Because of the repetitive work day after day, it is easy to cause some inspectors to get bored. Sometimes the inspections are not in place, and people have not arrived at the spot to inspect and inspect. The report has been fabricated and filled out, which obviously deviates from the purpose of setting up inspection posts. The progress of substation with few or no people on duty also requires people to inspect part of the equipment on site regularly.

How to solve the above problems in substation inspection has become a key problem that must be faced and solved. In this paper, image processing technology is used to study the problems in substation patrol inspection. Firstly, the status and shortcomings of image processing technology are analysed, and the advantages of image processing technology are introduced. How to introduce image processing technology in substation patrol inspection is elaborated, and a framework of substation-based security analysis platform is proposed. Several issues are discussed deeply. The importance of image processing technology for common scenes.

2. Method
Image processing technology originated in the 1920s. After nearly a century of development, it has been widely used in industrial, medical, aerospace and military fields, playing an increasingly important role in economic development. Image processing technology is a technology that uses computer to process image information. It mainly includes image digitization, image enhancement and restoration, image data coding, image segmentation and image recognition. With the rapid development of digital technology and Internet, digital image has become an important way for people to obtain information because of its large amount of information, fast transmission speed and long transmission distance. Digital image processing includes image enhancement, subtraction detection and edge tracking.

According to the indoor characteristics of the substation, this paper uses the difference method of image processing to process the scene image of the substation indoor in real time, so as to achieve the purpose of intelligent alarm. Geometric graphics (Graphics) is composed of points, lines, surfaces, colors and so on. It is generated by drawing program. It is a set of drawing instructions. Generally, it is made by various drawing software. The lattice image is composed of pixels and colors. It can be obtained by using camera, scanner, digital camera and other devices. It can also be generated by drawing software. The pictures represented by the images are delicate and rich in layers and colours [6]. Each pixel of the image is stored in the computer point by point, which occupies a large storage space. In this paper, the application of image processing technology in substation inspection is divided into: (1) image enhancement. The purpose of image enhancement is to improve the visual effect of images. It is a collection of various technologies, and has not yet formed a set of general theory. Common image enhancement techniques include contrast processing, histogram correction, noise processing, edge enhancement, transform processing and pseudo-color. In multimedia applications, image enhancement is mainly applied to all kinds of images, and image enhancement technology is generally supported by all kinds of image processing software. (2) Image restoration. The purpose of image restoration is to
Image restoration must first establish image deterioration model, and then restore the image according to the inverse process of fading. (3) Image recognition. Image recognition, also known as pattern recognition, is to extract the features of the image, then classify the image according to the geometric and texture features of the graph, and analyze the structure of the whole image. Usually, image preprocessing is needed before recognition, including noise and interference filtering, contrast enhancement, edge enhancement, geometric correction and so on. Image recognition is widely used, such as automatic control system of industrial substation, fingerprint identification system in patrol inspection, etc. (4) Image coding. The purpose of image coding is to solve the problem that digital image occupies a large space, especially when it is used for digital transmission. The core technology of image coding is image compression. For those unbearable loads, we have to use data compression to make the image data reach the level that the relevant equipment can bear. To evaluate image compression technology, three factors should be considered: compression ratio, complexity of algorithm and accuracy of reconstruction. (5) Image segmentation. Image segmentation is one of the key technologies in digital image processing. Image segmentation is to extract meaningful features from images, such as edges and regions, which is the basis for further image recognition, analysis and understanding. (6) Image description. Image description is a necessary prerequisite for image recognition and understanding. As the simplest binary image, its geometric characteristics can be used to describe the characteristics of objects. The general image description method uses two-dimensional shape description. It has two kinds of methods: boundary description and region description. For special texture images, two-dimensional texture features can be used to describe [7-8]. With the further development of image processing research, three-dimensional object description has been studied. Four image processing techniques, such as volume description, surface description and generalized cylinder description, are proposed, including point processing, group processing, geometric processing and frame processing. The most basic method of image processing is point processing. Because the object of this method is the pixel, it gets its name. Point processing method is simple and effective. It is mainly used for brightness adjustment, image contrast adjustment and image brightness inversion processing. The range of image group processing method is larger than point processing. The object of image group processing is a group of pixels, so it is also called "area processing or block processing". The application of group processing method in image is mainly manifested in detecting image edge and enhancing edge, image softening and sharpening, increasing and reducing image random noise, etc. The geometric processing method of image refers to the process of enlarging and reducing the image, rotating the image, mirroring the image, and translating the image by changing the position and order of the pixels of the image. The frame processing method of an image is to combine more than one image in a specific form to form a new image. Among them, the specific forms are: image synthesis by "logic and" operation, image synthesis by "logic or" operation relationship, image synthesis by "exclusive or" logic operation relationship, image synthesis by adding or subtracting and conditional composite algorithm, image coverage or average synthesis. Image processing software usually has the function of image frame processing, and synthesizes images in many specific forms. Image processing technology is generally divided into two categories: analog image processing and digital image processing. Analog Image Processing includes optical processing (using lens) and electronic processing, such as photography, remote sensing image processing, television signal processing, etc. The characteristic of analog image processing is fast speed. Generally, it is real-time processing. In theory, it can achieve the speed of light and can be processed simultaneously in parallel. Television image is a typical example of analog signal processing, which processes 25 frames/seconds of active images. Digital Image Processing is usually processed by computer or real-time hardware, so it is also called Computer Image Processing. Its advantages are high processing accuracy, rich processing content, complex non-linear processing, and flexible adaptability. Generally speaking, only changing the software can change the processing content [9-10]. The basic process is shown in Figure 1.
Figure 1. Procedure of Image Processing Technology Research

3. Experiments

Image processing technology is widely used in substation inspection. Aiming at substation inspection machine system, this paper proposes a feature matching method based on feature points. According to the requirement of the problem, the matching method based on multi-constraints is studied, which uses Harris corner as feature point and Bhattacharyya distance of gray level co-occurrence matrix as similarity. On this basis, RANSAC matching is further carried out, which effectively improves the correctness and speed of the whole matching process. In this paper, a simple and effective image matching method is proposed. This method uses the results of image registration as the initial hypothesis of Chamfer matching, and uses the original Chamfer edge matching method to calculate the edge similarity between images, so as to meet the requirement of measuring the correctness of target location results in the system. Experiments show that when the threshold is selected properly, the measurement effect is better [11]. In this paper, image registration technology is used to locate the target in the machine patrol image, and image matching technology is used to confirm the registration results, and then the accurate equipment location results are obtained. According to this result, image processing and recognition algorithms of substation equipment, such as knife gate, switch and instrument, are designed to realize image processing technology and pattern recognition function in automatic inspection system of substation equipment. The basic process is shown in Figure 2 and Figure 3.

Figure 2. Application Flow of Image Processing Technology in Substation Patrol Inspection
4. Result and Analysis
In this paper, image processing technology is generally divided into two categories: analog image processing and digital image processing. However, the disadvantage of analog image processing is poor accuracy and flexibility, and it is difficult to have the ability of judgment and non-linear processing. The disadvantage of digital image processing is that the processing speed is still a problem, especially for complex processing. Generally speaking, static images are mostly processed, if the real-time processing of digital images with general accuracy requires 100 MIPS processing capability; secondly, there are some limitations in resolution and accuracy, such as 512 *512 *8 bit for general accuracy images, 2048 *2048 *12 bit for high resolution images, and if the accuracy and resolution are higher, the processing required. Time will increase significantly [12]. Generally speaking, the general digital image is difficult to understand. Therefore, digital image processing cannot be separated from analog technology. In order to realize human-computer dialogue and natural human-computer interface, especially when people are required to participate in observation and judgment, analog image processing technology is indispensable.

5. Conclusion
Image is the main source for human to obtain and exchange information. Therefore, the application field of image processing inevitably involves all aspects of human life and work. It includes aerospace and aviation technology, biomedical engineering, communication engineering, industry and engineering, military and public security, culture and art, etc. With the continuous expansion of human activities, the application of image processing will also expand. Therefore, a feature matching method based on image processing is proposed in this paper. Image processing technology greatly improves the automation of unattended substation and greatly reduces the workload of power inspection technicians. This technology has been applied in mature unmanned substation patrol monitoring and remote monitoring system products, and has produced significant economic benefits.

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