The Application of the Power Grid Map Intelligent Recognition Technology in the Power Grid Early Warning System

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Abstract. As the power grid enterprises grow, the relationship between their power grid systems is becoming closer and closer. In the context of industrial development with the energy structure unbalanced, The operation of the power grid becomes more and more complicated, making the power grid system face the technical problems. In this context of technological development, power grid enterprises should follow the pace of the times and integrate intelligent technology into the technological innovation of the power grid to make the ability to predict the power grid fault come true in advance, and the grid map intelligent identification technology is the key technology to support the power grid enterprise to realize informatization and intellectualization. Because most of the original data of the power grid enterprise are stored in various kinds of power grid design drawings, the power grid intelligent identification technology can effectively visualize the data of such power grid drawings, and then realize the intellectualization which early warning technology means.

Keywords: Power Grid Early Warning System, Intellectualization, Power Grid Map Intelligent Recognition Technology

1. Application of the Visualization Technology in Power Grid Dispatch Early Warning

The visualization technology is different from the previous text or the graphic representation, which combines the forms to express all kinds of information such as the figure, color, sign, position, dynamic effect and strobe in a more distinguishable way.

The key of the visualization technology lies in presenting the data in the form of the figure, image and even the dynamic picture using the intuitive images, and integrate the interactive function to achieve the people- computer interaction to judge the data information much more precisely [1]. The visualization technology was mainly used to test the data and present visualization of the data calculation early. These data can be presented intuitively by the maps or other forms of the figures to assist the users to find the potential relationship of the data center. Among the power grid system, its work is also involved in a large quantity data such as the complicated data measurement and the experimental calculations. Therefore, achieving the visualization in a more scientific way can strengthen effectively the power system and its related technical research. What is more, the current
power grid enterprises also need to integrate the visualization technology to make the visualization of power come true.

Through power grid visualization technology, the unified management of terrain, map and grid data can be achieved effectively and it can be used for a real-time dynamic display, chart construction, geographic model intelligent research and judgment of power grid in the visualization program. In turn, electricians and other technical personnel can quickly obtain grid data information, improve grid maintenance efficiency, and ensure grid operation safety more efficiently [2].

2. Image Preprocessing of Power Grid Map Data

2.1. Gray Enhancement of Power Grid Image

The current power grid enterprises mostly adopt the form of the blueprint to present lots of the paper data such as the design of the relay protection, substation, power grid line, distribution network of the power grid.

| number | H1 | H2 | D1 | D2 | D3 | D3 |
|--------|----|----|----|----|----|----|
| pinball | High pressure PI | High voltage feed | Low voltage nooting line | Low voltage outgong line | Low voltage outgong line | Reactive power compensation |
| Primary system diagram | 3-LMVH/P4 | 3-LMVH/P4 |
| Switch cabinet model | RH2-10/0.5A | FZRN25-12D | S11-M-6 | HD138X-1500/231 | HD138X-600 | HD138X-600 |
| Main electrical components | JDZ-10 10/0.1 | T125-31.5 | 850KVA | DW15-1600 A | DZ20Y-400 | DZ20Y-400 |
| | C35-121/140T | (50A) | LMK1-0.661000/5 | DZ20Y-250 | DZ20Y-250 | DZ20Y-250 |
| | YBWS-1780 | LZZB-10 | 4218-4 500V | 4218-A 400-63A | JKP-40-3A |
| | 42L6-AV 10/1.5K | 50V/5 | 42L6-A 1000/5 | BSMJ-0.4-20-3 |

**Figure 1.** 400KVA box transformer

Figure 1 is the blueprint of the primary diagram of the 400KVA box transformer obtained by scanning. Figure 2 shows the histogram of R, G and B components after decomposing Figure 1.

Each channel formed by the color image in the blueprint needs at least 8 bits to store, so a large amount of memory is consumed, which will also lead to a prolonged image processing time. The grayscale image only has a single channel, so if the color image in the blueprint is converted into a grayscale image through MATLAB 2014a, it will reduce the memory and accumulate the computing speed. Grayscale image and grayscale histogram as shown in Figures 3:

**Figure 2.** The Histogram of R, G, B Components of a Blueprint for 400KVA Box Change
Figure 3. Gray image of primary wiring diagram of 400KVA box change

The grayscale histogram directly counts the characteristics of the grayscale after the blueprint conversion. It can be seen from Figure 4 that the 400kVA box-variant primary grayscale histogram has peak characteristics, and its grayscale is roughly 170-200. The grayscale difference is small. In order to realize the further calculation and processing of the gray-scale image of the power grid map, the key characteristics of the electrical equipment in the image are extracted, and the identification and classification of the electrical equipment are carried out. The decomposition of the two is more obvious.

The grayscale adjustment can effectively strengthen the contrast between the grayscale of the power grid image and the final target. According to a specific transformation function, the grayscale adjustment uses point cloud calculation to realize the grayscale expansion adjustment of the pixel, and the interior spatial connection of the image should not be moved [3].

2.2 Image Characteristics Extraction of the Power Grid Map

2.2.1 Feature Extraction Based on Improved Zernike Moments

In the discrete grid, the rotation and zooming of the image make it easier to resample and re-quantization. In this process, the electrical equipment should be reflected in the unit circle of each unit. In the process of enlarging the rotation angle of the existing electrical equipment, the normalization processing of the electrical equipment is realized, and the Zernike moments of each segment of the power grid are normalized. The following are the specific disposal extraction details:
(1) Calculate the gravity center of the rectangular image and transfer it to the origin;
(2) Reduce the internal grid electrical appliances of the extremely small circumscribed rectangle by \( \sqrt{a^2 + b^2}/2 \), which maps it into the unit circle;
(3) Calculate the 0-order moment of the power grid electrical equipment symbol in the unit circle:
\[
m_{00} = \iint f(x, y) \, dxdy
\]
(4) Calculate the Zernike moments of each segment within the unit circle:
\[
Z_{pq} = \frac{p + 1}{\pi} \sum_{x} \sum_{y} f(x, y) V_{pq}^x(r, \theta)
\]
The value of the Zernike moment is normalized by the formula
\[
m_{00} = \iint f(x, y) \, dxdy
\]
thereby obtaining the power grid equipment of the characteristic value
\[
|Z_{pq}|
\]

3. Power Grid Early Warning Architecture Design Based on Map and Asset Intelligent Identification Technology

3.1 The System Architecture
The system architecture can be seen in Figure 4.

![Figure 4. Architecture of Online Visual Scheduling and Early Warning System](image)

3.2 Hardware System Design
The hardware system design can be seen figure 5.

![Figure 5. The Hardware System Structure](image)
4. The Design Route Based on the Map Data Intelligent Recognition Technology and the System Presentation.

4.1 Fast Simulation and Modeling
In addition to complete technical support, the intelligent early warning of the power grid also needs a new theoretical system to support, and it needs to break through the limitations of the old theoretical framework and auxiliary tools. Individual traditional power grid system theories and implementation tools involve complicated models and calculation processes, and their operating speeds cannot meet the rapid data transmission requirements of modern intelligent systems. The blessing of the intelligent identification technology of map resources should be more targeted to incorporate rapid simulation models, risk factor analysis, and quantify the safety and reliability of the system. This function obtains topology, power flow, frequency, voltage, and equipment through a high-performance measurement communication system [4]. Real-time model status; then based on this status and online real-time analysis; finally determine the safety and stability of the power grid system. Simulation and modeling in the intelligent identification technology of map information is a prerequisite in power grid early warning, and it is an open platform to establish a complete set of power grids based on intelligent identification technology of map information for the transmission and distribution system and management of power grid enterprises early warning system. The following figure shows the ultra-real-time calculation and ultra-real-time short-circuit current identification of the static safety of the grid [5].

4.2 Platform Technical Support
The prerequisite for the stable operation of the intelligent identification technology of power grid map data is that it must have a strong technical platform as the support [6]. In addition to the automatic dispatch function for the power grid system, this platform also develops an intelligent environment based on the image interface as the support. The platform has the following characteristics:

1. The supporting platform is easy to use and is blessed with complete intelligent technology.
2. The technical realization of the early warning system adopts direct object-oriented thinking.
3. The development of the supporting platform should be carried out strictly according to different stages, that is, from the platform's underlying hardware and system, distributed database to the upper-level communication, data, and programming interface, it is divided into multiple levels of the organization [7].
4. Each module of the supported platform must have complete independence and scalability.
5. The output information is rich and highly intelligent.

At this stage, the existing power grid early warning system has a single early warning method and fewer early warning functions. Most of them use collected data to evaluate the stable operation of the power grid in real-time. For example, there are continuous power flow algorithms, sensitivity algorithms, and fault screening sequencing. Accurate detection of instability faults. On this basis, various online real-time detection information and real-time calculation data are comprehensively studied and judged to issue an early warning [8].

Based on the shortcomings of the traditional power grid early warning system, this research is based on the intelligent recognition technology of the image of the power grid, from component to system, from static to dynamic, from region to the whole network, to carry out the deployment and promotion of early warning system, as shown in Figure 6. Show.
In the actual power grid early warning work, once there is an abnormal situation in the power grid, a large amount of monitoring data information will be imported into the dispatch center as soon as possible. It is difficult for the staff to find the source of the problem in a very short time, which results in a missed optimal processing time [9].

Figure 6. The Multi-Dimensional Classification of the Intelligent Warning

The power grid early-warning system based on the intelligent identification technology of map information uses real-time information such as primary, secondary, static, dynamic, etc., to quickly classify and screen the early-warning information according to the sequence of Figure 7, and sort it according to the severity so that the monitoring personnel is possible to find the cause, type and severity of grid faults in the first time, and obtain the most important early warning information of faults at the first time [10]. The early warning information is accurate and clear, so that the monitoring personnel can determine the location of the fault in the shortest time. The internal designated disposal plan effectively strengthens the accuracy and speed of abnormal fault disposal.

Figure 7. The Intelligent Warning Information Screening

5. Conclusion
This research summarizes a set of early warning technologies and methods for the power system based on the intelligent identification technology of map and image. The early warning system based on map and image development mainly has the following characteristics:
Flexible use and deployment, diversified display of single data based on image recognition technology, and its visualization function can run simultaneously with other functions; and the maintenance is simple and convenient. The power grid early warning system based on the intelligent recognition of graphics and images can be compatible with common graphics and maintenance tools and can be displayed directly without the need to expand graphics conversion, achieving the maintenance-free.

At the same time, the improved Zernike moment algorithm reduces the deviation between the characteristic value of the transformed electrical equipment symbol and the original image and improves the stability of the early warning system.

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