Research on Visualization of Power Grid Big Data

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Abstract. With the constant improvement of power grid planning and management requirements and the gradual advancement of the urbanization process, the problems that need to be taken into account in the planning process are increasing, especially the demand for big data visualization of the power grid has increased sharply. About 80% of the information that humans obtain from the external environment comes from the visual system. A picture is worth a thousand words. A good visualization platform can monitor the overall operation of the power grid, which is convenient for analyzing and monitoring the operation of power supply companies to provide customers with high-quality services. The platform can complete the interactive simulation of different services, and can display the monitoring and analysis of the power grid through a rich visual interface, which is convenient for people to understand the real-time status of the power grid. This paper uses various advanced visualization technologies and data module algorithms at home and abroad to cooperate with the monitoring network to realize the visualization platform of power grid big data, promote the further development of power grid big data applications, and form a big data standard system for power big data technology research, product research and development, and pilot construction.

Keywords: Data visualization · Big data · Monitoring network

1 The Importance of Big Data Visual Analysis

Big data visualization analysis refers to the use of the user interface with information visualization and the human-computer interaction methods and technologies with analysis process while the automatic analysis and mining methods of big data are used to effectively integrate the computing power of the computer and the cognitive ability of the human in order to obtain insights into large-scale and complex data sets [7]. From the construction perspective of a smart grid visualization platform with big data structure, it is necessary to further consolidate and improve the optimization and design work of the computer visualization platform and the unified data interface of other sub-projects,

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so that the platform can play an active role in the storage and calculation of power big data and realize data analysis and control as well. Using intuitive visualization methods to display analysis results can effectively guide the operators to make scientific decisions, facilitate the realization of intelligent and visualization of electricity consumption, serve the company and related industries, and realize the intelligence of the production process.

2 System Construction and Realization

2.1 System Module

This paper designs four-layer system modules, which are:

The first layer is the collection and access of big data. Big data is a data collection with the main characteristics of large capacity, multiple types, fast access speed, and high application value. The characteristics of grid big data are shown in Fig. 1. We use sensors, smart devices, video surveillance equipment, audio communication equipment, mobile terminals and other information acquisition channels to collect data with a huge amount, scattered sources, and diverse formats.

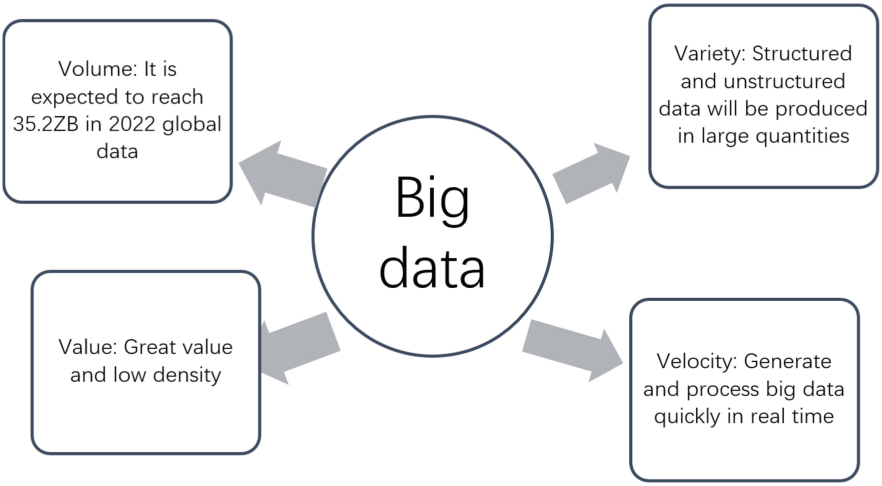

Fig. 1. 4v characteristics of power grid big data

The second layer is data storage. The storage technology used in this article is to use the current cloud storage technology to classify and store. The data types of big data are divided into structured and unstructured data. Sorting them into storage is conducive to subsequent efficient analysis and processing.

The third layer is data statistical analysis, mining, calculation, and management, providing security services with data backup and analysis services such as expert analysis and algorithm libraries. At present, methods such as feature extraction, data mining analysis, and statistical analysis of structured data have been widely used. For unstructured data, video, audio, and text are research hotspots, and intelligent analysis methods, such as machine learning, pattern recognition, and association analysis, are needed to achieve in-depth mining and multi-dimensional display of big data. Analyzing the data in the smart grid can help us to obtain information such as load and fault, which is helpful for the maintenance and operation of the power system, upgrading and updating. For example, the University of California, Los Angeles integrates the distribution of users, real-time electricity consumption information, temperature and weather and other information into a "electricity map", which can intuitively show the electricity consumption of people in each block and the power consumption of buildings, providing effective load data for the power sector.

The fourth layer is to integrate the information derived from various data algorithms such as classification, clustering, and association rules, and then visualize it graphically. Visualization is the use of graphics and images to describe complex data information. A reasonable and good visualization can make people have a more intuitive and three-dimensional understanding of data information. Each data item in the database is represented as a single graphic element and constitutes a data image, and the data is integrated, processed and analyzed according to different dimensions (time, space, etc.). The visualization of smart grid big data not only meets the needs of production and operation, but also meets the requirements of external support. Visualization can display the data status of power system production, operation, and operation as a whole and in an all-round way. When there is a special status or a warning status, it can be promptly and quickly discovered by operators and management personnel.

2.2 The Key to System Design

The third and fourth layers are the key modules of the big data visualization system. The key point of the third layer is the algorithm. This article does not use a single algorithm to apply to all modules, but uses the optimal and most suitable algorithm for this data module based on the conclusions drawn from the characteristics and needs of a certain data module. The algorithms to be used in this article include Hadoop, MapReduce, whole-process data processing, big data causal analysis algorithms, self-recommended adaptive full-life data, data set technology and hybrid computing technology. The key point of the fourth layer is to prepare to introduce advanced visualization technologies at home and abroad, including the latest network visualization, spatiotemporal data visualization, multi-dimensional data visualization, and WebGIS visualization (as shown in Fig. 2), and use these advanced technologies to build a visualization platform.

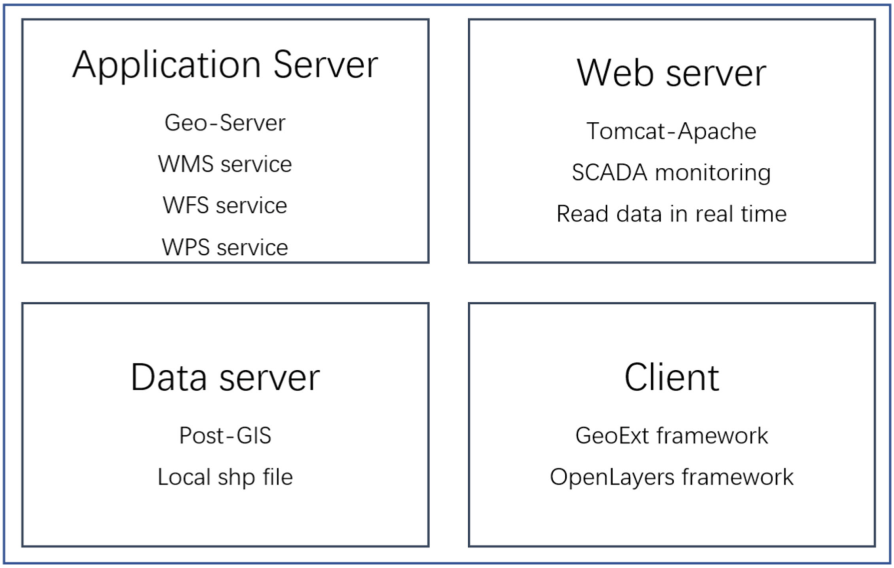

Fig. 2. WebGIS visualization architecture diagram

2.3 Realization of System Function Module

The system has built five application function modules, including statistical analysis center, trend warning center, intelligent search center, panoramic image center, and visualization display center. The smart grid visualization platform is mainly based on the overall perspective, using big data technology architecture to carry out the overall construction, and to accommodate the grid status data. The content involved includes various data collections that appear in the process of power grid operation, maintenance and energy collection.

The massive data and specific cloud computing models provided by the smart grid big data information platform can provide more targeted guidance for the operation and development of the smart grid to a certain extent. As a result, the realization of the smart grid visualization platform based on the big data architecture can become an important field of future development. The existence of big data technology can not only implement advanced applications from the perspective of the field of intelligent scheduling, but also solve the problems in state detection and conduct a comprehensive analysis of power consumption. The functional system of the big data visualization monitoring system is shown in Fig. 3.

In the report technology, we use a Python-based multi-dimensional report platform, the main types of functions are: Overall template design: it can be selected from the existing template library, or can be customized according to needs; Statistical chart type selection: 6 types of statistical chart forms including line chart, scatter chart, and histogram are provided, which are conducive to the intuitive display of data; Chart

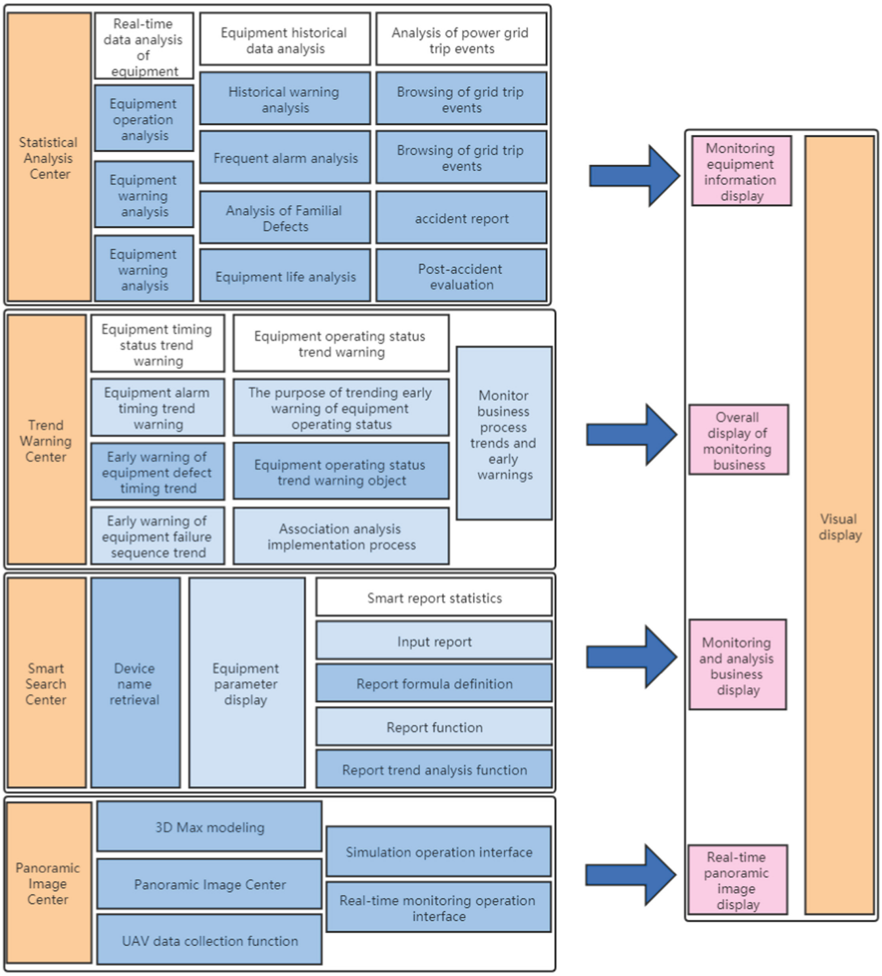

Fig. 3. The functional system of the big data visualization monitoring system

parameter setting: diversified operations can be performed, such as importing files and setting coordinates axis, add legend, add notes, etc. In the module composition of the automatic chart generation system, there are two major modules: template setting and chart generation, which cooperate with each other to support the operation of the platform [9] (Fig. 4).

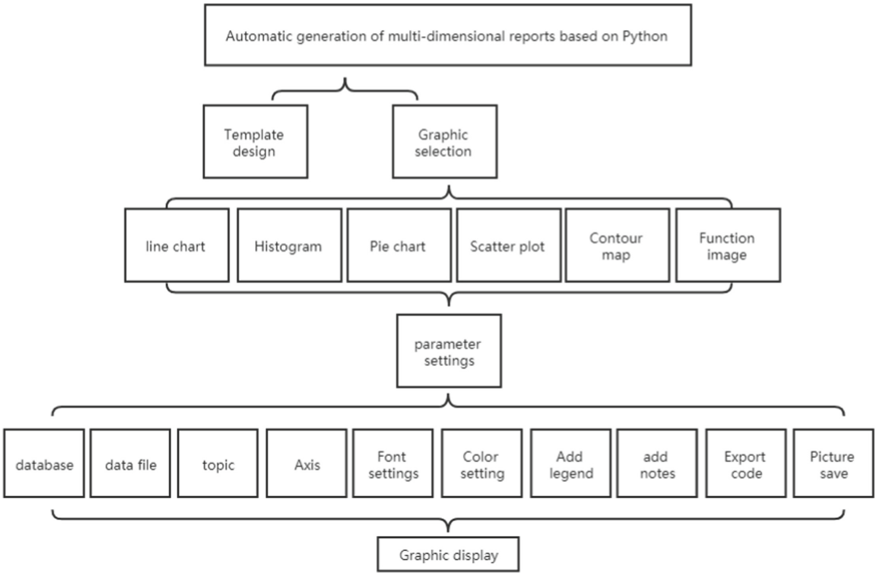

Fig. 4. The functional structure of a multi-dimensional report platform based on Python

3 Visualization Application Method of Power Grid Big Data

Through practical application, it is concluded that the application of big data visualization technology analysis in power grid big data is generally implemented in the following process. The main process is as follows: (1) The user puts forward the problems encountered in actual work, and clarifies the goal of the analysis. (2) By collecting and investigating the possible influencing factors of the target (equipment reliability, grid risk, etc.), analyze the data source and obtain relevant data. (3) Research factor classification attributes (such as time series, space, static, etc.). (4) Choose different big data visualization techniques for different types of factors (such as basic diagrams, network diagrams, tree diagrams, multidimensional diagrams, geographic diagrams, etc.). Variables of the same type can be put together for multi-dimensional analysis to realize the analysis of the degree of influence of potential factors on the target. (5) Through the feedback of the visualization results, continuously improve or replace the visualization technology to make the potential relationship or characteristics more obvious [4].

4 Prospect

Data visualization can show the potential connections between numbers more clearly. Through data mining and summarization of the massive data obtained by calculation, the essential connections within the data can be discovered and indirect indicators that can accurately represent the state of the system can be obtained. Finally, visualize it in the correct way. It can present a panoramic view of the development of the power grid system, thereby presenting the direction of changes in electricity-side data and economic development, and embodying the important role of the power industry in social and economic development.

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