# Research and Design of Electric Power Big Data Visualization

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**Abstract:** Based on the analysis and research of electric power big data and visualization technology, this paper analyzes the design and realization of the power big data visualization based on DataV, and describes the result display through the actual system design. The DataV large-screen display is a full-information simulation of the actual large-scale power grid in the virtual world. It can collect detailed data of power production and operation in any region at any time; clearly and intuitively display the comprehensive statistical data of the power grid, real-time operating data and equipment monitoring on the computer Data, count all the lightning damage area, bird damage area, and pollution flashover area of the power grid, and can intuitively display the power grid early warning situation, and obtain the latest data of the power grid operation at any time.

**Keywords:** DataV; Electricity Big Data; Visualization

## 1. Introduction

Data visualization originated from computer graphics in 1960s. People use computers to create graphics and graphs, visualize the extracted data, and present various attributes and variables of data. With the development of computer hardware, people create more complex and larger digital models, and develop data acquisition equipment and data storage equipment. Similarly, higher-level computer graphics technology and methods are needed to create these large data sets. With the development of data visualization platform, the increase of application field, the continuous change of expression, and the increase of real-time dynamic effects, user interaction, etc., data visualization is expanding like all new concepts.

Electric power big data is the practice of big data concepts, technologies and methods in the electric power industry, and it is one of the key areas of big data application. Compared with traditional charts and data dashboards, today's data visualization is dedicated to presenting business insights hidden behind fast-changing and complex data in a more vivid and better format. DataV intends to let more people see the charm of data visualization, and help non-professional engineers to easily build professional-level visualization applications through a graphical interface. DataV can also provide a wealth of visualization templates to meet the display needs of various businesses such as conferences and exhibitions, business monitoring, risk warning, and geographic information analysis.

The operating state of the power system is characterized by massive amounts of data, and various analysis and calculation results are continuously produced at all times. With the extensive

BDEIM 2022, December 02-03, Zhengzhou, People's Republic of China

DOI 10.4108/eai.2-12-2022.2328693

interconnection of systems and the recommendation of power marketization, the amount of data has increased exponentially. Existing energy management systems are incapable of processing and realizing these data. How to efficiently organize and display massive data with the help of visualization technology has become a hot research topic.

## 2. Research Ideas on Visualization of Transmission and Distribution Data

According to the actual situation of power transmission and transformation data visualization, the overall structure of power big data visualization is shown in Figure 1 (including the integration relationship with other external stones).

After the development of the power big data visualization component is completed, other grid systems can seamlessly integrate functions such as multi-data source configuration management and data analysis process visualization by adding the component to the system and doing a small amount of configuration. Need to provide some external interfaces, these interfaces include the back-end interface, but also include the front-end interface. Various types of interfaces have reasonable classifications, and the interface center can manage and query the interfaces. There will be many interactions with external systems or time suites, and the interface system is responsible for encapsulating the data and services required for these interactions. The design involves the invocation of power big data related services, and also involves the provision of standardized data interfaces to the outside world. The integration between the two requires functions and procedures such as data filtering and data adaptation [1].

For some basic functions, the component will provide some key parameter configuration. For some special functions, the component will not only provide parameter configuration, but also pluggable control configuration, allowing users to freely use and load some special functions in the component system.

The power big data visualization component mainly provides some functions related to visualization, healing some functions related to big data analysis, such as data calculation and mining. This component needs to call related distributed services to complete. Functions such as the interaction of distributed services related to the underlying big data will be encapsulated in the system.

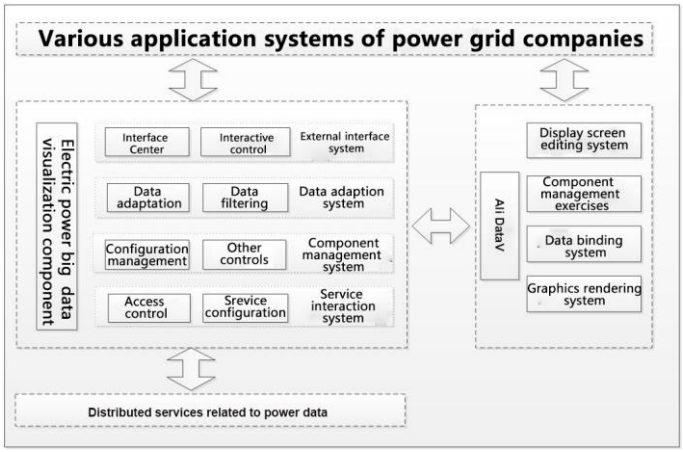



Figure 1: The overall architecture of electric power big data visualization

## 3. DataV application scenario analysis

From the perspective of practical DataV, three aspects need to be involved: design, deployment, and data: the following is a brief overview of these three aspects.

In terms of design, it provides various scenario templates such as operational dynamic live broadcast, comprehensive data display, equipment monitoring and early warning, etc., which can directly serve the visualization needs with a little modification. Flexible visual layout can be realized by dragging and dropping. Anyone can use their creativity on the basis of templates to realize your own visual application [2].

Supported by WebGL technology, it can draw geographic trajectories, flying lines, heat, blocks, 3D maps/earth under massive data, and support multi-layer overlay.

In terms of deployment, first, the created visualization application can be published and shared, and data variables can be controlled through URL parameters so that different users can see different data pages. Second, deploy the configured applications locally to facilitate the use of scenarios with limited Internet connections.

In terms of data, the integration of multiple data sources supports Alibaba Cloud analytical database, relational database, Restful API, CSV, static JSON and other data sources, and can be polled dynamically. Multiple data sources can be gathered in a visual interface [3].

DataV products are suitable for large-screen display, that is, using this product, after formulating some display styles and configuring some data sources, use DataV's front-end and back-end services to display the data on the large screen in a graphical manner.

## 4. Visual analysis of electric power big data

Big data visualization generally includes a series of complex data processing including data collection, analysis, intelligence, management and mining, and then designers design a form

of expression, which is three-dimensional, two-dimensional, dynamic, real-time or interactive. Then the engineers create the corresponding visualization algorithm and technical means. It includes modeling method, architecture of processing large-scale data, interaction technology, zooming method and so on.

Electric power big data visualization mainly involves the statistical analysis of power grid asset management, the statistical analysis of real-time power grid operation data, and the monitoring of power grid equipment status.

The main purpose of statistical analysis of power grid asset management is to display the results obtained after analysis, calculation, and statistics of the power grid system to users. It itself focuses more on friendly data display methods and beautiful display interfaces.

The purpose of data visualization design is to make the visual effect better. The design results must be very easy to understand, so that people who do not understand the data analysis technology and power, or who do not know anything about the sales and business departments can also understand. Most of the time, the data visualization results are used to make reports, which may be internal or external, it's also important to make data visualization reports easy to understand. What we need to do is to accurately grasp the psychological needs of different types of users, conform to the user's operating habits, and make it easier for users to understand the different levels of information brought by different operations.

Beautiful display interface focuses on the user's subjective feeling of using the product. There are many factors that affect the user's subjective feeling, which can be roughly divided into three parts: information architecture, interactive experience and visual design. The level of information architecture affects the user's operation logic. It is necessary to arrange the information level reasonably, clearly show the logical relationship between the data at all levels, and distinguish the primary and secondary. In the interactive experience stage, users change from passively accepting data to actively controlling data and exploring information. Aesthetic principle is an important criterion that can not be ignored in information communication design. All design works will be displayed in visual form. In the process of power big data visualization, the visual communication theory will make the data statistics and equipment status more eye-catching, so that users can grasp the necessary information more clearly and intuitively.

Many equipment in the power grid need to monitor fault conditions. Some monitoring data generated by these monitoring facilities need to be processed and analyzed to determine whether the equipment is abnormal. In similar situations, you can use DataV to correlate the abnormal data found during monitoring. Statistics and display of the equipment, so as to achieve the purpose of equipment monitoring.

## 5. Power big data DataV display design

This article will mainly extract equipment scale statistics, defect distribution, wildfire information, power grid flow and other indicators from several aspects such as power grid asset management statistical analysis, power grid real-time operation data statistical analysis, and power grid equipment status monitoring.

## 5.1 Cloud search

The search interface fully displays the functions of each area and plays a guiding role as shown in Figure 2.


Figure 2: Equipment scale

## 5.2 Defect distribution display

The power supply bureau is used as the statistical unit to show the distribution of power transmission and transformation defects in the power grid, which is convenient for analyzing defects and eliminating defects. The defect statistics are displayed in the form of multi-dimensional histograms or looped broadcast by each power supply bureau. The defect distribution of the defect level indicator dimension statistics is shown in Figure 3.

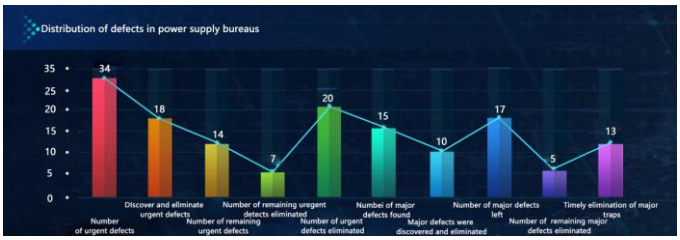
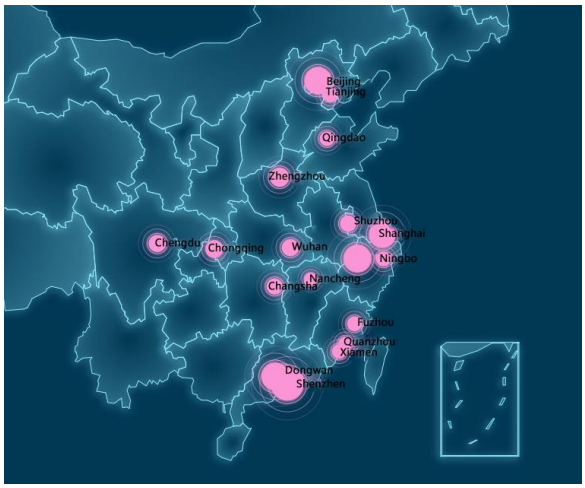



Figure 3: Defect distribution

## 5.3 Mountain fire information display

Show the real-time wildfire situation in the province and the annual wildfire area as shown in Figure 4.



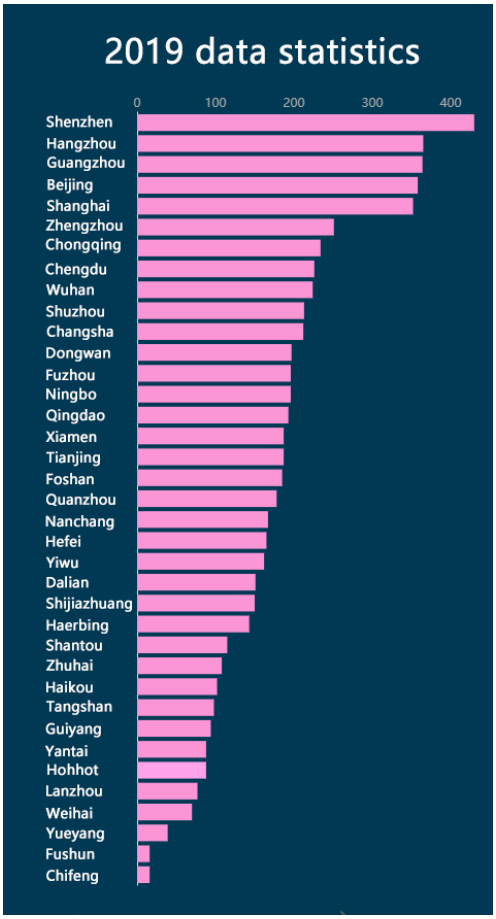




Figure 4: Distribution of wildfires

### 5.4 Power grid trend display

On the basis of the power transmission and transformation grid, combined with dispatching and metering data, the dynamic power flow diagram of the grid is drawn. A certain speed and arrow and its color are used to indicate the direction of the power flow and the size of the load, as shown in Figure 5.


Figure 5: Power grid tidal current display

Combining the comprehensive display of grid statistical data, real-time grid operation data display, equipment monitoring related data display and other display indicators, combined with the functions of DataV, the power big data is displayed on a large screen in full screen, and the effect diagram is shown in Figure 6.

Figure 6: DataV large-screen visual display

## 6. Summary outlook

Based on the analysis and research of electric power big data and visualization technology, this paper analyzes the design and realization of data-based electric power big data visualization requirements, and describes the result display through actual system design. This article analyzes the overall design ideas, principles and the composition of the software and hardware system for the power big data visualization requirements, and introduces the necessity of power grid visualization. The engineering practice results of this system show that it has good application prospects and in-depth research value, and provides technical support for the further development of smart grids.

**Acknowledgment**

The thesis was completed under the careful guidance of Qiu Feng's supervisor. Thanks to the guidance of Mr. Qiu Feng, the instructor's profound professional knowledge, rigorous academic attitude, and work style of excellence, and deeply pay tribute to the teacher. Thanks to other teachers and students of the college for their valuable and constructive comments. Thank you for working together to complete the paper.

## Authors' contributions

Authors Yang Siqi and Ren Fuchen participated in the research. Yang Siqi proposed research topics, two collaboratively designed research plans, implemented the research process, and collected and sorted out data.

The author Yang Siqi writes articles, researches and sorts out the literature, designs the thesis framework, drafts and revises the thesis.

The author Qiu Feng and Ren Meng provided work support, statistical analysis, technical or material support and instructional support, and final review of the paper.

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