Application of Visualization System in Power Grid Dispatching

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Abstract. In recent years, the scale of power grid has been expanding, the demand of users for electricity has been increasing, and the importance of power dispatching system has been reflected. However, in order to improve the security and reliability of dispatching operation and reduce the working pressure of dispatching personnel, this paper proposes to use visualization technology to cooperate with other systems in the actual operation of regional power grid, and to help technicians to analyze and process the local data information extracted from many data by means of man-machine interface.

1. Introduction
With the national attention to the development and the use of electric power; with the extension and expansion of social use of electric power enterprises; with the continuous improvement of people's living demand for electric power, electric power enterprises are also making continuous progress in the use of more information means. As a bridge between the whole power system and users, the power dispatching system plays a very important role in the development of the whole power enterprise. At the same time, it is one of the important problems for the power system to operate safely and reliably when the data of power grid dispatching increases with an exponential explosion. However, it is very difficult to extract useful abnormal data analysis results and corresponding early warning information from many monitored data when the actual operation of the dispatching system analyzes the monitored data. Therefore, based on the above problems, this paper proposes to use visualization technology to effectively improve the reliability and security of data analysis by SCADA and EMS energy system.

2. Current Situation of Power Grid Dispatching System
With the increase of electric power demand and the rapid development of technology in recent years, smart dispatching grid has changed from focusing on solving the urgent need of dispatching to innovative practice and exploration based on information communication and control technology. Since the mid-1980s, in order to realize the technical requirements of cross-provincial and cross-regional
dispatching operation security monitoring, power enterprises have introduced the EMS energy management system and its development and application technology for the first time. In the practice of this technology, the power grid also uses the SCADA system for data collection and analysis processing, forming an integrated system which can basically meet the needs of cross-provincial dispatching and monitoring.[1] However, with the rapid development of the power system, more and more data are processed and the operation mode is more and more complicated. The efficiency and reliability of the operation become the main factors that restrict the power dispatching. These adverse factors are mainly reflected in two aspects: 1 each site of the power network is mostly established and implemented in the early stage, the monitoring situation of each site and the deployment environment of the network where the site is located are different, which leads to the failure of real-time data sharing in different network scheduling, which affects the unified data information management and power dispatching. With the development of inter-provincial and inter-regional dispatching of power system, the information quantity is large and the working interface is complex, which brings a lot of inconvenience to the dispatcher to process the information and supervise the work.[2] This paper proposes a visual technology based on EMS energy management system and SCADA data collection system to optimize the dispatching system to help regional power network dispatchers quickly identify effective information and process it efficiently.

3. Application of Visualization Technology in Scheduling

3.1. Definition of Visualization Technology
Visualization technology is mainly based on computer technology, the complex abstract power network information into intuitive and concrete graphics, so that people can work through the monitoring interface clearly understand and master the required data information.[3] The core of this technology is that people are the main body of cognitive law and analysis requirement. It emphasizes the concept of human-computer interaction and the use of human-computer interface. It aims to integrate the ability of human analysis and visualization technology to transform data so as to facilitate data processing and analysis.[4] In power system dispatching, visualization technology can display the data information carried by different power load in power system clearly and appreciably in the form of graphic picture to the dispatcher, so as to facilitate the insight and analysis of large-scale dynamic change data.

3.2. Integration of visual technologies with other subsystems
The construction goal of power system production and operation process is as shown in figure 1. Under the premise of satisfying the safe and reliable operation of power system, the dispatcher makes full use of the information collection and processing system such as SCADA, DTS in combination with the actual situation of the regional power network.
The realization of the integrated function of visualization system depends on three subsystems: SCADA, DTS data collection system, EMS energy system state analysis and man-machine interface display platform.

3.2.1. **SCADA, DTS Data Matching Collection System.** SCADA system (data acquisition and monitoring control system), as the source of real-time data in power system dispatching, provides the dispatcher with information that the power grid is in dynamic change. Meanwhile, the SCADA system also needs to cooperate with the DTS system (dispatcher simulation training system) which is responsible for collecting grid parameters and relay protection setting value to realize the data collection and collation of a regional network in the power network.

3.2.2. **EMS Energy System Analysis.** State estimation of SCADA collected and transported data is the core function of EMS energy management system. The state estimation obtains the bus voltage and the power flow distribution of each branch in the complex network of power system by means of the collected measurement data information and the analysis of network topology. And the result of state estimation will be sent back to the SCADA system again, so that it can monitor and control the primary operation equipment in the field, and realize the functions of data acquisition, equipment control, measurement and all kinds of signal alarm, that is, " four remote " function. The SCADA system and the EMS energy management system cooperate with each other to estimate and calculate the state of the real-time changing data of the power grid, and then compare with the DTS provided power grid parameters and relay protection setting value to determine whether the fixed value meets the normal operation requirements of the power grid[5]. The process is as follows:
3.2.3. **visualization technology man-machine interface display platform.** In big data analysis, information visualization technology is actually a series of processes that transform the most raw data into visual form and then into human perception and analysis. And in power network dispatching system, the core function of visualization technology is to change the process of dispatching data information analysis and early warning processing from abstract and difficult data to visual image. In the actual operation of the dispatching system, the data information can be summarized between each visual module through the sharing and transmission of data, which can greatly facilitate the process of data extraction and analysis, and reduce the labor intensity of dispatchers. And each function module carries on the data collection according to the respective interface and the way, simultaneously carries on the data processing according to the respective business logic, finally carries on the data display on the platform. The visual scheduling process implemented by this system is developed in a way oriented to different functions, which represents that each interface in the scheduling system corresponds to a class of functions, which relatively guarantees the security of the system. At the same time, through the fusion of independent data and multiple data of each module, the massive power grid dispatching state data is finally screened and displayed to the dispatching operator centrally, and then the purpose of assisting the dispatcher to complete the management work is realized, and the labor intensity of the power grid dispatching staff is reduced.

In the process of information display, because the visual system includes power grid data, state prediction, accident warning, safety check and corresponding fault auxiliary decision and other functional modules, and these modules are independent of each other, the whole function of dispatching operation is realized under the regional power system platform.

Therefore, we need to visualize the platform display interface, that is, man-machine interface distribution unified regulation management, its functional distribution as shown in figure 3:
The HMI presentation is divided into the following parts:

a) title bar. The title bar shows a grid area currently being shown for dispatch;

b) management function column. This column for each function page indicator bar and search bar to each function page navigation;

c) alarm radio. Display alarm numbers, unconfirmed alarm numbers, and display alarm details in turn;

d) content bar. Show each specific functional interface, support full screen display.

From the man-machine interface function display diagram, we can see the data display at the platform level, and realize the visual effect of the system, which not only guarantees the independence of each module of the system, but also embodies the overall platform of the system, and at the same time, it also ensures the expansibility and extension of the power grid dispatching and monitoring. By adopting the management mode of each sub-function module of the system, the system can easily realize the use and adjustment of each module in the process of managing multiple management function modules, realize the rapid interface data transfer and information display of each module, and enrich the visual display platform. At the same time, the implementation of the system needs to fully consider the user’s operational friendliness and interface interactivity. Therefore, in the information display of the system in addition to the use of general interface elements for a special layout of the system, but also the use of color collocation, so that users in the interface representing different meanings and colors clearly distinguish different modules and need to pay attention to the functional points. Based on the above analysis, the design of this system is realized after fully considering the elements layout, interface color, animation display and the display order of each functional component. At the same time, in order to improve the interaction of the interface, the system also carries on the default display and the default query to some more important data in the power network, which greatly facilitates the user to carry on the data query and the interface interaction.

4. Visualization System Functions
Real-time monitoring of power grid operation status, intelligent on-line analysis and optimization of auxiliary decision-making on the key issues of power supply safety, voltage level exceeding limit, overload, power grid disturbance and so on. The functions include:

1) real-time monitoring of grid operation;
2) disturbance identification and alarm;
3) on-line computing and early warning of grid safety, including real-time state early warning and planning early warning;
4) the on-line decision support system of power grid safety, it can give the auxiliary decision of prevention control and accident handling online;
5) can query the maximum load and current of any line and main transformer in any time period, and can generate reports.
6) the preservation and query of historical information.

5. conclusion
The design and implementation of visual scheduling system not only represents the market value of a simple software product, but also shows the benefits of the continuous development of science and technology to people's lives. With the continuous improvement and development of our network SCADA system and EMS system, the form of visual dispatching system will be more and more diversified, it will continue to develop and progress towards higher efficiency, more intelligence, more convenient to use, and finally slowly form a new power enterprise dispatching management mode. I believe that the visual dispatching system will represent the development direction of power dispatching for a long time in the future. The platform of visual scheduling system will have a wider world, more immeasurable prospects, I believe that all intelligent, efficient, object-oriented all kinds of new systems and new technologies will face a better prospect, for all fields of industry to bring more professional and friendly service experience.

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