Power Grid Planning and Dynamic Intelligent Management System Construction Based on Operation Simulation

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Abstract. The operation simulation system of the power grid is a complex and huge dynamic model, and its establishment and management are of great significance in power enterprises. The intelligence of the power grid is to manage the power system through computer technology, so that it can provide users with high-quality, convenient, safe, reliable and high-efficiency services. To this end, this article is based on operating simulation experiments to construct a power grid planning and dynamic intelligent management system. The purpose is to provide people with a fast and accurate power management system to facilitate life. This article mainly constructs the system through investigation method, experimental analysis method, data analysis method and so on. Experimental research shows that the accuracy of data obtained by using information technology in power grid planning and intelligent management system construction is relatively high, reaching 93.2%.

Key words: Operation Simulation, Power Grid Planning, Dynamic Management, Intelligent System

1. Introduction
With the rapid economic development, our country's demand for electricity has also grown rapidly. But at present, there are problems in our country's power planning [1-2]. The inconsistency between power supply planning and planning, the emphasis on effective evaluation of planning schemes, and the subjectivity of planning work, the emergence of these problems requires the need to incorporate advanced computer technology into the construction of planning assistance decision-making systems. Many people have done related research on power grid planning and dynamic intelligent management system construction based on operation simulation. For example, some scholars have developed a targeted data processing and analysis intelligent management system based on the current power supply demand relationship and the actual operation of the power company [3]. Some people have also established a coordinated automatic control system for the voltage regulation equipment of the power grid for how to carry out real-time automatic coordinated control of the voltage regulation equipment of the power system, and achieved good results [4]. In addition, some scholars analyzed the integrated debugging method of smart grid dispatching control system based on analog substation. Before the new substation is connected to the smart grid dispatching control system, the relevant dispatching master station debugging work is carried out, and the operation information of the substation is sent to
the dispatching master station to enhance the accuracy of the basic data of the grid dispatching control system [5].

The main content of this paper is the construction goal of power grid planning and management system, and then the construction of the system based on the technical tools of the system design according to the target demand. Do experimental research for the realization of the system and draw corresponding conclusions.

2. Power Grid Planning and Construction Of Dynamic Intelligent Management System

2.1 Construction Goals of Power Grid Planning and Management System

The power grid planning plays a decisive role in the construction of our country's future power grids and the development of UHV power grids. It is related to the implementation of the company's development strategy and the sustainable development of the power industry. It is of great significance. After the Sichuan Electric Power Company's plan is determined, the company's grid development plan rolling optimization adjustment should be initiated at an appropriate time to strengthen the planning's leading role in the development of the power grid. According to the strategic significance and development requirements of power grid planning, it is necessary to comprehensively strengthen power grid planning management, further improve planning concepts, innovate planning methods, and build a power grid planning system in the company system that has unified technical standards, standardized management standards, and advanced planning tools[5-6]. The construction of the power grid planning management system is mainly to realize the application of informatization within the current business scope of the Ministry of Development, and to comprehensively improve the level of informatization with the planning business as the center.

Establish a planned project library. Including at least one planned project during the planning period, as a project reserve library for power grid construction to realize source management of power grid projects.

Establish a planning information database. Power grid planning information includes result data such as load forecasting, power supply planning, power grid planning, and capacity-load ratio calculations. In the process of planning work carried out by the provincial network company, some intermediate data and final results are designed to be indexed, stored in the database, and a unified planning information database is formed to realize the unified management and sharing of data.

Establish a planning feasibility study database. According to the time sequence of power grid construction, the planning office selects the project in a timely manner to initiate the project, initiates the feasibility study, entrusts the design unit to carry out the feasibility study design work, and completes the feasibility study review and approval to carry out various projects for the project Prepare for thematic assessment work.

In accordance with the method of "integration of resources, information sharing, and comprehensive utilization", based on the core business of planning, docking and association with other business systems of the Development Department, to achieve the extension of the Development Department's project-based management method.

2.2 ITechnical Tools of Power Grid Planning And Management System

(1) System architecture: It adopts advanced, reliable and flexible J2EE + relational database framework structure, supports JAVA characteristics, and supports open standards [7-8].

(2) Easy to maintain and expand: The system provides an open data interface to ensure the scalability and openness of the system.

(3) The power grid planning and management system adopts the B/S structure of a three-tier system that follows the J2EE specification. The server adopts SAP NetWeaver, the presentation layer adopts EXTJS rich client technology, and the communication with the middle layer is realized through STRUTS technology. The back-end database is deployed on the database server. To improve performance, it can be separated from the application server or combined on a single machine. Adopt
SQL database and provide persistence layer support through tables and views.

(4) Three-tier architecture: The system involves the presentation layer, business logic layer, and data persistence layer. Among them, DSH (Dwr, Spring, Hibernate) is used as the overall infrastructure of the system [9-10].

2.3 System Performance and Functional Requirements

(1) Functional requirements
The design of the power grid planning management system in this article is based on the characteristics and needs of the power grid planning of the power sector, and mainly includes system management, data management platform, overall main network, main network operation, medium voltage distribution network, power market, load and power analysis, power market forecast and evaluation are comprehensively displayed with ten major parts. The details are shown in Figure 1:

![Figure 1. Network Planning Management System Functional Requirements](image)

(2) Performance requirements
1) Technical performance. The power grid planning management system not only enables computers to query various power grid planning information, but also enables real-time browsing, query, and submission of various power grid planning and planning project information through mobile terminals. The management system has the following characteristics:

First, a powerful information engine. Based on the powerful J2EE power grid planning information engine, the power grid planning management system can be operated 24 hours a day to ensure the latest, most complete and fully automatic push of information on power grid planning projects.

Second, the adaptability is high, and the supported mobile terminals are abundant, providing personalized information services for the rapid dissemination of grid planning information, and you can browse the system to obtain various employment information [11-12].

Third, it fully integrates modern power grid planning business with mobile Internet, computer and other technologies, and has researched and developed client-side power grid planning service software and website system based on the Web system, and realized the functions of querying and browsing power grid planning information through the terminal. Compatibility issues when users access this system.

2) Software performance
Power grid planning and management system design, the system has functional stability. The multiple user visits of the power grid planning management system should be able to meet certain standards. In the power grid planning and management system, when the power grid data management process or
requirements change, all functional modules are designed using programmable and visualized operation methods.

2.4 System Construction

(1) Physical architecture
It is developed with a B/S (Browser/Server) structure and is divided into internal users and external users. Users can realize all functions in browsing. At the same time, a firewall is added between the external users and the server link to improve the security of the system and prevent hackers and viruses from entering.

(2) Business architecture design
There are some interactions between different levels of architecture, and there are also mutual influences.

Figure 2. System Business Architecture Design

(3) Application architecture design
Use IT information system analysis method to conduct a comprehensive analysis and abstraction of business processes and business goals. The overall design is divided into six functional domains, including system support functions, data collection and maintenance, current grid analysis, power market analysis, market forecasts, and comprehensive evaluation of forecast results.

(4) Data architecture design
The data model design is based on the business model and demand analysis, and first carries out the top-level conceptual model design. Then carry out top-down design for each data classification.

(5) Technical architecture design
The system adopts a three-tier architecture based on the B/S model, and uses Web application servers and transaction processing middleware to provide a running environment for applications.

(6) Database security architecture design
In order to ensure the security of various data in the system, the system adopts server-side and client-side dual-end security verification technology, and uses encrypted network transmission technology to prevent illegal intrusion. This intrusion detection model is divided into two parts, one
part is based on FSVM binary classification, and the other part is based on MLR multi-value classification.

1) FSVM first-level intrusion detection model
   In FSVM, if the data set needs to increase the attribute of membership, it can be expressed as
   \((b_1, a_1, v_1), \ldots, (b_n, a_n, v_n)\). Assuming that the kernel function is mapped to \(\chi(a)\),
   the second optimization of the optimal classification hyperplane of FSVM is transformed into the
   solution of the following formula:

   \[
   \min \frac{1}{2} q^2 + D \sum_{i=1}^{n} v_i \sigma_i \\
   b_i [q \cdot \chi(a_i) + y] - 1 + \sigma_i \geq 0, i = 1, 2, \ldots, n
   \]

   Among them, D is a fixed constant and a relaxation factor.

2) MLR secondary intrusion detection classification model
   The logistic regression classification algorithm is a classic binary classification algorithm, which
   takes the linear sum of the training sample characteristics as a variable into the logistic regression
   function, and the calculated logistic regression value is used for classification. which is:

   \[
   j_i(a) = k(\ell R a) = \frac{1}{1 + w^{-\ell R a}}
   \]

3. System Implementation

3.1 System Development Environment
   System name: Power planning and dynamic intelligent management system based on operation
   simulation
   Development tools: Myeclipse 8.0
   Database version: Oracle10g
   Operating system version: Windows 2000, XP, Win 7
   JDK version: jdk1.5
   Application server version: tomcat5.5
   Special component requirements: Applet.

3.2 The Main Interface of the System

(1) Login interface
   The distribution network load management system is a web application system with B/S structure;

(2) Management main interface
   If the user name and password entered by the operator are incorrect, the system will display an error
   message when returning to the home page;

(3) Interfaces of load analysis module
   The load analysis module can analyze the annual load, monthly load and daily load;

(4) Power market forecasting module
   This module can quickly predict monthly power, monthly power, annual power, annual power, and
   annual curve. After logging in to the system correctly, enter the electricity market forecast module, set
   the forecast month and year settings, click the forecast item you need, and enter the page to set it. If
   you need to check each item, click the forecast item you need to view the forecast information.
4. System Forecast Data Analysis

Survey of Piano Students’ Learning. In this paper, the system is constructed and simulated to test the accuracy of the prediction results. This article uses historical data from 2016 to 2021. We forecast the data in May of each year. The data is shown in Table 1.

| Historical Data | Forecast Result | Overall Result Adjustment | Growth Rate | Reverse Thrust |
|-----------------|-----------------|---------------------------|-------------|---------------|
| 796534          | 798321          | 2.32%                     | 12.36%      | 16%           |
| 873625          | 867352          | -1.23%                    | 4.37%       | 13%           |
| 958632          | 943528          | -3.45%                    | -1.38%      | -7%           |
| 982563          | 975637          | -3.27%                    | 8.97%       | 6%            |

It can be seen from Table 1 that the system prediction results are not much different from historical data, and the accuracy has a certain degree of credibility. Therefore, facts have proved that the design of the system is reasonable, but we can see from the data sheet that the power grid planning and dynamic intelligent management system constructed in this paper needs to improve the accuracy of detection and the credibility of prediction data.

5. Conclusions

The power grid management of the whole country or a certain province is a huge and complex systemic project. It involves a wide range and many fields, involving various aspects of the local economy, life, production, environment, etc., especially the right The impact of the economic sphere. According to the current power supply demand relationship and the actual operation of the power company, it is necessary to develop a targeted data processing and analysis intelligent management system, and it is also an important part of strategic operations. As a basic public facility for national economic and social development, the distribution network is closely related to people's production and life for its safe and efficient operation. With the continuous development of the smart grid, the problems that existed during it have also been exposed. This system is written in Java language, which satisfies the needs of users and realizes the function realization of each module. Aiming at the uneven distribution of normal data and abnormal data in large-scale smart grids, this paper proposes a two-level intrusion detection model. The functional requirements of the electricity market continue to extend forward, which requires us to constantly explore new technologies to make the system more intelligent.

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