Research on an Intelligent Search Function Architecture in Distribution Network Situation Awareness System

Hailei Meng¹², Mu Fang¹², Longtan Li¹⁴, Zhiqiang Wang¹⁴, Qingtao Cao¹³ and Chunxiu Liu¹³*

¹State Grid Shandong Electric Power Company Power Service Big Data and Artificial Intelligence Application Lab, Dezhou, China
²State Grid Shandong Electric Power Company, Jinan, China
³State Grid Shandong Electric Power Company Dezhou Power Supply Company, Dezhou, China
⁴State Grid Shandong Electric Power Company Pingyuan Power Supply Company, Dezhou, China

*Corresponding author e-mail: lcxs_g@yeah.net

Abstract. After the establishment of the distribution network situation awareness system, it faces the problem of large-scale data search technology. We implement path analysis through a complete intelligent search function, and propose a big data search engine framework suitable for situational awareness systems, and solve the problem of data sharing and intelligent access in multiple systems. Especially in the collection and display of cross-region data, we combed the calling relationship between the systems in detail, and based on this, carried out the exploration of the optimal technical path of the intelligent search technology adapted to the situation awareness of the distribution network. Finally, the overall framework of the intelligent search engine in the current operating mode of the power system is proposed, and the specific analysis of the implementation path is given.

1. Introduction
In the distribution network system based on situational awareness, it is necessary to solve the problem of fast search engine technology of redundant data. Intelligent search can accurately, timely, flexibly and comprehensively obtain comprehensive information, including not only information search engines in the general sense, but also intelligent push of important events and user reservation information. It can also serve as a unified entrance for users’ commonly used application modules. References [1]-[3] analyze the use of big data in power grid systems. References [4]-[6] study the application of search technology in power grid information systems. In short, intelligent search is essential in the distribution network system, because it can provide scientific, accurate, comprehensive, and intuitive data support for related business and decision-making, and escort the economic, safe, and stable operation of the power grid.

2. Intelligent search function technology to achieve path analysis
The intelligent search engine takes natural language as input and introduces semantic analysis technology, which can obviously improve the Chinese sentence understanding ability of the intelligent search system. By constructing a panoramic ontology library in the field of power system distribution
network, using the panoramic ontology library and its inference rules, the intelligent search engine can achieve accurate, effective, comprehensive, and comprehensive information on structured information, unstructured information, reports, application function modules, flexible search. In the design of the system architecture, attention needs to be paid to avoid unauthorized access to information through the use of flexible and effective permission control policies.

We completed the construction of the intelligent search engine based on the data of the first, second, and third districts, combined with functional modules such as integrated intelligent alarm, collaborative platform, OMS, OA, maintenance system, local server, morning meeting report, and BBS. When a fault occurs, you can push out regulations, plan changes, and relevant meeting minutes to provide big data support for technicians' decision-making. When the system is stable, you can customize the search and read related content.

The main functional points of intelligent search that we research and design include:
1) Realize the search of all data scattered in the security zone I, II, III area;
2) Comprehensive search of structured and unstructured data such as files, databases, pages, and emails;
3) Realize the intelligent recommendation function of user search target related information;
4) Achieve intelligent and active reminders of important and emergency events and information;
5) Active reminding of user-defined information.

3. The overall system architecture of intelligent search

3.1. Implementation ideas

![Figure 1. Schematic diagram of technical ideas](image)

The optimal idea of the technical path of the intelligent search function is shown in Figure 1 above.
3.2. Unified search library
a) Establish a search library for intelligent search, including: thesaurus, ontology knowledge base, index database.
   b) Thesaurus and ontology knowledge base are mainly used by the semantic analysis engine, and provide corresponding establishment and maintenance tools to achieve automatic and manual creation and maintenance functions.
   c) The unified index library is used by the data search engine to implement data query, and the data is extracted from the I, II, and III system through the data acquisition software, and the index is established and stored in the index database.

3.3. User search mechanism
a) The user enters a search query in natural language through a search interface.
   b) The search system performs word segmentation and synonym replacement based on thesaurus.
   c) After the natural language is processed by word segmentation, it flows to the semantic processing link. The semantic processing link first implements syntactic analysis based on predefined grammar rules and grammatical rules learned from a large number of corpora according to statistical learning methods, and then realizes semantic understanding, functions such as error diagnosis, and finally generate a query model for data search.
   d) The query model is transmitted to the data search engine and the application search engine respectively. The data search engine and the application search engine respectively perform data search and application search based on the obtained query model, and return the search results to the search system interface for display.

3.4. Overall architecture design
The intelligent search architecture should be able to filter all types of data in areas I, II, and III based on the input natural language, and search for information related to the natural language input by the user, and actively push other information related to the search information.

The intelligent search system is constructed on the basis of three basic libraries such as an index library, an ontology library, a thesaurus, etc., and has realized four major centers such as a collection center, a search center, a security center, and a display center.

Index Library: we index and store all the data in areas I, II, and III, and provide support for the search center to realize rapid retrieval.

Ontology library: According to the characteristics of the power business, we model the power business objects and their relationships to provide support for structured data search of the power business.

Thesaurus: we realize the object-oriented modeling of power business terms according to the habits of the power industry, improve the accuracy of search, and convert random natural language into standardized standard vocabulary.

Data collection: All types of data in areas I, II, and III are collected, and data indexes are established and stored in the index database.

Data search: we retrieve all types of data and application modules in areas I, II, and III, and return search results. Different types of data use different search strategies and implement active subscription and push of information. Introduce a flexible and effective permission control strategy to restrict the scope of data collection and search to avoid unauthorized access to information.

Data display: Different display methods are used for different types of data. For example, text information is displayed in a manner similar to Google, Baidu, etc., while structured information is displayed in a table or graphical manner to improve the intuitiveness and data availability of the data.

Readability.

The overall architecture design of the intelligent search function is shown in Figure 2 below.
The intelligent search system is deployed across areas II and III, and the main program is deployed in area III, which realizes the collection and search of all data in areas I, II, and III. The data in area III is collected directly through the collection center and indexed. The historical data in areas I and II are periodically synchronized to area III, and then collected through the collection center and created an index.

In addition, a separate collection center is deployed in the area II of the security control area to collect real-time fault information in real time and push it to the main program in area III for display. At the same time, a search engine is used to search for information such as processing procedures related to the fault. And the fault information collected in real time is transferred to the index database.

4. The relationship between intelligent search and other systems

The intelligent search system can search structured, unstructured, reports, documents and other types of data. In the field of power dispatching, these data are scattered in different security zones and different systems (for example, integrated intelligent alarm, collaborative platform, OMS, OA, Maintenance system, morning meeting report, BBS, etc.), so the problem of data sharing needs to be solved.

The overall relationship between the intelligent search system and other systems is shown in Figure 3 below.
Figure 3. Intelligent search data diagram

The intelligent search system is deployed in Zone III. This system can adopt different sharing methods according to the types and characteristics of different data.

For large-scale data, the system only indexes a small amount of key data, and searches for information through the index. When users need to see detailed information, they will automatically jump to a specific business system to consult. This kind of data does not need to store a redundant data in the search engine data server, which reduces the data maintenance cost and difficulty and improves the flexibility of the system.

For small and frequently searched data, we establish a complete index information to improve user search speed and user experience.

For the document data managed by the file server, only the document is indexed upside down, and there is no need to save a redundant document data in the search engine data server. When the user needs to view specific document information, it will automatically jump to the document server. The user is allowed to check the detailed information of the document, and on the basis of ensuring a good user experience, the information maintenance cost and hardware cost are minimized.

For the search of application modules, reports, and other data, no business migration is required, as long as the descriptive information of application modules, reports, and so on is indexed, and the retrieval function of application modules and reports is achieved through the index information. According to the entry configuration information of application modules and reports, the automatic jump technology is used to implement the detailed information viewing function of application modules and reports.

According to the actual business system and data distribution, the intelligent search system needs to establish data sharing schemes with other business systems. For the data that is mirrored in area III, the
index table is used to implement the search. For real-time data which is not available in Zone III, data acquisition clients need to be deployed in Zones I and II, and E-files are used to transfer the data to the intelligent search system deployed in Zone III to establish an inverted index and store it in the index database.

For the data in the three areas, such as OMS, integrated intelligent alarm, and data in the collaborative platform, only a small amount of key data is inverted and stored in the index database. The index library is used to find the data. When you want to view the detailed information, you can jump according to the source data link address recorded in the index. The jump can directly jump to a specific module or a specific report of a specific business, and use the business system to display the information required by the user. For unstructured information in OA, morning meeting reports, BBS and other systems, the intelligent search system only needs to build an inverted index of these document information, and use the index library to implement the document search function, and use the original system to display the detailed information of the document.

5. Conclusion
Based on the analysis of current distribution network situation-aware multivariate data, this paper mainly solves the technical problem of intelligent search engine for large-scale power grid data, proposes a data search system architecture that can be applied to multiple systems, and does data fusion in-depth research and practical exploration.

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