Intelligent Monitoring Analysis of Power Grid Monitoring Information Based on Big Data Mining

Renjie Lu¹, Ning Liu¹, Di Li¹, Xingzi Luo¹, Ying Fan¹,*
¹Bijie Power Supply Bureau of Guizhou Power Grid Co., LTD, China

*Corresponding author e-mail: Lrjdg@gz.csg.cn

Abstract. With the rapid economic progress of various regions in China, the demand for electricity is also gradually increasing. In order to effectively solve this problem, we increase the coverage of the grid and the upper limit of power consumption. This has not only led to the economic development of some regions. Big data analysis technology has also been widely used [1]. However, the increase of power consumption also increases the burden of power grid staff. The working pressure of intelligent monitoring system of power grid monitoring information is also increased. In order to simplify the process of power grid information monitoring, data mining technology will be applied to the construction of intelligent monitoring system. According to the theory of power grid inspection, big data information monitoring technology can monitor the operation of power grid in real time. This paper briefly analyzes the current power grid information monitoring problems. This paper puts forward the structure design of power grid monitoring information system based on data mining. Finally, this paper proposes an effective data mining information monitoring algorithm.

Keywords: Data Mining, Power Grid, Monitoring Information

1. Introduction
Facing the problem of power consumption surge in some areas, the coverage area of power grid is becoming larger and larger. The internal structure of the power grid has become very complex. This means that the work of power grid regulation will become more and more important. The premise of power grid regulation is the accuracy of information monitoring measures. However, there are many problems in the process of power grid monitoring. The working pressure of the original power grid information monitoring system is not small. Under the influence of these problems, the surge of work pressure makes staff miserable. In this case, the innovative design of power grid information monitoring system is imminent.

Today, the development of big data technology has driven the economic progress of all walks of life. The rapid progress of the power grid makes the amount of information and information types of power data proliferate rapidly (see Figure 1). There is no doubt that big data mining technology must be the technical reform of the power industry. On this basis, scholars combine data mining technology with the design of power grid information monitoring system. With the advantages of big data analysis...
technology, the system can effectively sort out the information in the power grid operation. At the same time, the system can use data mining to process the information. This monitoring information processing method can meet the progressive needs of power grid integration.

2. There are some deficiencies in the current power grid information monitoring system

2.1. The information flow of power grid monitoring is huge
Generally speaking, the work of power grid information monitoring system is completed by human. With the increase of the coverage area of the current power grid, the flow of monitoring information becomes larger. This has led to a sharp increase in the working pressure of enterprise staff. This will also indirectly lead to the reduction of the efficiency of power grid monitoring information and the quality of information monitoring work. A large number of power grid signals are a great challenge for the staff.

![Figure 1. Pilot project of power grid monitoring information micro-grid.](image)

2.2. The analysis of power grid monitoring information is more difficult
The operation process of power grid monitoring information includes many technical support stations such as photoelectric conversion and measurement and control device. Unfortunately, the update of these technologies is very slow. Many of the technology updates are the lowest. In addition, the version and model of the monitoring equipment are also different. The information received by the monitoring system of power grid is not completely accurate. These backward technologies and outdated systems make it more difficult to analyze the power grid monitoring information.

2.3. Frequent occurrence of invalid dynamic information
A small part of power grid information is invalid dynamic monitoring information. When receiving this information, the monitoring system will issue a warning [2]. However, today's monitoring system issued a lot of warnings. Most of the warnings are caused by invalid dynamic information. Although invalid information can not affect the normal operation of the system. It distracts the people in charge of the monitoring system. This will have a side effect on people monitoring effective information.

2.4. Shortage of data storage and sharing
Today's power grid monitoring information collection business is running smoothly. However, it can not store data information perfectly. Sometimes, unstructured data cannot be identified. This leads to some effective information can not be detected by the power grid. Besides, the ability to collect and share data is very poor. The data sharing between the regions covered by adjacent power grids is
limited by the technical level.

3. Innovation structure analysis of power grid monitoring information system based on data analysis

3.1. Data receiving system
The monitoring data sources of power grid system include many aspects. It includes distribution, energy management and dispatching management. The types of structure can be divided into structured information, semi-structured information and unstructured information. Because it is difficult to identify unstructured information in traditional power grid system, the designer should improve the sensitivity of information receiving in the design of data receiving system. It is also necessary to improve the unity and comprehensiveness of receiving relevant data.

3.2. Data storage system
The data storage system has realized the storage of monitoring data based on data receiving. The traditional storage system of monitoring information is relational database. The new storage system of monitoring information is memory database. We combine relational database and memory database effectively. It not only solves the problem that unstructured information is not recognized, but also solves the problem that the memory database cannot determine the relationship of information.

3.3. Data mining and analysis system
Monitoring data is received first. After that, the data will be simply backed up. According to the difference of data types, the data analysis system will establish corresponding big data analysis model. Through the statistics and analysis of the model parameters, we can get the analysis conclusion of power grid monitoring information. In addition, through the combination of causal analysis and correlation analysis, we can infer the comprehensive evaluation of normalized regulatory information.

3.4. Intelligent search system and early warning system
The ability of intelligent information search can help the power grid information monitoring system to work efficiently. Intelligent search system can also analyze user behavior. Users can also use the intelligent search system to search for relevant electricity information. The main function of early warning system is to predict the risk in advance. Early warning system can improve the application model of equipment status trend. It can give an early warning before the grid fails.

4. Algorithm form of association rule data mining

4.1. Big data mining and Apriori algorithm
The purpose of data mining technology is to extract the hidden information with rich value from a large number of power grid data [3]. The construction of power grid monitoring information system needs to write the corresponding program. Therefore, we need to use mathematical algorithm to express the whole process of data mining. We can use the algorithm of association rules to describe the relationship of data. This paper plans to use Apriori algorithm to describe the form of data mining.

4.2. Description of association rule algorithm
We set I as the set of all items. We can set t as a collection of partial items. We can set D as the set of all transactions. The rules of transaction set should be constrained by support and certainty. The data mining of association rules is the calculation of the relationship between minimum support and minimum certainty. Using Apriori algorithm, we can decompose association rules mining into two sequential steps.

4.3. Project set with minimum support
We can first find all the items in the database with the minimum support selected by users. The
collection of these items must be greater than or equal to the user specified collection of items. After selection, we can find the set of projects with the least support. We can name this set frequent itemsets. Support for this project collection can only be included in the items of the project collection.

4.4. Generation of association rules
According to the generating conditions of frequent item sets, we can find the association rules in the data. In the last step, we got a lot of frequent itemsets. We need to find the nonempty subset of each itemset. If the ratio of support between frequent itemsets and non empty subsets is greater than the minimum support. We consider that the confidence degree of non empty subsets is greater than or equal to the difference between the certainty of frequent itemsets and non empty subsets.

5. Power grid monitoring information with multiple precision analysis

5.1. Analysis of transaction monitoring information by days
We take the monitoring information of each day as an independent transaction of algorithm analysis. The number of transactions is the monitoring days of grid information [4]. Through the information mining of minimum support and minimum certainty, we find that with the increase of power grid monitoring information, the value of support and confidence will also increase. According to the analysis of historical data, we choose the value of high minimum support degree and confidence degree to take data mining measures (see Table 1).

5.2. Analysis of transaction monitoring information by hours
In order to analyze the content of monitoring information more accurately, we can reduce the precision of time. We need to take the hourly monitoring information as a transaction. The number of transactions will reflect the number of hours the grid information is monitored. Due to the reduction of time precision, the amount of information will also become smaller. According to the information of historical data analysis, we choose the minimum support degree and confidence degree to take data mining measures.

| Monitoring information analysis                        | Metering unit | Insufficient               |
|--------------------------------------------------------|---------------|---------------------------|
| Analysis of monitoring information by days              | Every day     | Information interruption  |
| Analysis of monitoring information by hours             | Every hour    | Information loss          |
| Analysis of monitoring information by seconds           | Every second  | The period is too short   |
| Analysis of historical monitoring information          | Historical record | Need memory             |

5.3. Analysis of transaction monitoring information by seconds
After a lot of experiments, we found that there are many deficiencies in the analysis of the above two kinds of monitoring information [5]. They include information interruption and information loss caused by time nodes. More importantly, the above two monitoring forms can not identify instant information. In order to solve these problems, we further shorten the time accuracy. We take the monitoring information per second as a transaction. Repeat the above steps to complete the information analysis.

5.4. Analysis of historical monitoring information
When the power grid monitoring system receives a familiar message, it will send a prompt to the staff. Due to the powerful memory function of the power grid monitoring information system, it can back up the monitoring information of any period. Through the data analysis of historical monitoring information, the analysis results are compared with the analysis results of new monitoring information. Mining association rules between data. The calculation results will form a unified event library.
6. The practical significance of power grid monitoring information intelligent monitoring based on big data mining

6.1. It strengthens the information monitoring system of power grid
In fact, the technology of traditional power grid information monitoring system is backward. Some unstructured information is difficult to identify. Moreover, it cannot filter invalid information. With the gradual increase of power grid coverage, the increase of monitoring information makes the work pressure of power grid staff increase. The updating of information monitoring system based on data mining technology is fast. It strengthens the information monitoring system.

6.2. It extends the scope of data mining technology
The emergence of data mining technology leads to the innovation and breakthrough of computer technology [6]. However, in recent years, the application of data mining is limited to the traditional computer industry. The backward technology of power grid monitoring information system forces people to look for more powerful innovation methods. After this, people gradually found the main application of data mining in power grid system. It extends the scope of data mining.

6.3. It greatly reduces the frequency of grid system collapse
Due to the increasing power demand of the power grid, the power demand is increasing. Due to the lack of skilled technicians, the power grid system is prone to collapse. This situation will lead to power failure in some areas. The power grid monitoring information system based on data mining technology simplifies people's work process. It greatly reduces the frequency of grid system collapse.

7. Conclusion
With the gradual increase of power grid coverage area, the innovation of power grid information monitoring system is imminent. Although the power grid monitoring system is not perfect in the application of data mining technology.

References
[1] Hu W, Zheng L, Liu X, et al. Power grid's Intelligent Stability Analysis based on big data technology [C]// IEEE Pes Asia-pacific Power & Energy Engineering Conference. IEEE, 2016.
[2] Kang Y, Xiwu L, Fei X, et al. Intelligent analysis method of power grid monitoring based on big data label technology [J]. Electrical Measurement & Instrumentation, 2019.
[3] Xueliang L, Jian W, Kuihua W, et al. Study of power grid planning integrated information platform based on big-data technology [C]/ 2016 China International Conference on Electricity Distribution (CICED). IEEE, 2016.
[4] Cuijia H, Haifeng Y E, Wenbing W U, et al. Research on construction of intelligent decision support system for remote sensing and big data analysis of power grid [J]. Power Systems and Big Data, 2019.
[5] Su S, Chang X, Li J, et al. A Power Grid Operations Monitoring Platform Based on Big Data Technology [M]// Artificial Intelligence and Security. Springer, Cham, 2019.
[6] Dong L. An Integrated Power Grid Equipment Operation and Maintenance Solution Based on Big Data, Cloud Computing, the Internet of Things and Mobile Internet [J]. Automation Control and Intelligent Systems, 2017, 5(5): 67