Research on Operation Monitoring Technology of Power Consumption Information Collection System Based on Intelligent Optimization Algorithm

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Abstract. In modern society, with the rapid development of economy and service quality, electric energy has become one of the necessary energy sources for people's production and life. The emergence of problems, such as such as distribution network, metering, meter reading, information and so on, have seriously blocked the development of power consumption management. In the construction of power consumption information collection system, the introduction of intelligent optimization concept has brought about new innovations in management and brought new opportunities. This paper is mainly to build an operation monitoring system of power consumption information collection group based on the intelligent optimization algorithm for the monitor, and the case analysis is carried out to prove the effectiveness of the optimization algorithm.

Introduction

The construction of user power consumption information collection system plays a decisive role in building smart grid. It is also consistent with the development direction of the international power grid, meets the requirements of economic and social development and is an important measure to speed up the transformation of urban and rural power grids and expand domestic demand. It will lay the foundation for measuring marketing, constructing meter reading fee standard and information system engineering of electric power enterprises, make the decision of the electric power enterprise more immediate and reasonable and get the effective technical support, which will play a very strong role in promoting the leap-forward development of electric power enterprises [1-3]. With the continuous promotion of power marketing, it is not only power consumption information collection system can help electric power enterprise to get more data to maintain power consumption order, but also a lot of technology is also effectively used, such as computer hardware and software, digital communication and so on. These facilities and technologies together constitute a new modern power load management system to promote the improvement of the electric power enterprises to manage the power technology products. From the point of view of functional modules, the new load management system has the following functions: User management, data statistics and processing, power abnormal warning, query function, report generation, load control, remote control and so on [4].

Related Research Based on Intelligent Optimization Algorithm

This paper uses an intelligent optimization algorithm based on K-means clustering to calculate and analyze the line loss in the operation monitoring of power consumption information collection. The combination of user power consumption information collection system and intelligent optimization algorithm can fully reflect the management level of power supply enterprises. At the same time, the introduction of line loss management in power consumption information collection technology can solve the problem of power grid information, which has a strong feasibility and practicality and determines the development trend of the management in future intelligent green grid environment.

Promoting the transformation of line loss management from result management to process management can improve the efficiency and management level of power supply operation.

The essence of K-means algorithm is to transform the clustering problem into a combinatorial optimization problem.

Known a set of data sets D, given the cluster numbers K and the standard function F, this algorithm divides D into K known sets of data sets. It usually starts with an initial division or an initial accumulation point set and uses iterative control strategy to optimize the objective function, so that the objective function can reach optimum under mean division. The algorithm flow chart is shown in Figure 1.

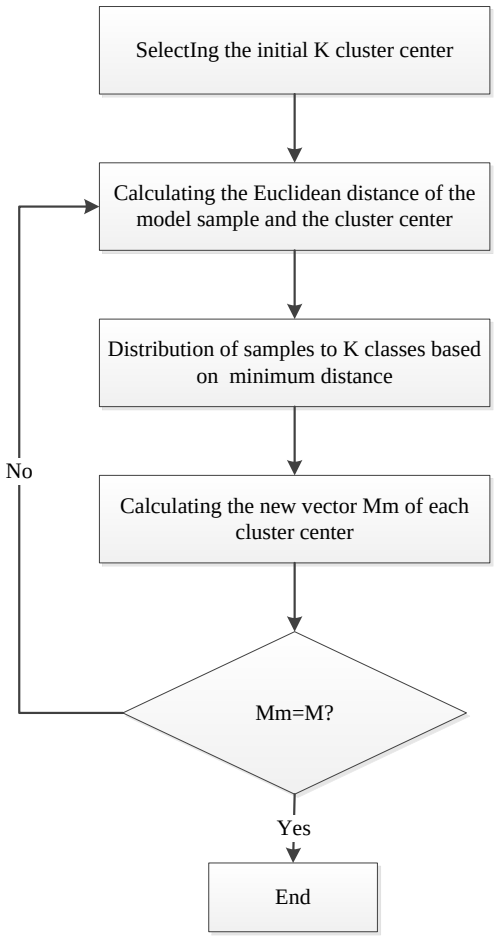

Figure.1 The algorithm flow chart

K-means algorithm needs to specify the number of clusters K in advance, and the clustering process can be described as following steps:

(1) First, the randomly selected K targets are regarded as the "center" of a class to represent different K classes.

(2) Taking the closest to the center as the basis to select similar classes and classify other targets into one class.

(3) Calculating the average value of all the targets in each class and defining it as the new "center" of the class.

(4) The distribution of each class is re-carried out

(5) Return to the step (3) until there is no change.

The calculation process in the data mining software SPSS is as follows:

(1) First, the user is required to specify how many types to cluster (such as K classes).

(2) Then SPSS determines the initial class center points of K classes. SPSS will select K representative sample data as the initial class center points according to the actual situation of the sample data.

(3) Calculating the Euclidean distance from all the sample data points to K class center points. Taking the closest to the K class center points as the basis, SPSS assigns all samples to the classes where each cluster point is located to form a new K class and complete one iteration process. Where, the calculation formula of Euclidean distance is as follows:

$$EUCLID=\sqrt{\sum_{i=1}^{k}(x_i-y_i)^2} \qquad (1)$$

(4) SPSS redefines the center point and mean value of the K classes and takes mean value point as the new class center point.

(5) The calculation process of (3) and (4) is repeated until the judgement is satisfied. SPSS calculates the variable values of variables in each class until the specified number of iterations is reached or the iteration is terminated.

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Data collection of monitoring platform

Taking the whole line as the monitoring object and monitoring it in sections. Analyzing the area through the data to determine the high loss branch of the line. As shown in Figure 2. After 4 days of real-time monitoring and combined statistical analysis, the west section of the line is located first, the north end of the trunk line is a high-risk suspected area, and the key households in the region are tracked and monitored in one to one and the suspected users are locked. The specific data table is shown in Table 1. As can be seen from table 1, this paper mainly tests 6 sets of data.

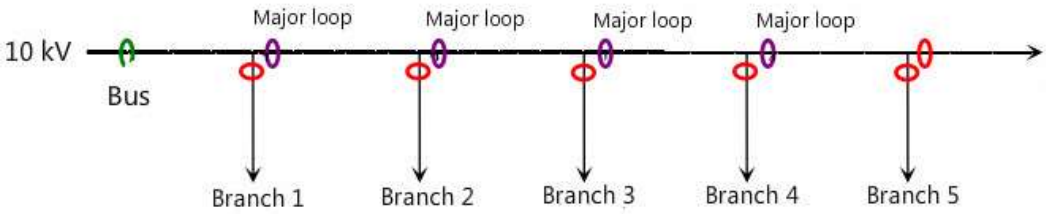

Figure.2 Branch line loss monitoring in monitoring line

Table.1 Monitoring data table

	Rest Temple one group			Rolling mill			Break Brick Factory			Yu Gao Society			Measured load in the eastern segment of Lubaozhi			Measured total load of Lubaozhi		
Time	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
0	..	..	..	..	..	..	2.8	-2.8	2.8	12.7	12.7	12.4	16.7	22.9	27	97.3	94.8	97
1	..	..	..	..	..	..	0.15	-0.1	0.05	8.64	8.7	8.51	9.8	16.2	14	26	31.3	28.5
2	..	..	..	..	..	..	0.1	-0.12	0.06	12.67	12.8	12.42	27	34	33	83.6	82.6	78
3	..	..	..	..	..	..	0.12	-0.14	0.08	12.67	12.8	12.42	7.9	6.8	6.6	69.4	73.7	61.9
4	..	..	..	..	..	..	2.9	-2.9	2.76	8.19	8.26	7.81	7.7	7.4	7.1	84	75.4	67
5	..	..	..	..	..	..	2.56	-2.6	2.6	13.5	13.5	13.1	6.4	5.6	5.3	138.3	132.2	138.1
6	..	..	..	..	..	..	4.18	4.25	3.76	12.42	12.61	12.16	8.50	6.90	6.40	67.2	70.8	76.9
7	..	..	..	..	..	..	3.69	3.64	3.53	13.38	13.44	13.06	10.1	8.90	8.6	118.7	112	108
8	..	..	..	..	..	..	5.86	5.9	5.61	12	12.86	12.42	17.9	15.9	17.2	99.3	110	106
9	..	..	..	..	..	..	6.35	-6.32	5.99	0.19	0.06	0.06	20	17	18	59	64	60
10	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
11	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
12	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
13	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
14	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
23	..	..	..	..	..	..	0.16	-0.15	0.2	12.67	12.61	12.29	12.4	10.4	8.9	25	26.1	23.8

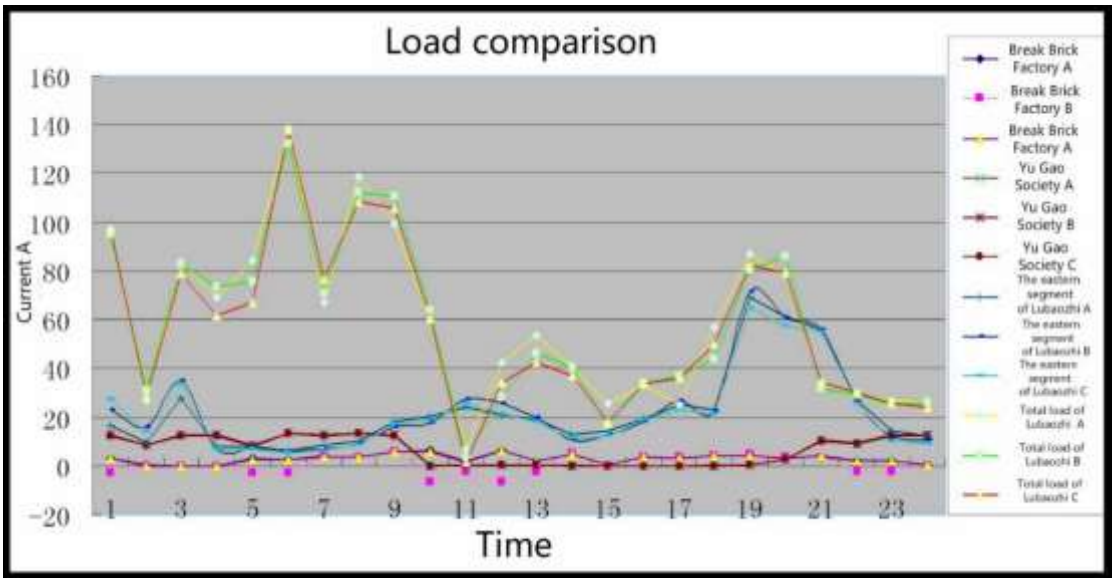

Figure.2 Load comparison

From Figure 3, it can be seen that from 0 am to 9 am are the high line loss period, there is a great difference between the branch total load and the sum of the household. The eastern section is the measured total load of the line, and the total is about 20A. The western section of the branch mainly includes Yu Gao Society (Medium frequency furnace smelting iron, the main starting time 23 pm to 8 am in the next day) and break brick factory (Wire drawing, all day operation) with high-risk suspects. Tracking it in one to one and then lock it.

Algorithm analysis results

This system adopts data mining analysis method based on K means clustering algorithm to preprocess data. The data collected from the power consumption information system are screened to get the data with abnormal line loss rate of lines, stations and large users. According to a certain judgment condition to determine whether line loss is abnormal. For example, under normal condition, three phase voltage exists and the number is greater than zero. In the case that there are five consecutive points in the case of $U_A < 70\%U_n$ or there are five consecutive points in the case of $U_B < 70\%U_n$ or there are five consecutive points in the case of $U_C < 70\%U_n$, it is considered to be the undervoltage of the electric energy meter. For a phase current I, when the I is greater than 2A and less than 50% of the rated current and the number of continuous points is at least 5 points, it is considered to be the undervoltage of the electric energy meter. Then the corresponding line loss rate is calculated according to the selected abnormal data, and the line loss is calculated and analyzed. Based on current and cumulative actual line loss rates to make a comparison with plan index value, screening out lines with abnormal line losses and comparing with line loss rates in the same period. The abnormal fluctuation of line exceeding line loss index being sorted and dynamically queried, and the result of classification is evaluated. The result of the algorithm runs as shown in Table 2.

Table.2 The result of the algorithm runs

Number	Household name	Judgment result	Results after a query
1	Break Brick Factory	Primary load is16~20A, the table and the meter load are about 0.01.	The user uses two sets of cables to operate, over meter load is lighting, and so on, and Load measurement of production load
2	Yu Gao Society (smelting)	Primary load is50A, the table current is 8A, the electric meter current is 2A, less electric quantity 75%.	After tested by verification department, the meter is less than 77.7%
3	Iron average steel structure East	Primary load is50A, the table current is 8A, the electric meter current is 2.67A, less electric quantity 66%.	After tested by verification department, the meter is less than 66.6%
4	Iron average steel structure West	Primary load is50A, the table current is 8A, the electric meter current is 2A, less electric quantity 75%.	After tested by verification department, the meter is less than 77.7%

According to the judgment result, the power supply department and the public security department quickly seized these illegal electricity users. The results of measurement department and equipment monitoring are identical, so as to realize the real-time monitoring of the power consumption information collection system.

Conclusion

With the popularization of the power consumption information collection technology, the intelligent optimization algorithm is introduced in the monitoring and management, which brings the opportunity for the line loss management in the monitoring technology. The application of K-means algorithm based on power consumption information collection system is analyzed in this paper, making full use of the favorable environment and actively innovating and exploring the new method of line loss monitoring. Therefore, this paper constructs a data mining line loss analysis technology based on power consumption information system, which effectively solves the problems existing in line loss monitoring. This paper can study and analyze the abnormal line loss of electrical system in lines, stations and large users, which make the management more transparent and efficient, give full play to its comprehensive management application, and finally achieve the goal of saving energy and reducing damage and standardizing management.

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