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Optimization of Distributed System Energy Detection Method Considering Cloud Computing

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Abstract: Distributed power generation is a new type of renewable energy that can improve energy utilization efficiency and reduce environmental pollution. Its power generation mode is wind power, photovoltaic and cogeneration. This paper introduces the problems faced by the application of cloud computing system in power network and studies its solutions. Aiming at the shortcomings of the traditional uncertainty analysis method based on the node voltage, such as low accuracy and easy loss of data, an improved algorithm is proposed to improve the power quality of the node and improve the global resource utilization ratio, combining with the characteristics of distributed power generation. After that, the energy detection method of the system is tested. The test results show that the distributed energy system has short detection time and low average detection time, which indicates that the distributed energy system has fast energy detection time, good performance, high detection power and low error rate.

1. Introduction

With the continuous development of cloud computing technology, distributed energy system is more and more widely used in various fields, and its application range has become very broad. Among many planning schemes, the most common is to maximize resource utilization, minimize cost and optimize user service level [1-2]. Therefore, it is one of the important ways to improve the economic efficiency of an enterprise or a country to study the optimal control method considering resource efficiency and cost.

The construction and application of distributed generation has always been a hot topic for scholars at home and abroad. Its main purpose is to improve the safety and stability of the power system during operation and reduce the impact of unnecessary factors on the power grid. A variety of constraints are formulated for different types of user groups, such as user online time and load rate [5-6]. In the aspect of communication protocol design, the multi access gateway strategy and multi terminal (heterogeneous network or switch) access restriction are also proposed. The distributed power planning and control technology is optimized based on load prediction, and the safe and stable operation ability of the system is improved by reasonably selecting the number and capacity of nodes. Foreign research on it is also more in-depth, detailed and mature, and has achieved good results. In China, many enterprises have introduced the concept of cloud computing and conducted a lot of research. There are many solutions to the problem of power resource allocation in China, such as distributed generation access control strategy (GIS), renewable energy scheduling planning system based on load characteristics and time division management, and energy demand forecasting model based on geographic information system [7-8]. Therefore, based on cloud computing, this paper optimizes the energy detection methods of distributed systems.

With the rapid development of cloud computing and Internet of things technology, distributed energy systems are more and more widely used in various fields of economic production, life and social activities. In this paper, the real-time monitoring, analysis and prediction of renewable energy consumption in distributed network environment management considering resource consumption and cost constraints are studied to achieve more safe and efficient deployment and utilization of available space resources. In view of the above problems, optimization methods such as limiting the node capacity to itself and its region to calculate the global energy consumption and formulate reasonable and effective control measures to minimize the energy risk and improve the system flexibility and stability are proposed.

2. Discussion on Optimization of Distributed System Energy Detection Method Considering Cloud Computing

2.1. Distributed Network Topology

The topology of distributed network is related to the number of nodes. It is mainly composed of three basic units: nodes, edges and aggregation. Each basic unit has its own independent physical address. The distributed network topology is the physical layer of each computing sub network that takes one computing unit and multiple nodes as a whole [9-10]. When any extension protocol constrains multiple grids (such as between adjacent grids), a connection relationship will be formed. The distributed deployment strategy is similar to the traditional network topology because there is no correlation between the subnets in the cloud computing system, and the virtual resources are not related to each other. The topology of distributed network mainly includes sub networks (such as trunk and sub trunk) and branch networks. The core node is the bus, which is connected with the terminal to form a closed loop. In cloud computing, in order to prevent bus fault from harming the whole system, the technology of segmentation and block is usually used. Since each layer has corresponding sub links that can be connected into independent distributed networks between different layers, the data center generally uses structures such as master station, sub trunk and branch network for management control and isolation. It not only has the data storage function and the resource sharing and load balancing required by other application services such as forwarding control and communication interface (such as server cluster technology). Because the capacity of the cloud terminal is limited and cannot be expanded indefinitely or the deployment space is large, there may be an island phenomenon (that is, multiple hosts fail to provide network access requirements) and there is no effective connection between nodes in the distributed system. Therefore, it is necessary to re allocate the computing units. Figure 1 is the topology diagram of the distributed network.

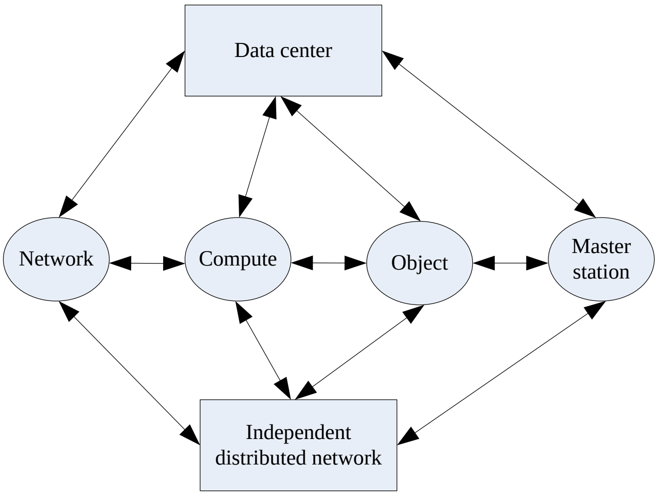

Figure 1. Distributed network topology

2.2. Distributed Energy Detection

In a distributed system, its access control to nodes is mainly carried out through ads, so its computing capacity will be limited. If the power supply of a node fails or fails to work normally in case of other emergencies, it is necessary to detect whether all access points in the network are idle and whether the number of adjacent clusters exceeds the limit indicates that the network service range is higher. If there are multiple branch circuits on a line and there is no load, it is necessary to operate them in sections, Otherwise, divide this branch into two sections for inspection to obtain the monitored area [11-12]. In the distributed energy system, the number of nodes is obtained by comprehensive calculation of the environment, service capacity and other factors. Under the traditional ground network management mode, the centralized power supply mode is adopted when multiple users share resources. However, considering that each independent power source may face problems such as power failure, excessive load and network congestion (i.e., insufficient access backup capacity), and these conditions may cause multiple independent power sources to exist in the same place at the same time or the island operation state caused by different communication protocols cannot be accurately predicted, which will affect the safe and stable operation of the system, and the number of distributed energy nodes is small. Considering the constraint of cloud computing technology on the demand of distributed energy, aiming at the problem of node location in distributed resources and multi type heterogeneous networks, this paper proposes a solution to the above strategy based on cloud computing technology. The algorithm first determines the power balance of each distribution provider (such as the State Grid and renewable energy suppliers) by analyzing the load sharing relationship between different access servers and the central station and between each end user. Secondly, after the power required by each user is maximized according to the local optimal solution, the global optimal control is carried out for the whole distributed energy system, and the voltage deviation of the power supply and the generator set under the load at a single node is solved by the piecewise equilibrium state method[13-14].

2.3. Cloud Computing

Cloud computing is a network-based service mode, which reasonably distributes resources and information according to needs, and divides and deploys resources in different areas according to needs through a core server.[15-16] Users can access the software or hardware devices that need to be configured according to their location. Because there are physical connections (such as data, storage, etc.) between the nodes in the distributed system and the physical layer is connected to form a closed network structure, it is a virtualized "isolated island" state service mode. At the same time, it uses a unified open protocol and resource sharing technology. On the basis of cloud computing, resources are allocated to different service nodes according to demand, and the optimal decision is obtained by analyzing and processing the data. The effective utilization of resources is needed to be considered and realized in establishing a virtual distributed network and a scalable system under a parallel heterogeneous network architecture. Because there are a lot of uncertain factors in the distributed environment that affect its deployment and management, how to reasonably plan and configure the storage devices on the server cluster and other critical issues also need to be solved. On the other hand, the formulation of communication protocols between nodes plays an important role in the whole cloud computing deployment scheme[17-18]. The following is the energy detection calculation formula:

$$d_1 = 2\sqrt{(x_g - x_{ti})^2 + (y_g - y_{ti})^2}, l = 1,2,3,...., MK \tag{1}$$

For the energy detection system with split transceiver, the distance from the target to the ith transmitting station and the jth receiving station in the lth channel can be calculated by the following formula:

$$\mathrm{d}_3 = \sqrt{|x_{yi} - x_a|^2 + |y_{tg} - y_b|^2} + \sqrt{|y_{rj} - y_b|^2 - |x_{fr} - x_a|^2}, l = 1,2,..., JH \tag{2}$$

In the big data environment, users can choose different service types according to their own needs, so as to allocate and utilize resources reasonably and effectively. At the same time, they can also monitor the status of the facilities on the deployment server through remote control and timely adjust the relevant configuration scheme to meet the load balance and security requirements. The node equipment in cloud computing is composed of one or several virtualized networks, that is, computers or mobile terminals with certain capacity, operation speed and corresponding functions.

3. Experimental Process of Optimization of Distributed System Energy Detection Method Considering Cloud Computing

3.1. Optimization of Distributed System Energy Detection Method

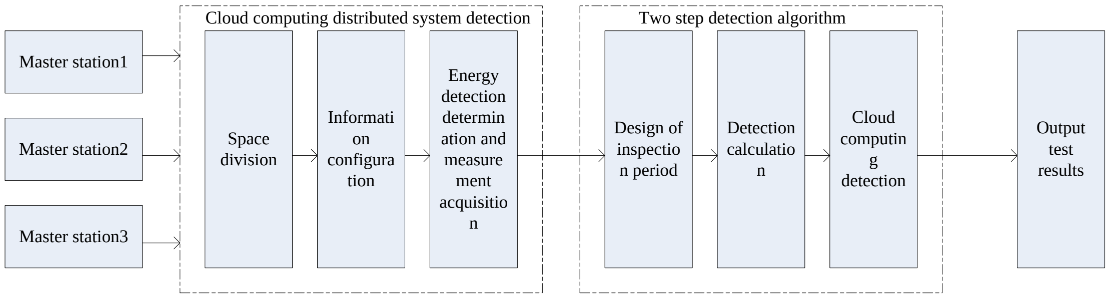

Figure 2. Distributed system energy detection method

Energy detection of distributed system is the most important link in the whole cloud computing network (as shown in Fig. 2). Its purpose is to ensure that the entire network can be accurately and reliably analyzed and located in case of node failure or abnormal conditions. The traditional statistical method of electric energy consumption is mainly based on historical data and determined by manual estimation. However, with the increasingly extensive application fields of power electronic technology and the higher degree of intelligence after maturity, as well as the continuous development and improvement of distributed systems, the traditional methods can not effectively meet the needs of users and improve the service quality. During the operation of the distributed energy system, a large amount of data will be generated, including the active power and reactive power generated by electric energy, fans, air conditioners and other equipment. Therefore, it needs to be detected and analyzed. This method is to judge whether the load requirements are met and calculate the active output by using the level difference between the modules on the node. If the real-time output voltage and current signals are collected through the bus interface or the external network, it can be considered as reaching the set value, that is, determine the information provided by the node according to the current environmental conditions of the node and decide whether to take the next decision.

3.2. Energy Detection Method Optimization Test of Distributed System

The detection of renewable energy in distributed power generation requires real-time monitoring. At present, the energy system in the cloud computing environment is facing a lot of unpredictable factors and complex and changeable operating conditions. In these cases, the effectiveness and reliability of monitoring results can be effectively improved through analysis and evaluation. A variety of multi-level comprehensive evaluation systems have been developed for different types, scales and functional requirements to improve the node safety management ability of distributed power system in the whole intelligent power grid and provide better and better services for the power market. Firstly, an optimization model based on the global search algorithm (PCA) and local optimal solution is established in the cloud computing environment. Secondly, aiming at the problem of data redundancy and low resource utilization, the traditional center of gravity method is used to solve the distributed power supply jointly built by the thermal power plant and other power generation enterprises, and the remote monitoring dispatcher sends node instructions to each access terminal. Finally, the performance test of the above-mentioned method is carried out.

4. Experimental Analysis of Optimization of Distributed System Energy Detection Method Considering Cloud Computing

4.1. Test and Analysis of Optimization Degree of Cloud Computing on Distributed System

Table 1 shows the optimization test data of cloud computing.

Table 1. Cloud computing test

Test times	Capacity factor(kW)	Efficiency(%)	Error rate (%)
1	7942	74	4
2	7356	84	2
3	7276	73	3
4	7847	78	3
5	7562	74	2

In the life cycle of distributed system, its resource utilization efficiency, network configuration capability and environmental factors will all help cloud computing. However, these supports are limited, highly integrated and difficult. Therefore, in order to improve the overall efficiency and competitiveness of the whole general application field, it is necessary to consider the problems of various nodes in the unified management, and formulate corresponding countermeasures to ensure that all nodes can operate safely. The final decision is made after comprehensive consideration of resource utilization efficiency, network configuration capability and environmental factors among the stages of the distributed system life cycle. Considering the real-time requirements of cloud computing on distributed systems, when resources are insufficient, the above problems can be solved by integrating node information and other resources to form a virtual network. According to the test results (shown in Table 1), compared with the traditional parallelization, the scalable access rate is improved, the detection power is relatively high, and the error rate is low.

4.2. Test Analysis of Energy Detection Module

Table 2 shows the performance test data of distributed system energy detection module.

Table 2. Performance test of the distributed system energy detection module

Test module	Fixed search time(s)	Mean search time(s)	Maximum search time(s)
Independent detection module	6	4	7
Cloud computing detection module	4	3	6
Information configuration module	5	4	6
Space division module	5	2	5

After integrating the modules in the new system, we can find the problems through testing and improve them. In the process of resource point and node detection, the location and size of nodes cannot be determined due to the limited capacity of the center and incomplete data collection. In view of this situation, the combination of regional and centralized monitoring strategies can be adopted to realize the information sharing among each block unit in the region, and the energy consumption buffer zone can be established by using distributed computing technology to monitor the energy risk level of the whole cloud computing system, so as to provide a reliable basis for control and management. It can be seen from Fig. 3 that the distributed energy system has short detection time and low average detection time in terms of detection, which indicates that the distributed energy system has fast energy detection time and good performance.

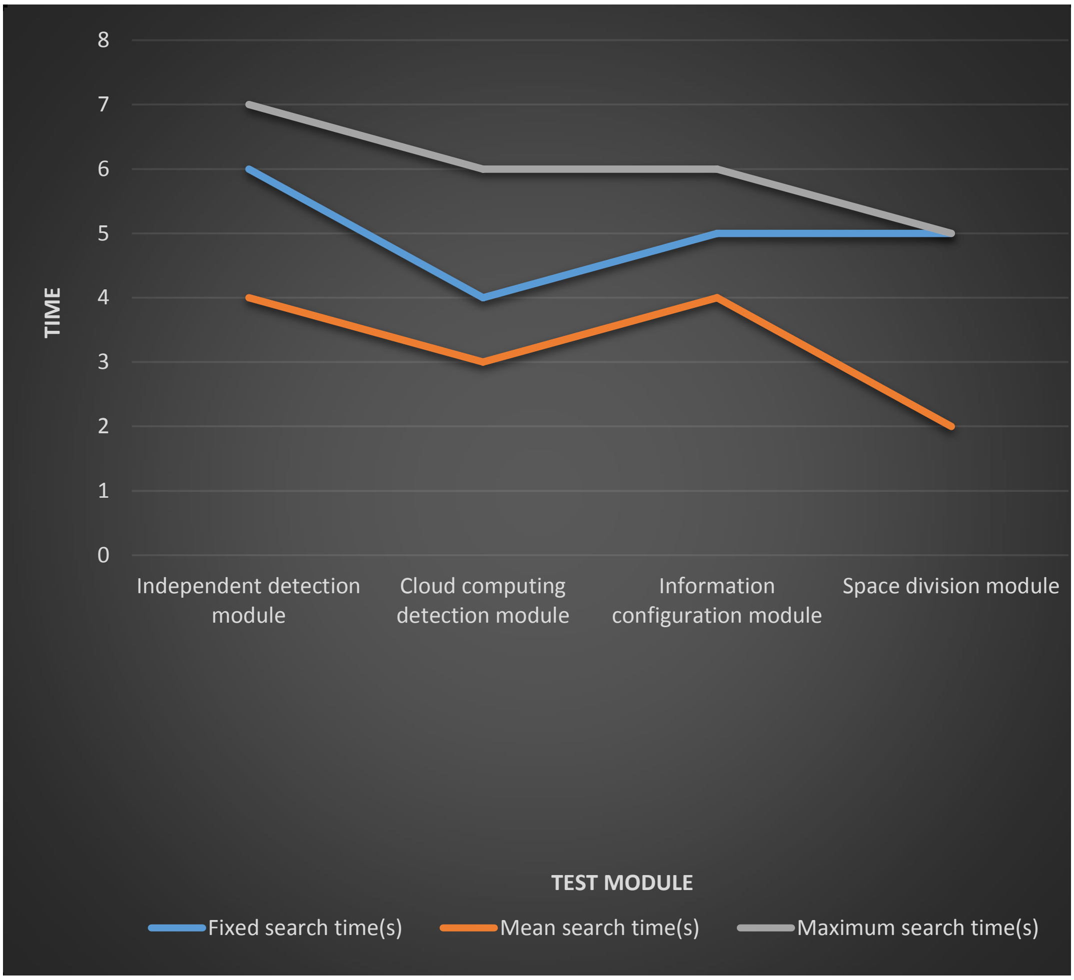

Figure 3. Energy detection module test

5. Conclusion

With the rapid development of cloud computing technology, distributed energy system has gradually become the mainstream. This paper evaluates it based on fuzzy method. Firstly, the principles of fault-tolerant reduction strategy, resource scheduling and cost minimization are introduced. Then, according to the maximum load, the analytic hierarchy process structure model is established and the search algorithm is combined to evaluate it and obtain the optimal solution. Finally, the genetic algorithm is used to realize the matching between the data points required for the shortest path decomposition solution and the number of renewable energy storage on the nodes and the value of the electric energy meter, so as to achieve global, consistency and stability.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

References

[1]Zulfiqar Ahmad, Ali Imran Jehangiri, Nader Mohamed, Mohamed Othman, Arif Iqbal Umar:Fault Tolerant and Data Oriented Scientific Workflows Management and Scheduling System in Cloud Computing. IEEE Access 10: 77614-77632 (2022).

[2]Adeel Ahmed, Saima Abdullah, Saman Iftikhar, Israr Ahmad, Siddiqa Ajmal, Qamar Hussain:A Novel Blockchain Based Secured and QoS Aware IoT Vehicular Network in Edge Cloud Computing. IEEE Access 10: 77707-77722 (2022).

[3]Nawaf Alharbe, Mohamed Ali Rakrouki, Abeer Aljohani:An Improved Ant Colony Algorithm for Solving a Virtual Machine Placement Problem in a Cloud Computing Environment. IEEE Access 10: 44869-44880 (2022).

[4]Abid Ali, Muhammad Munwar Iqbal:A Cost and Energy Efficient Task Scheduling Technique to Offload Microservices Based Applications in Mobile Cloud Computing. IEEE Access 10: 46633-46651 (2022).

[5]Majed S. Alsayfi, Mohamed Y. Dahab, Fathy E. Eassa, Reda Salama, Seif Haridi, Abdullah S. Al-Malaise Al-Ghamdi:Securing Real-Time Video Surveillance Data in Vehicular Cloud Computing: A Survey. IEEE Access 10: 51525-51547 (2022).

[6] SeongMo An, Asher Leung, Jin B. Hong, Taehoon Eom, Jong Sou Park:Toward Automated Security Analysis and Enforcement for Cloud Computing Using Graphical Models for Security. IEEE Access 10: 75117-75134 (2022).

[7] Andrea Garbugli, Andrea Sabbioni, Antonio Corradi, Paolo Bellavista:TEMPOS: QoS Management Middleware for Edge Cloud Computing FaaS in the Internet of Things. IEEE Access 10: 49114-49127 (2022).

[8]Muhammad Hataba, Ahmed B. T. Sherif, Reem Elkhouly:Enhanced Obfuscation for Software Protection in Autonomous Vehicular Cloud Computing Platforms. IEEE Access 10: 33943-33953 (2022).

[9]Boonhatai Kruekaew, Warangkhana Kimpan:Multi-Objective Task Scheduling Optimization for Load Balancing in Cloud Computing Environment Using Hybrid Artificial Bee Colony Algorithm With Reinforcement Learning. IEEE Access 10: 17803-17818 (2022).

[10]Mohamed S. Zalat, Saad M. Darwish, Magda M. Madbouly:An Adaptive Offloading Mechanism for Mobile Cloud Computing: A Niching Genetic Algorithm Perspective. IEEE Access 10: 76752-76765 (2022).

[11]Adil Khan, Ar Junejo, M. Naeem, M. Sattar, A. H. Malik:Inter-Organizational Cloud Computing and Robust Scalability in Current Scenario and Beyond. Autom. Control. Comput. Sci. 56(1): 26-37 (2022).

[12]Arif Ullah, Nazri Mohd Nawi, Soukaina Ouhame:Recent advancement in VM task allocation system for cloud computing: review from 2015 to2021. Artif. Intell. Rev. 55(3): 2529-2573 (2022).

[13]Elena Verdú, Yuri Vanessa Nieto, Nasir Saleem:Call for Special Issue Papers: Cloud Computing and Big Data for Cognitive IoT: Deadline for Manuscript Submission: August 15, 2022. Big Data 10(1): 83-84 (2022).

[14]Amanpreet Kaur Sandhu:Big data with cloud computing: Discussions and challenges. Big Data Min. Anal. 5(1): 32-40 (2022).

[15]Henry Chima Ukwuoma, Arome Junior Gabriel, Aderonke F. Thompson, Boniface Kayode Alese:Post-quantum cryptography-driven security framework for cloud computing. Open Comput. Sci. 12(1): 142-153 (2022).

[16]Rasha M. Abd El-Aziz, Rayan Alanazi, Osama R. Shahin, Ahmed Elhadad, Amr Abozeid, Ahmed I. Taloba, Riyad Al-Shalabi:An Effective Data Science Technique for IoT-Assisted Healthcare Monitoring System with a Rapid Adoption of Cloud Computing. Comput. Intell. Neurosci. 2022: 7425846:1-7425846:9 (2022).

[17]Doaa Wagdy Trabay, Ibrahim M. El-Henawy, Wajeb Gharibi:A Trust Framework Utilization in Cloud Computing Environment Based on Multi-criteria Decision-Making Methods. Comput. J. 65(4): 997-1005 (2022).

[18]Ahmed Fathalla, Kenli Li, Ahmad Salah:Best-KFF: a multi-objective preemptive resource allocation policy for cloud computing systems. Clust. Comput. 25(1): 321-336 (2022).