

Demand Analysis of Wireless Sensor Networks for New Energy Micro-grid

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Abstract. Wireless sensor networks are self-organizing networks composed of a large number of energy-limited sensor nodes. Due to the factors such as distributed power, energy storage equipment, power load density, operation mode and geo-environment in the microgrid region of the new energy grid, each device in the new energy microgrid has multiple regions and diversified forms, So it is difficult to carry out a unified real-time monitoring. Therefore, this paper designs to integrate the detailed operation status of the independent new energy power supply network into the existing station monitoring system through the wireless sensor network to implement unified energy management. According to the real-time acquisition ,immediately to take appropriate measures to greatly improve work efficiency.

Keywords: new energy microgrid,sensor network, ZigBee,Information Physics fusion system

1. Introduction

According to factors such as distributed power, energy storage equipment, density of electricity load, operation mode and geographical environment of new energy microgrid, each equipment in new energy microgrid has different distribution forms: (1) Multi-regionalization: the new energy micro-grid is not only distributed in a relatively dense population, the power load is relatively concentrated geographical area, also located in remote areas, so the new energy micro-grid has the characteristics of geographical diversification. (2) Diversification of forms[1]: The forms of new energy microgrids are diversified due to the new energy access forms of new energy microgrids, differences in energy storage equipment and load types, and differences in the capacity of distributed power sources.(3) Spacing Randomization: Taking into account the different influences of power load density and environmental factors in different regions and regions where new energy micro-grid power supply, energy storage and electric equipment are distributed in the new energy micro-grid, equipment selection, installation and geography[2]. The position is different, so the new energy micro-grid equipment presents a multi-spacing and distribution of random distribution characteristics. It is necessary to take into account factors such as the number of power supplies, energy storage and electrical equipment distributed in the new energy microgrid, the operating environment and the uneven geographical distribution, and comprehensively construct a reasonable topology to meet the requirements of the new energy microgrid communication network .



2. Analysis of Wireless Sensor Information Transmission Methods

In the new energy microgrid region, the sensor nodes can utilize short-range wireless communication for information transmission. At present, short-range wireless communication network technologies include Bluetooth, Wi-Fi, WirelessUSB, and ZigBee[3]. Bluetooth is a short distance communication technology, which stipulates the communication speed of 1Mbps and the communication range of which is within 20m, adopts the 2.4GHz frequency band wireless communication technology and only supports point-to-point and point-to-multipoint communication, which restricts its application in the development of wireless sensor networks. Wi-Fi is IEEE defined wireless network technology, the maximum transmission rate is 11Mbps, supporting for data connections below 100 meters, the bandwidth performance is good but it also consume a lot of power. WirelessUSB (WUSB) is a wireless technology based on the star topology[4]. The maximum bandwidth is 480Mbps, and do not exceed more than 10 meters. ZigBee technology is a close-range, low-power, low-rate, and low-cost two-way communication technology. The transmission rate is 10 ~ 250KB / s, which can work in the 2.4GHz, 868MHz, 965MHz three bands. The frequency 2.4GHz is the global free band. Communication distance can reach more than 400 meters. Signal communication distance could amplify to more than one kilometer[5]. Meanwhile ZigBee technology has strong network expansion ability. Because ZigBee technology has the features such as safe and reliable, short delay, large network capacity, low cost and low power consumption, good network topology capability, large effective range and flexible working frequency band. considering comprehensively network cost, communication distance and Convenience of network combination, ZigBee wireless network communication technology can be used to achieve new energy micro-network monitoring system for information transmission.

3. Wireless sensor network optimization of CyberPhysical System for new energy micro-grid

3.1 Overall design

The independent power grid remote monitoring system is mainly composed of the collection terminal (data acquisition node), concentrator (aggregation node), the main station (data processing center) and the system which constituted of the efficient and reliable data transmission and communication mode that connects these devices to each other. Independent new energy power supply network unified management of energy in Figure 1.

As the hardware distribution structure of the network is closely related to the network topology, in the design process, the topology of the network remote monitoring network should be determined first. According to the distribution characteristics of power network, its obvious tree-like characteristics can be seen[6]. Therefore, Zigbee network topology selection tree topology used in this paper. The data acquisition node and sink node must use full-featured device FFD. Each acquisition node in the network can play the role of coordinator to form a wireless sensor network communication lines along the power network.

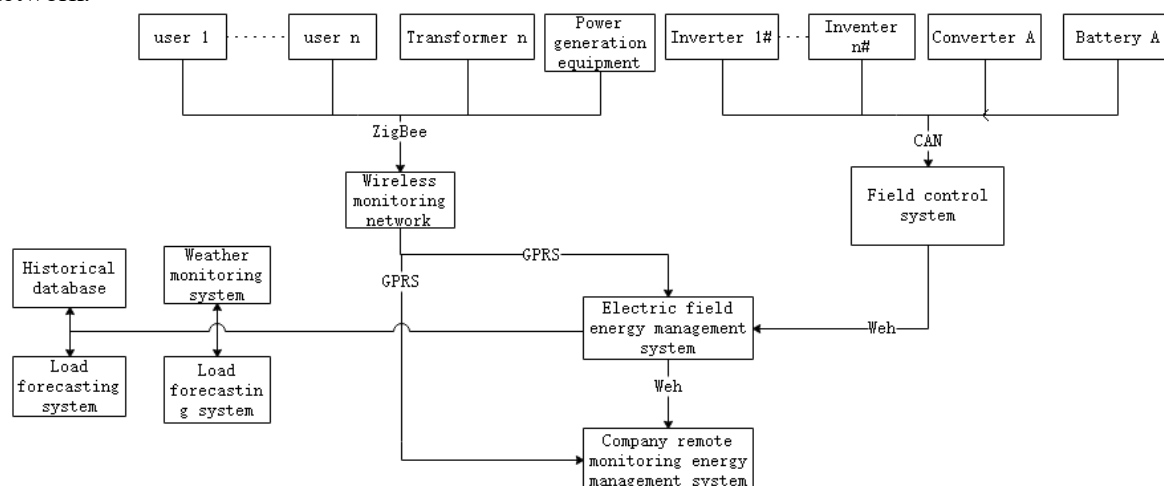
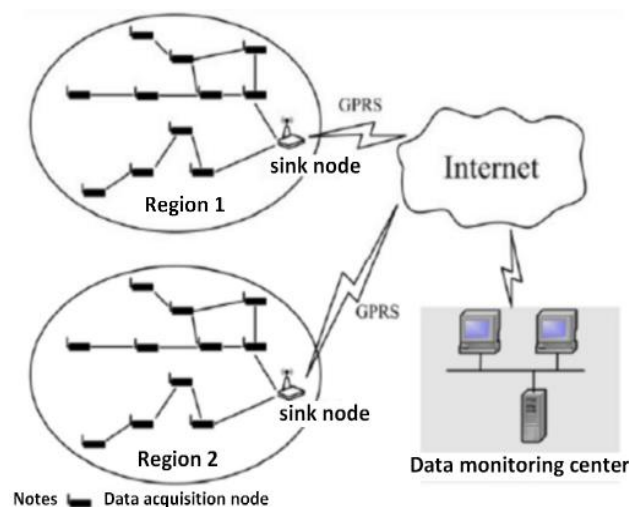


Figure 1 independent new energy supply network management system diagram

In order to transmit the information received by the sink node to the data center in real time, we chose the GPRS technology which is currently relatively mature [7]. ZigBee network transmission distance is relatively limited, if the data monitoring center distance from the collection area is very far, the use of wireless sensor network routing method will be collected data sent to the data center, both from a cost point of view or the difficulty of system implementation, it is not worth. Therefore, the collected data is sent by the convergence node to the data center through the GPRS device point. Finally, the data center will draw the real-time data of the scene according to the data sent from each place. The schematic diagram of the whole system is shown in Figure 2.

**Figure 2** Zigbee-based remote monitoring system structure diagram

3.2 Components of wireless sensor network based monitoring system

This monitoring system designed for the 3 parts: Zigbee Self-network, GPRS network, data monitoring center. Zigbee Self-network can realize data acquisition, storage and communication in complex area. GPRS network can realize data communication between aggregation node and data monitoring center. data monitoring center is equipped with database and microprocessor to store all the data, Analyze, process, and make decisions.

Data collection node: The collection node is set at any position of the power grid and transmits the power quality parameters of the location, such as voltage and current, and also surrounding data such as temperature, humidity and brightness to the regional joint equipment immediately through the Zigbee network. Each node has its own ip address, so the data center can find the data relative location.

Aggregation node: A summary of all the data in a certain area in the Zigbee network. Only one aggregation node in a region of the wireless monitoring system. aggregation nodes collect all information from all the collecting nodes and transit nodes, then stores the data. If necessary, the data can be uploaded to the data monitoring center through the GPRS network, and it can also receive data and transmit it to data acquisition node which from data monitoring Center.

The data center receives the data uploaded by the joint node then through further processing and storage by the computer. Through the configuration software to build a data center management platform for all data analysis, and display. managers can make observations by discussing the data to make decisions.

4. Sensor Network Rate, Communication Quality and Life Cycle Performance Analysis

In view of the multi-regionalization, diversification of forms and randomization of new energy microgrids, the wireless sensor networks are used to monitor the environment. collected data flows are evenly distributed in time and space and it is very stable. collected data used for monitoring new energy

network equipment. To ensure a high communication rate and high reliability of communication quality, meanwhile the reliable operation of the sensor network is essential. With the development of science and technology, the communication speed and reliability of the sensor network have been greatly improved, which has basically satisfied the monitoring requirements for the equipment in the new energy micro-grid. The reliable operation of the sensor network mainly refers to the network can maintain a longer life cycle, and the case when no energy exhaustion it can not work. Its working life is defined as the period from the start of the network to the death of the first node. Since WSNs are characterized by such features as no-center, self-organizing, dynamic network topology, multi-hop routing, limited energy and bandwidth limitation, large network size. However nodes use the same transmit power, multi-hop relay communication and many- Traffic characteristics, making the entire network serious uneven distribution of network traffic. The nodes close to the receiving station consume energy first due to excessive traffic, causing network partitioning and destroying the connectivity of the network, resulting in a serious decline of the network service life. Due to the large number of nodes and the working environment, the sensor network can not supplement the battery energy. Limitation node battery energy will severely restrict the working life of the wireless sensor network and bring a high network maintenance costs, the sensor network must extend the service life, to ensure reliable monitoring of the new energy micro-grid in order to maintain its stable operation.

4.1 Life cycle extension method based on route optimization

In the new energy micro-grid environment, the sensor nodes according to the types of information collected can be divided into fixed nodes and mobile nodes. The fixed node collects the information of a device in the microgrid, and the mobile node is used for the safety of the site operation.

Wireless sensor networks collect information in real time through a large number of sensor nodes distributed over a large area, and then process the information through an embedded system. Finally, the sensed information is transmitted to the user terminal through the wireless communication so that the user Take full control of and respond to the situation in the monitored area. As the key technology in wireless sensor network, routing technology is mainly used to select the path with better performance between the source node and the destination node. The routing information is transmitted from the source node to the destination node along the optimized path, to complete the data communication between nodes. each node's energy is limited, which requires WSN routing protocols and algorithms with efficient energy utilization, and the existing routing protocol has been unable to meet the requirement of wireless sensor network. especially in reducing the energy consumption, effectively using the node energy and prolonging the lifetime of the network, it shows the congenital deficiencies. Therefore, it is necessary to design a reasonable and efficient routing protocol to prolong the life cycle of the wireless sensor network, in order to enhance aspect of timeliness and reliability, etc.

4.2 Life Extension Method Based on Wireless Charging

For the new energy microgrid in a remote environment, once the battery is exhausted, the node will no longer have the ability to work and can not monitor important equipment in the microgrid, so a wireless chargeable sensor network with energy harvesting capability has emerged. In a wireless chargeable sensor network, a node can collect a radio-frequency injection signal in the environment to charge itself. Wireless charging technology original from the wireless power transmission technology, which uses electromagnetic resonance or electromagnetic jurisdiction to transmit electrical energy from the power side of through wireless transmission to the electrical equipment, so it can achieve the energy transfer easily. Due to the economic and security restrictions, the wireless charging device can not be completely installed on the monitoring site. Therefore, the wireless charging device can be charged by a carrier / robot which is automatically operated in a running environment. When the node has been deployed in a remote area In the wild, energy may be supplemented by UAVs. Because of the periodicity of the power supply of the wireless charging device, it is not possible to supply power to the node in real time. Therefore, the routing algorithm should be improved to adapt to the chargeable wireless sensor network and prolong the life of each node in the network to ensure the reliable operation of the sensor network.

4.3 Function expansion analysis

New energy microgrid is the distributed power generation access and the user terminal, in order to ensure the safety of electricity users and to avoid the microgrid information island, so it is necessary to monitor power quality continuously at real-time and control power quality. microgrid contains a large number of Distributed renewable energy generation systems, and it has great connection with the natural environment, its output power will change with the factors like sun, wind speed, temperature and other external changes in the objective. The information physics fusion system realizes the real-time and dynamic information control and information service of objects based on the environment perception and the interconnection of objects and objects through the deep interaction and fusion of the information system and the physical system, and can be implemented in a safe, reliable and efficient manner. Real-time way to detect or control physical entities. Application of CPS technology can be real-time processing of a large number of different types of data sent from different sensor, real-time control of electrical physical devices. Compared to other components of the power system running for many years, micro-grid is more conducive to the use of new technologies and technological advantages. In response to the trend of the development of smart grid in the future, information fusion system technology can be introduced into the construction of the microgrid, and technologies such as environment awareness, embedded computing, network communication and network control are integrated to serve the construction of a new energy microgrid Operation, making the micro-grid electrical equipment system has abilities with computing, communications, precise control, remote coordination and autonomy. the establishment of new energy micro-network CPS, in order to achieve human interaction with electrical equipment.

5. Conclusion

In this paper, the design of the independent new energy power supply network in the detailed operation of the state through the wireless sensor network into the existing station monitoring system to implement a unified energy management, management staff in the data center can grasp data and surrounding environment information. Such as the voltage, current, power factor, power output of the power generation equipment and the power consumption of the user terminal from the power network nodes. Meanwhile it may analyze and decide the data of a period of time, such as the peak current at morning and night, different regions. Fluctuations in the use of electricity, accident inquiries, prediction and avoidance. staff can maintain power network more convenient and economical. When there is an accident on the power network, the power grid remote monitoring system can provide the function of fixed point or two-point positioning to find out the accident accurately and quickly. at the same time, according to the data Judge the type of accident, and immediately to take appropriate measures to greatly improve work efficiency.

Acknowledgment

National network company science and technology project: Research and Application on key technology of Rechargeable Wireless Sensor Network

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