Research on the Information Construction of Smart Grid Based on the Internet of Things

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Abstract: With the rapid development of science and technology, the construction and research of the smart grid based on the Internet has been paid more and more attention in the current grid information construction. The smart grid based on the Internet of things can significantly improve the level of information perception and information processing, which is of great importance to improve the work efficiency of grid. This paper first analyzes the concept of Internet of things and smart grid and the relationship between Internet of things and smart grid. Then it explores the strategy of smart grid information construction based on Internet of things, serving as a reference.

1. Introduction

At present, with the rapid development of social economy, people's living standard is constantly improving. The grid is the important foundation of power supply. With the rapid development of the Internet of things nowadays, the construction of smart grid is imperative. In the construction of smart grid, grid information construction is the mainly encountered problem. How to build a system based on the Internet of things and the perfect smart grid system needs the construction personnel to continually achieve the organic integration of the Internet of things and the smart grid and give full play to the smart grid applications.

2. The Overview of the Internet of Things and the Smart Grid

2.1 The Internet of Things

The Internet of things is a kind of new technology produced in the information era and is an important development stage of the modern information era [1]. The foundation and core of Internet of things technology is still Internet. The specific technology of Internet of things is the technology of radio frequency automatic identification. Through this technology, information exchange and communication between goods and goods can be realized, greatly expanding the scope of communication. In the current background of the e-commerce network development, the Internet of things also provides important help for automatic identification of goods and information interaction.

2.2 The Smart Grid

The smart grid is an important form of grid, which is to make the traditional grid intelligent in short. The smart grid needs to rely on a specific network. It requires the network to be of the characteristics of integrated and high-speed two-way communication. It also needs some advanced technology, equipment and control means to support the operation of the system [2]. The smart grid appears relatively late in our country and it is at the initial development stage. In the operation of smart grid, the network basis and the network communication provide important basis for the efficient operation of the power grid.

The main problem in the current construction of smart grid is that the current grid information technology is hard to achieve the required level of smart grid, which makes many functions of smart grid not effective. Of course, although smart grid has failed to play a role completely, it has shown the following advantages in practice: (1) The information acquisition is more rapid and convenient.

The smart grid makes people collect enough information in time with the help of modern Internet information and control technology, which can predict the grid fault and protect the grid system effectively through analyzing information; (2) The smart grid is of the strong foundation and technology system and can effectively defense all kinds of external interferences and attacks, which makes the robustness of the current grid is greatly improved; (3) The modern smart grid make comprehensive use of the communication and the management technology, which makes the utilization rate of grid equipment significantly improved and the power loss decreased significantly at the same time and greatly improves the economic efficiency and high efficiency of grid; (4) The information system of smart grid can summarize and analyze all kinds of information used by grid, which provides great help for the formulation and the implementation of related control scheme and decision scheme.

2.3 The relationship between the Internet of things and the smart grid

There is the closed relationship between the Internet of things and the smart grid. In the construction of the smart grid information, it needs the support of the technology of the Internet of things [3]. The Internet of things can achieve information perception, efficient and reliable information transmission and information processing by using the technology of radio frequency automatic identification, which makes the Internet of things technology provide strong technical support for the information construction of smart grid and greatly promotes the information development of power system.

3. The Information Construction of the Smart Grid Based on the Internet of Things

The information construction of smart grid Based on the Internet of things needs to build the Internet of things of power with the following functions and study the personalized and key technologies appropriate to the characteristics of the grid.

3.1 Build the Internet of Things of Power with Multifunction

3.1.1 The Integration of the State Detection and the State Maintenance of Power Equipment

In the operation of grid, the state maintenance of the power equipment is the key to ensure the stable operation of grid. In the maintenance of equipment condition, the main work lies in the condition monitoring and state evaluation of the equipment. In order to improve the quality of monitoring, we can make real-time collection of operating parameter of power equipment with the help of modern technology of the Internet of things and the whole-process control of 24h at the same time to ensure the safe operation of power equipment.

Based on the state monitoring of the power equipment of Internet of things, it is often necessary to take full account of the relationship between horizontal and vertical state information [4]. With the help of the Internet of things, monitor and collect the running status information, offline information and static information of power equipment. Analyze the operation status of the equipment. Detect the abnormal operation of equipment in time. Meanwhile, make comprehensive judgment of the development trend of the abnormal location, severity degree and abnormal situation. Identify the early signs of the malfunction of power equipment and maintain it in time. Realize the whole-process management of power equipment and greatly improve the reliability of the grid operation.

3.1.2 The Monitoring and Early Warning of External Wide-area Information of Power System

Most of the power equipment of grid is exposed in the natural environment, so the power equipment is often affected by the natural environment. To protect power facilities, we can rely on meteorological information constructed by meteorological department and obtain macroscopic meteorological data in time. And conduct on-line monitoring of the external information of power equipment owned by regions. The monitoring contents include temperature, relative humidity, wind speed, air pressure, and precipitation and so on [5]. Obtain various environmental data through monitoring, then send the data to the analysis system and compare them with the meteorological

conditions which are easy to cause equipment malfunction. Analyze and predict the long-term and short-term threats of power equipment with the help of mathematical model and artificial intelligent technology.

3.1.3 Construct the Asset Management Based on the Technology of Radio Frequency Identification and Mobile Terminal

In the operation of grid, the asset management is the very important content. In order to improve the efficiency of asset management, we can monitor the asset with the help of the technology of radio frequency automatic identification. Through inputting the basic information of fixed assets of the grid, setting electronic tags for assets and establishing the radio frequency communication link with the electronic tags by the reader, we can realize the acquisition and monitoring of the of asset information. In addition, through summarizing and analyzing the collected asset information, we can improve the efficiency of asset management. The electronic tags based on the radio frequency identification is of the following several high qualities: first, it can achieve real-time and synchronous management of maintenance of asset, which can significantly improve the efficiency of asset allocation; second, it can realize the intelligent management of the whole life cycle of power asset, improve the quality of asset management through real-time tracking and monitoring management, by avoiding the condition of low efficiency of asset management caused by artificial operation and intervention; third, it can provides important reference data for the management and the investment decisions and reasonable allocation of assets of enterprises, which can significantly increase the investment benefit and improve the efficiency of assets.

3.1.4 Construct the Service Platform of the Information Sharing and Intelligent Use of Electricity

In the information construction of smart grid, the information sharing is the very important content. We can realize the exchange service of power-consumption information, collection of power-consumption information, the management of energy efficiency, power storage and so on with the basis of the Internet of things of power. Avoid the information island effectively and expand and extend the use efficiency of power resources. Meanwhile, in the service of power consumption, we can achieve two-way interaction with grid users by the Internet of things of power. It can satisfy users' personalized and diverse service requirements and expand the routine power-consumption service. It can significantly increase the service domains of smart grid. Meanwhile, it can realize the visualization interaction with users by the Web service to provide good service for users' power consumption.

3.2 Key Technologies Applied by the Internet of Things of Power

3.2.1 Technology of Smart Meter

The smart meter can well realize the real-time communication between the supplier and the user and is also of the unique and addressable sign. With the help of smart meter, we can analyze and predict the energy consumed by users, make reasonable planning and adjustment of the power-supply mode to better meet the users' requirements of power consumption [6]. In the operation of electricity, the price of electricity has always been the concern of the users and it is often difficult to control the price elasticity of the electricity price. For this, we can collect users' short-term price elasticity by the smart meter and provide a good solution for customers and suppliers.

3.2.2 Technology of Virtual Energy Storage Based on Smart management and Information Sharing

In smart grid, the storage function is often of intermittent and fluctuating characteristics in practical applications, which is also the foundation of other renewable energy. Under the current information construction of smart grid, energy demand should be well coordinated. For the specific realization, we can make good use of the current virtual energy storage device of electric vehicles

which can charge and discharge. Through the smart management and online information sharing of energy storage device, build a virtual energy buffer space between users and suppliers. With the help of dynamic data driven, we can conduct virtual energy buffer to fully reflect the thought that the demand focuses on management.

3.2.3 Interactive and Operational Communication Technology Based on Web

In order to get a stable position in the market, the modern smart grid needs to be of standardized interfaces and interactive network protocols and it should also be of the simple and feasible characteristics. Some Web services can play a significant advantage in terms of accessibility and any sensor device can often make information interaction and communication by the gateway and related services to realize information sharing and transmission. Meanwhile, it can also make information interaction and communication with related servers without gateway channels.

3.2.4 Technology of Cloud Computing

In general, the Internet of things of power contains large amounts of information which often exceeds the amount of information generated by dynamic detection of some traditional grids [7]. At the same time, network with the help of cloud computing technology of the Internet of things, resolve and process the massive information of the Internet of things of power. Meanwhile, improve the transformation of some of the used distributed redundancy storage system, increase the amount of stored data and improve the reliability of data to achieve applications suitable for large-scale data set. In addition, based on this, adopting management mode according to data can support the efficient management of some large-scale data sets and read some real-time applications.

3.2.5 Technology of Information Security

The Internet of things plays a great role. At the same time, there are some security problems in sensor network, application system, wireless public network and other aspects. And there are also some new security risks in system integration. Therefore, in the Internet of things of power, we often use some security technologies which are as follows: (1) By the perception of the Internet of things, protect the safety of related power equipment; (2) Using a kind of security mechanism and measures of the artificial authentication, the protection of integrity of information transmission and confidentiality information , continually strengthen the security of the network system; (3) Make use of the security module to store crucial business data and to identify information and realize the protection of local security of related data; (4) Make use of related password technology for application commonly and constantly improve the security of the Internet of things of power. Realize the source authentication, freshness data integrity of system. For system, continuously strengthen the fault-tolerant ability of some software.

4. Conclusions

In a word, as a new type of information technology, the Internet of things plays a role in current information construction of smart grid. However, the construction and the function of the Internet of things are still in the stage of research and exploration, so the information construction of smart grid is also in the stage of constant construction and perfection. With the deepening development of application and research of the Internet of things technology, the development of smart grid will continuously accelerate in the future and meet the electricity-consumption demand of residents.

References

[1] Liu Haimei. *Research on Fault-monitor System of Smart Grid Based on Internet of Things* [J]. Power Source Technology, 2015, 39(10): 2275-2276.

[2] Zhu Fengxia, Ynag Ruixin. *Grid Technology of Smart Communication on the Sea Based on Internet of Things* [J]. Ships Science and Technology, 2015, 24(4): 195-198.

[3] Wu Fan, Sun Jing. *Research on Information Management System of Smart Grid Based on Multi-agent Technology* [J]. Modern Power, 2017, 34(2): 87-94.

[4] Gao Zhaoli, Liu Zhao, Sun Gang, etc. *Research on Internet of Things Technology and Smart Grid System* [J]. Automation and Instrumentation, 2017, 15(4): 185-186.

[5] Li Yizhong. *Information Intelligent Network of Manufacturing Enterprises Based on Internet of Things* [J]. Engineering Machinery, 2015.

[6] Zhao Yongzhu, Zhang Genzhou, Ren Xiaolong, etc. *Design of the Whole Life-cycle Management System of Smart Grid Asset Based on RFID* [J]. Shaanxi Electricity, 2017, 45(11).

[7] Luo Liming, Guo Bao. *Information Processing and Scheme Design of Smart Grid Combined with Mobile Terminal* [J]. Automation and Instrumentation, 2017, 16(9): 73-74.