

Various Green Energy Sources in Smart Grid Power Network Based on Cloud

Ming-Shen Jian, Yen-Lung Chen, Rui-Wei Tong, Yu-Huei Lin, Chih Cheng

Department of Computer Science and Information Engineering, National Formosa University,

No.64, Wunhua Rd., Huwei Township, Yunlin County 632, Taiwan

jianms@nfu.edu.tw, chenmono822@gmail.com, s1594679@gmail.com, v26012tom@yahoo.com.tw, macmax2011@gmail.com

Abstract— In this paper, we propose a various green energy sources method that can improve performance. This method collects data from green power storage system and smart meters by internet. In order to deploy power in smart grids, the control system collects data and analyze it by cloud computing. The green power storage system can predict the power status and control the system to work. Smart meters will collect user's data and send it to cloud computing servers, then it will predict the power status of green storage system and provide extra energy to smart grid. If the green power storage system cannot supply the users enough energy, it can extend the number or variety of green energy sources to increase the provided energy.

Keywords— smart grid, green energy, cloud computing, power system, power management

I. INTRODUCTION

In these years, smart grid becomes a popular study for saving energy, improving the efficiency of power supply, and so on. Smart grid is composed of two parts: electric equipment and communication equipment [3]. The electric equipments are deployed for the remote users or to generate the electric power. In addition, the communication equipments including the sensors are used to exchange the information or data of the power utilization state. The sensor will monitor the data from several places. Then the communication module or devices transmit the data or information by network, e.g. smart meters.

Cloud computing in smart grid is used to propose a decision to deploy the energy from the power plant and green power storage system according to the data from sensors. Thus, not only power plants can reduce the cost of providing energy, but also users can make the lower fee.

However, some areas were not able to build the excellent power circuit because of the reasons like terrain, weather, and so on. Also, it will make a lot of waste in a long distance power transmission. Therefore, a study said: the designer can get extra electric power by setting several kinds of green energy devices which is suits for the environment of the smart grid system.

This research focuses on how to store the green energy to the storage devices effectively, and deploy the power to users. With analysis of cloud computing, the control system will do the best decision to deploy the energy and increase the performance of the whole smart grid system.

The rest of this paper is structured as follows. Section II presents the smart grid, cloud computing and green energy storage system, Section III presents a various green energy sources method, lastly the conclusion in Section IV.

II. RELATED WORK

A. Smart Grid

In these years, smart grid has been one of the applications in IoT. The control system will collect the data from several areas through a communication network. After the analysis by cloud computing, the control system will deploy the energy [6].

As Figure 1 show, a schematic of the communication framework in the smart grid [4]. In each user, smart meters are used to monitor the energy status. In the control center, the energy deploy system will be based on the analysis from smart meters. In this case, we can improve the effect of the energy providing.

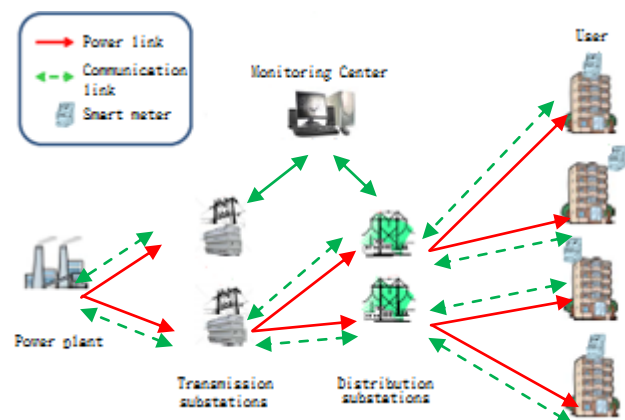


Figure 1. The smart grid communications framework schematic

B. Cloud Computing

Cloud computing is an internet connection technology, user can share resources with each other. In these years, the applications of cloud computing are improving every day. The users can request services on the internet without relevant expertise [2].

By cloud computing, the user service request will compute on the internet instead of sensors. As a result, it can make the user's devices simpler.

In smart grid, the smart meters can monitor user's energy status, and send the data to cloud servers. According to the result, the control system can make the power supply optimally.

C. Green Energy Storage System

A research [5] has shown a method, which stored green energy like wind, solar, and so on, is used to supply the extra electric to the smart grid.

The advantage of this method is the power distribute of the generator adjustably. In the case of residential and industrial areas, the power consumption of industrial areas was usually much than residential areas. Therefore, by using this method, the power plant can provide more energy to industrial areas without reducing the energy of residential areas.

In the literature [1], the study proposed an installation method of various sources of green energy. When the system is installed and configured, the system manager can choose several green power sources effective in this area.

Due to green energy is limit by various renewable sources, the system might be invalid. In order to avoid this situation, the system can install various sources of green energy. Besides, the storage system can store the green energy. Therefore, the steps of green energy electricity storage system are as follows:

1) Setting various sources of green energy according to different places, then save it to the storage system. The control system will deploy the power into the smart grid by analysis from cloud computing.

2) After smart meters upload users' data to the database, the cloud servers will analysis and assist the control system to provide the energy to users.

3) Cloud servers will analysis charging status in each green storage device. To make the system act for a long time, control system will schedule the work time of devices.

III. DIVERSITY GREEN POWER PROVIDING METHOD

A. System module

In this research, the control system is used to schedule the green energy storage devices' working time. Due to the charging time of green energy storage system is affected by renewable sources of the place. In other words, if the schedule of green energy storage devices does not appropriate, it means power might be shortage.

Therefore, the method in this research is: First, cloud computing will analysis and choose the higher energy storage device to discharge. Second, if the select one is less than a certain percentage or consumed completely, it will choose a new one. Finally, if the system cannot save the energy for a long time, it means this area is consuming more energy than others. Thus, the control system will send a request to the power plant for changing the power supply.

As mentioned above, the method in this research is divided into three parts: power source of the smart grid, smart meter monitoring, and the control system based on cloud computing. Its features are as follows:

1) **Power source of the smart grid:** The power source comes from green energy device and the power plant. The green energy device is constituted by various green energy, then charge into the energy storage device.

2) **Smart meter monitoring:** Each user will install a smart meter to monitor the energy status. Smart meters will return data to the control system, then deploy the energy.

3) **The control system based on cloud computing:** Cloud servers will analyze the green power electricity storage system and monitoring the value of smart meters.

In Figure 2, it shows the system schematic which is proposed in this research.

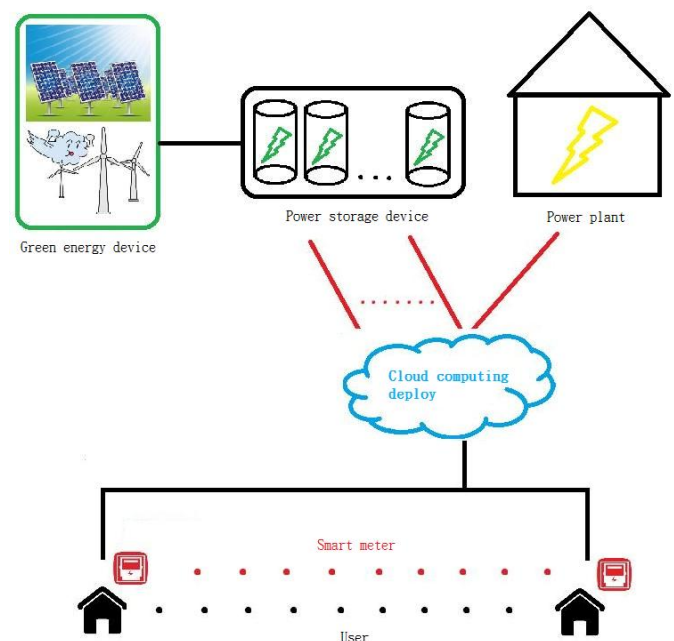


Figure 2. Various green energy sources in smart grid power network based on cloud schematic

B. Algorithm

In this research, to deploy the green energy power, a power providing algorithm is proposed. First, power plants are supply a stable energy. This energy is the average power between users. Next, if the power is not enough for a user, the Green Energy Storage System will choose a battery that can make the energy supply contentedly. Finally, if the Green Energy Storage System cannot offer smart grid system enough power, the control system will request power plants to increase the power supply.

With this method, the flow chart in the smart grid system can be shown as Figure 3.

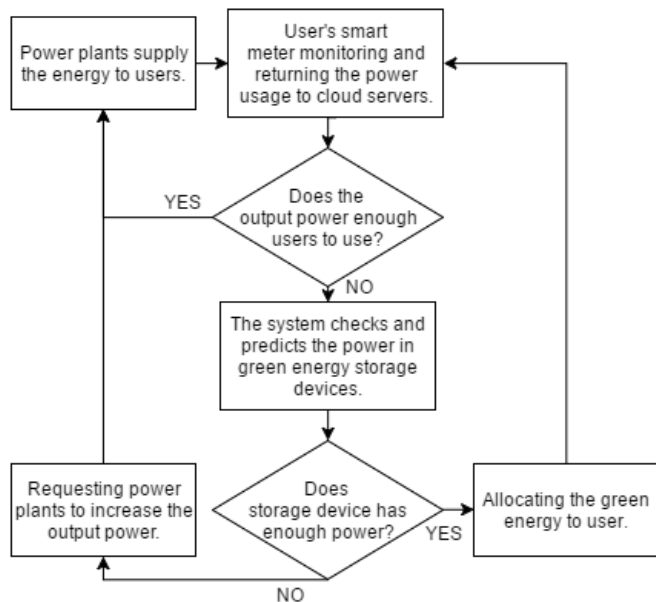


Figure 3. The flow chart in the smart grid system

The algorithm of the method is as follows:

```

int b_n; //number of the green energy storage devices
var user[k]; //users in smart grid

for( i = 0 to ( b_n - 1 )){
    input(battery[n]);
    //input the green storage system data
}

if(battery[n]>=user[k]){
    output(battery[n])
    //the green energy storage device work when it is enough to
    supply the power
}

if( output == NULL ){
    power_plant(increase);
    //power plants will increase the supply energy if the green
    energy storage system cannot offer enough power
}
  
```

In class array battery[], it need three data to assist the algorithm. First is the current power in storage device. Second is the value of predict power. Last one is the type of the green energy. Due to each green energy has different generation function, the system will choose the correspond generation function according to the type of green energy. The class array battery[] is shown as follows:

```

class battery {
    var b_save; //current power in storage device
    var b_pre; //predict power
    var gp_type; //type of the green energy
    b_pre = gp_generate(gp_type);
    //predict the power according to different generation functions
}
  
```

IV. CONCLUSIONS

The main target of the smart grid deploys provide energy to the users effectively. Thereby, the power plant can reduce the cost, and the user can also reduce electric fees. With the analysis of cloud computing, the distribution system of the smart grid will deploy the best energy provide from green energy storage system.

In the future, this research will improve the performance of the system. Then, the algorithm proposed in this paper will perform a simulation test. Finally, installing and testing the system in real environment. Thereby we can prove this method is feasible.

REFERENCES

- [1] Ming-Shen Jian, Yi-Chi Fang, Rui-Wei Tong, Yu-Huei Lin, "Wireless Green Energy Power Transmission System Based on Assembly Method and Pivoting Antenna Module," in *Applied System Innovation (ICASI)*, 2016, p. 1.
- [2] Ming-Shen Jian et al., *Cloud Computing Operation System & Implementation*, CCISLab, NFU, Yunlin, Taiwan, 2015
- [3] R. Vijayanand, D. Devaraj, and B. Kannapiran, "A Novel Dual Euclidean Algorithm for Secure Data Transmission in Smart Grid System," *Computational Intelligence and Computing Research (ICCIC)*, 2014 IEEE, pp. 1-5.
- [4] Zubair Md. Fadlullah, Yousuke Nozaki, Akira Takeuchi, and Nei Kato, "A Survey of Game Theoretic Approaches in Smart Grid," *Wireless Communications and Signal Processing (WCSP)*, 2011 IEEE, pp. 1-4.
- [5] Vytelingum et al., "Agent-based Micro-Storage Management for the Smart Grid," in *Proc 9th International Conf. on Autonomous Agents and Multiagent Systems (AAMAS'10)*, May, 1014, 2010, Toronto, Canada.
- [6] Internet of Things Part 8: Smart Grids - The Future of Energy Delivery, Available: <https://infobright.com/blog/internet-of-things-part-8-smart-grids-future-energy-delivery/>



Ming-Shen Jian is an assistant professor of Dept. Computer Science and Information Engineering at National Formosa University. Ming-Shen Jian's current research interests are in the area related to IOT application, Big Data, optimal solution, Intelligent System, and cloud computing. He received B.S. degree at Electrical and Control Engineering in National Chiao Tung University and Ph.D. at the Department of Computer Science and Engineering of the National Sun Yet-Sen University in Taiwan, 2007, investigating resource management in 3G mobile communication systems.



Yen-Lung Chen is a master degree student of Dept. Computer Science and Information Engineering at National Formosa University. His current research interests are in the area related to Internet Of Things (IOT) and intelligent system. He received B.S. degree at Computer Science and Information Engineering at National Formosa University, 2014.



Rui-Wei Tong is an undergraduate student of Dept. Computer Science and Information Engineering at National Formosa University. His current research interests are in the area related to IOT and Intelligent System.



Yu-Huei Lin is an undergraduate student of Dept. Computer Science and Information Engineering at National Formosa University. His current research interests are in the area related to IOT and Intelligent System.



Chih Cheng is an undergraduate student of Dept. Computer Science and Information Engineering at National Formosa University. His current research interests are in the area related to IOT and Cloud Computing.