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MANAGEMENT OF SMART GRID POWER SYSTEM USING ZIGBEE TECHNOLOGY

Ritesh S. Kakade[1], Ankush V. Mhala[2], Kirti B. Nagane[3]

[1]*Student, Dept. of Electrical Engineering, DES'S COET, Dhamangaon Rly*
[2]*Student, Dept. of Electrical Engineering, DES'S COET, Dhamangaon Rly*
[3]*Professor, Dept. of Electrical Engineering, DES'S COET, Dhamangaon Rly*

Abstract **-** *Smart Grid is preferred because it uses both renewable energy and non-renewable energy sources to meet the total demand, digitally send meter to suppliers for more accurate energy usage, control of energy and operate power plant. Loop network technique helps to maintain reliable and secured transmission data when ZigBee network is used in Smart Grid. This paper presents the ZigBee module. The non-conventional system like solar energy system, wind energy and energy source from urban waste is also connected to Smart Grid to meet the total demand. Minimum number of wireless junctions is used to cover all consumers with continuous and renewable data supply to control house. An alternate methods for generating electricity are highlighted and these methods uses renewable sources like solar power, wind power, tidal energy and so on. Many research companies concentrate on the elemental technologies to generate the power but the energy generated from these resources is not sufficient as the growth of power demands and need efficient and intelligent distribution system to distribute the energy. The intelligent energy distribution management system is developed and the results of managing the distribution of energy which is generated from renewable resources are used effectively as presented.*

Key Words: **Efficient Energy Distribution System, Load Demands, Power Monitoring Device, Solar Systems, Smart Grid, Zigbee Module.**

1. INTRODUCTION

The traditional electricity system structure consists of electricity flow in single direction that is from grid to thousands of consumers. The challenges with this traditional grid system is to tackle the increasing demand of electricity, reducing the generation, transmission and maintenance cost, reducing the use of fossil fuel for generation and incorporating non-conventional energy source like wind and PV cell for generation and balancing load consumption and the power generation. Therefore, a solution which considers environment sustainability, power distribution and generation costs, and total power demand at house must be produced. Technique of monitoring and measuring helps to receive data to find abnormality and grid integrity with advance reading of meter, elimination of the process of billing and power theft detection. Advanced equipment assists in determining the performance of the grid-condition which helps to maintain quality, reliability, and prevent the outages. ZigBee is a low price advanced technique used in sensor network. This paper explains idea of Smart Grid system using ZigBee model called as ZigBee model of Smart Grid system. This paper presents a Smart Grid system which consists of a ZigBee model and a control unit as "Microcontroller". The two renewable energy sources like wind and solar energy are considered for the system design and used Embedded C programming language for system configuration.

The use of the non-renewable energy sources such as fossil fuel has increased drastically from past few years. It has carbon as the main element which has a great impact on environmental life. When coal is burnt to produce power, it mixes with oxygen producing the carbon dioxide as byproduct. Carbon dioxide is the gas responsible for the global warming. The alternate power source for the generation of electricity is fuel cell, wind power, solar power. The hybrid energy sources have great advantage compared to conventional power sources and it can eliminate the pollution caused by burning the fossil fuel. The wind turbine converts the mechanical energy into electrical energy. The PV converts solar energy into electrical energy. The fuel cell is device that generates electricity by a chemical reaction with hydrogen and oxygen leaving behind water as byproduct. With all this advantages it has some limitation due to its slow transient response which affects current delivered from it.

Therefore the hybrid energy sources need to be combined with other power sources like ultra-capacitor, DC power supply. This hybrid combination provides better response. The hybrid combination of different electricity network for generating electricity with better system stability used to fulfill the energy need of specific location. There are various renewable energy sources available, some examples are wind power, photovoltaic, fuel cells, fuel cells are better option compare to wind power and photovoltaic but need of the continuous supply of hydrogen gas is required. The wind power generation requires huge lands and large size of turbines but when combines with fuel cells and photovoltaic, it becomes good power source for the village. The fuel cell based power generation needs less space and it may be continuous power source if there is uninterrupted supply of hydrogen.

2. Renewable Energy Resources

Renewable sources are also called Echo friendly technologies are very important due to their pollution free energy generation and having sustainable growth. There are many sources of energy that are renewable and considered to be environmentally friendly and harmless natural processes. These sources of energy provide an alternate „cleaner" source of energy, helping to negate the effects of certain forms of pollution. All of these power generation techniques can be described as renewable since they are not depleting any resource to create the energy. While there are many large-scale renewable energy projects and production, renewable technologies are also suited to small off-grid applications, sometimes in rural and remote areas, where energy is often crucial in human development.

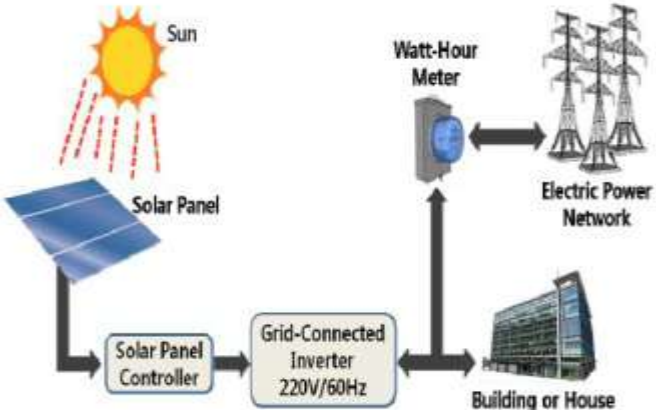

Fig.2.1: Structure of General Renewable Energy System

But the disadvantage with the renewable sources is that their power generation varies with climatic condition and hourly based. To store this unsteady generated energy from renewable sources required a huge, efficient battery and inverter, and these are necessary to connect to the power grid. In case of solar power systems variation in the power generation is largely depends on weather and season. Hence every renewable energy system requires storage systems.

2.1 Conventional power system

The traditional electricity system structure consists of a system in which the flow of power is restricted to a single direction i.e., from centralized power platform to many end users. The generated power step-up using transformer to transmit over long distance through overhead transmission line to the consumer premises. The generated power from different power plants is transmitted to a common point is known as electrical grid. It consists of substation, HV lines, and distribution lines which connects consumer premises network as shown in figure 2.2.

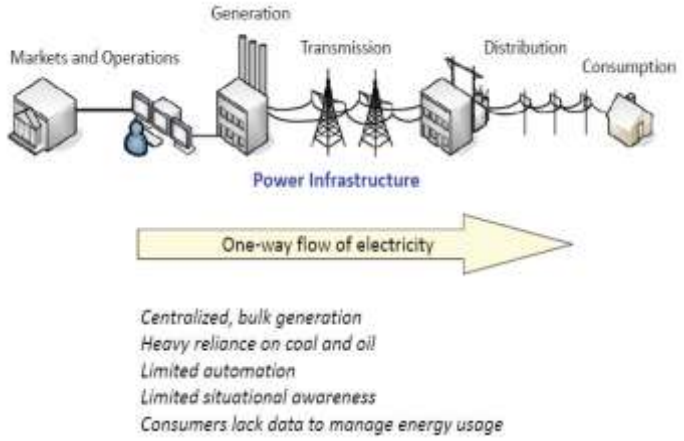

Fig.2.2 Conventional Power System

2.2 Smart Grid Power System

A power system should be able to supply power from multiple source such as wind energy source, solar energy source and electric vehicle may plug in since large variation in the generation of all nonconventional source with time, therefore grid should able to store power by using advanced storing batteries, supper capacitors to maintain the reliability of grid and also advanced generation, transmission technique, control technique and duplex meter called smart meter must be used to maintain reliability of Smart Grid. It helps both suppliers and consumer to set up real time pricing for more accurate energy bills and energy usage.

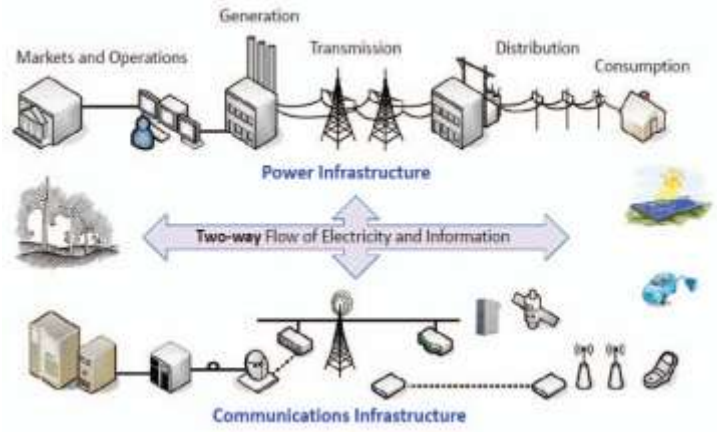

Fig.2.3: Smart Electricity Grid System

2.3 Benefits of Smart Grid

The following benefits are

a) **Self-repair:** If any contingency incurred system immediately detect the problem and reduce losses by bringing the system to normal state.
b) **Motivates and involve buyer:** system gives real time pricing to users such as bulk consumer,

commercial and domestic consumer and offer them to select best price.

c) **Resist Attacks:** system has self-protected from ground up.
d) **Quality:** system supply power which is free from fluctuation, dips, low frequency and supplies desired voltage level.
e) **All Generation and Storage Options:** system helps to "plug-and-play" connection to different power plant and advanced battery device.
f) **Optimize and effective operation:** A system helps to build small renovation in existing system and enables us transfer huge power from existing Smart Grid and hence reduce the grid operation cost.

3. CIRCUIT DESCRIBTION

The challenges with this traditional grid system is to tackle the increasing demand of electricity, reducing the generation, transmission and maintenance cost, reducing the use of fossil fuel for generation and incorporating nonconventional sources like wind and solar generation and balancing load consumption and the power generation. Therefore, a solution which considers environment sustainability, power distribution and generation costs, control of energy and monitor required matching power at the house should be produced. The current electrical system needs to cope with the rising demand of power while reducing the fossil fuel use for power generation, including renewable sources of power generation in the grid, reducing the cost of energy unit and achieving balance between the supply and load ends. The Smart Grid concept provides a solution to all the problems mentioned allowing the generation of electrical energy using renewable sources at the consumer end reducing the transmission overhead and cost and monitoring and control of the load at both supply end and load end is done to achieve balance between source and load.

3.1: Circuit Diagram of Solar Light Trap

The model gives a basic understanding of the Smart Grid concept wherein the load will be sourced by any one of the generating methods. By comparing the amount of power generated by conventional and renewable energy sources the load must be controlled and sourced by any one of the sources. At the load side information is provided regarding which type of energy the load is consuming.

As shown in fig.3.1 of proposal system the power is to be managing in a grid system through zigbee. The first block makes a comparison of which source has more amount of power and controls the load based on this information. This information is passed on to the second block where it gets displayed. The main Electricity module represents the Electrical source generated by any of the conventional generation methods (fossil fuels). The solar Cell and the wind mill modules represents energy source from renewable sources such as solar and wind energy.

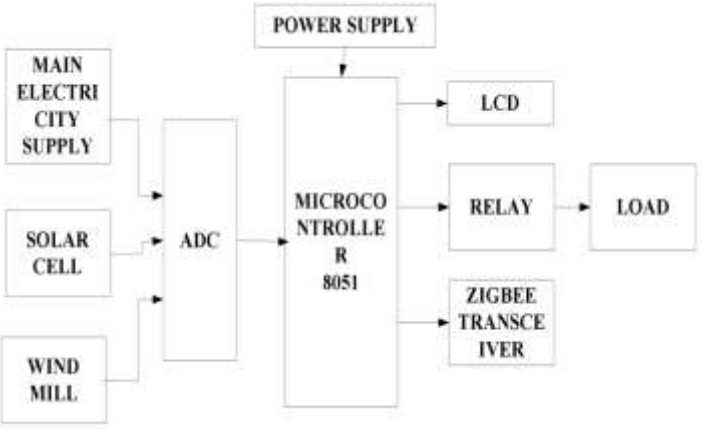

Fig.3.1: Block Diagram of Proposed Work

The electrical energy forms these sources are fed to Analog to Digital Converter (ADC) module to measure the energy generated. The measured energy from each of the three sources is fed as an input to Microcontroller module, which performs the comparison and decides which electrical source has sufficient power to meet the power requirement of the load. If the controller finds a suitable source that meets the load requirement then the load will be turned on and power will be provided from the selected source. The information of which source is selected to provide power to the load will be displayed on LCD module by the controller and at the same time this information is Wirelessly transmitted to the load end side. ZigBee module is used here to act as wireless transceiver for transmitting the source information from the source end to the load end.

4. CONCLUSION

In this paper, we present the implementation of prototype of Smart Grid concept. Electrical energy was generated using the three methods and a controller was used to control the power consumption at the load side. The monitoring of the energy source being used to drive the load is made available at the load side. This paper implements the Smart Grid concept by providing Automatic Control of the load and Monitoring of the Source Provider. The paper was proposed taking a single load which can be enhanced with more loads. The system can be further enhanced by incorporating a two communication between the consumer end and the supply end.

REFERENCES

[1] A.O. Converse, "Seasonal energy storage in a renewable energy system "proceedings of IEEE, vol.100, pp.401-409, 2012.

[2] Aadesh Kumar Arya1, Saurabh Chanana2 and Ashwani Kumar3," Role of Smart Grid to Power System Planning and Operation in India ", Proc. of Int. Conf. on Emerging Trends in Engineering and Technology.

[3] Amab Ghosh and Niladri Chakraborty," Design of Smart Grid in an University Campus using ZigBee Mesh Networks ",1st IEEE International Conference on Power Electronics, Intelligent Control and Energy Systems (ICPEICES-2016).

[4] Antonello Monti and Ferdinanda Ponci, "Electric Power Systems" Springer-Verlag Berlin Heidelberg 2015 E. Kyriakides and M. Polycarpou (eds.), Intelligent Monitoring, Control, and Security of Critical Infrastructure Systems, Studies in Computational Intelligence 565.

[5] Backline Hoang," Smart Grids ", Originally published on the IEEE Emerging Technology portal, 2006—2012.

[6] G. M. Shafiullah, Amanullah M. T. Oo, A. B. M. Shawkat Ali, Peter Wolfs "Smart Grid for a Sustainable Future", Smart Gridand Renewable Energy, 2013,4,23-34.

[7] Huang, S., Xiao, J., Pekny, J., Reklaitis, G., and Liu, A. (2012). "Quantifying System-Level Benefits from Distributed Solar and Energy Storage." J. Energy Eng., 138(2), 33–42.

[8] J. Lee, B. Han and K.Chol, "High efficiency grid tied power conducting system for fuel cell power generation," power electronics and ECE asia (ICPE&ECCE),2011 IEEE 8th international conference on 2011,pp,1492-1497.

[9] Jimmy J. Nielsen, Hervé Ganem, Ljupco Jorguseski, Kemal Alic, Miha Smolnikar, Ziming Zhu, Nuno K. Pratas, Michal Golinski, Haibin Zhang, Urban Kuhar, Zhong Fan, and Ales Svigelj ," Secure Real-Time Monitoring andManagement of Smart Disttribution Grid Using Shared Cellular Networks", IEEE Wireless Communications April 2017.

[10] M.B .Nisssen" high performance development of distribution generation". Potentials, IEEE, vol 28, pp 25-31, 2009.

[11] M.M.Amin and O.A. Mohammed," development of high performance Grid connected wind energy conversion systems for optimum utilization of variable speed wind Turbines" Sustainable energy. IEEE transaction on, vol 2, pp 235-245, 2011.

[12] Mushu Li, Peter He, and Lian Zhao," Dynamic Load Balancing Applying Water-filling Approach in Smart Grid Systems ", 2327-4662 (c) 2016 IEEE.

[13] Rosario Miceli," Energy Management and Smart Grids", An article in Energies 2013, 6, 2262-2290.