Smart Grid System To Monitor and Control Renewable Energy Source Based on Web of Things

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ABSTRACT

This paper describes a smart grid system of renewable energy source based on Web of things. The smart grid evokes the application of digital technology and information management practices and is a core ingredient in the ongoing modernization of the electricity delivery infrastructure. The renewable energy source considered here is solar energy hence use a photovoltaic cell. This system consist of three major subsystems namely power generation and storage, power monitoring and billing and power control and managing by using WoT. WoT technology can effectively combine the infrastructure resources in increase the quality of power system information, and increases the utilization efficiency of infrastructures in the existing power system. The part of vision of a smart grid is its ability to enable informed participation by customers making them an integral part of the electrical power

Keyword: - *Web of things, Smart Grid, Power control and manage, modernization of electricity*

1. INTRODUCTION TO SMART GRID AND WEB OF THINGS:

A SMART GRID delivers electricity from provider to consumers using full duplex digital technology to control devices at consumers' homes to save energy, reduce cost and increase reliability and transparency. It mainly include electricity distribution grid with information and smart metering system. Power passes from the power plant to customer through an amazing system called the power distribution grid. Such a modernized electricity links is being promoted by many governments as a way of addressing energy independences, global warming and emergency flexibility issues. Smart meters may be part of smart grid, but alone do not constitute a smart grid. A smart grid comprises an intelligent monitoring system that keeps record of all electricity flowing in the system [1]. It also unites the use of superconductive transmission lines for less power loss, as well as the capability of the integrating renewable electricity such as solar and wind.

When power is least expensive the customer can allow the smart grid to turn on selected home applications such as washing machines or factory processes that can run at arbitrary hours. At ultimate times it could turn off selected appliances to reduce demand. Understanding the requirement for smart grid requires acknowledging a few realities about our infrastructure. The power grid is the backbone of the modern civilization, a multifarious society with often conflicting energy needs-more electricity but fewer fossil fuels, increased reliability also lower energy costs, more secure distribution[1] with less maintenance, effective new construction and efficient disaster reconstruction. But while demand for electricity has risen hugely, its transmission is outdated and stressed. The bottom line is that we are demanding more from a grid that is simply not up to the task. Building the smart grid means adding workstation and communications technology to the present electricity grid. With a connection of digital technology, the grid promises to work more efficiently and reliably. It can also accommodate more solar and wind power, which are uneven sources of energy that can become more reliable with better controls. Much like computers and routers manage the flow of bits on the Internet, smart-grid technologies use statistics to optimize the flow of electricity [3]. Web of Things, explicitly "the Internet in which all the things allied to each other", is the tremendous extension and expansion of Internet network Building the smart grid means adding workstation and communications technology to the present electricity grid. With a connection of digital technology, the grid

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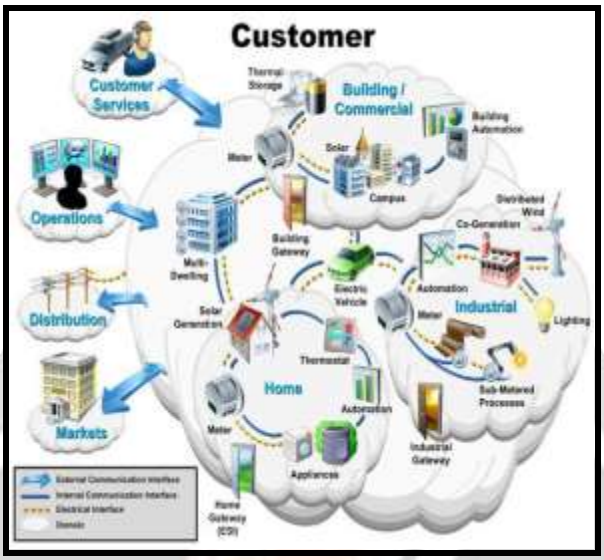

Fig -1: Concept of smart grid

Web of Things, explicitly "the Internet in which all the things allied to each other", is the tremendous extension and expansion of Internet network .The protocols, with WOT key technologies: radio frequency identification technology (RFID), sensor technology, smart technology, and nanotechnology, the communicated information can be exchanged, and the intelligent identification, positioning, tracking, monitoring and management can be easily managed.

What happens when everyday ordinary objects have inter-linked microchips inside them is the WoT. The microchips not only keep record of other objects, but also help in many of these devices sense their surrounding and report it to other mechanisms as well as to the human's being. Two types of communication in the WoT are thing to person and thing-to-thing communication.[5]The highly united with smart sensor data acquisition technology, information and communication technology, data analysis of the decision-taking technology, automatic control technology, and energy power technology is smart grid and power grid. By compared in present and proposed smart grid, smart grid has been improved distinctly in the optimization of power control, the flexible use of grid structure, optimizing the allocation of resources, and increases the power quality of services and increase in efficiency of power.

2. LITERATURE SURVEY

Web of Things consist of a set of Web services provided on top of a numeral of Internet aided embedded devices .The Web browser on any computer can work as an interface to the services provided by these Web of Things. (Saswat Mohanty, Bikash Narayan Panda, 2014) [1]. The literature states that The Web interfaces offer us real time information on every energy meters that are mounted on location and communicate to the Embedded Internet devices using MODBUS communication protocol. Real Time energy source arrangement, energy source selection, power connection and disconnection are some of the amenities that are provided to an on-line identified user. The Embedded Systems lab Substructure at the TIFAC CORE for 3G/4G Communication at National Institute of Science and Technology was applied for the hardware testing of the embedded components. We were greatly helped by the Software developers at NIST Technology Consultancy Services in designing the web applications and interfaces for our Web of Things architecture. Mahesh Hiremth, Prof: Manoranjan Kumar(2012)[2] The target of the Energy management using Internet of Things (IoT) is to provide the reliable power supplies to the consumers by making supreme use of renewable energy to the smart metering data from current sensors and stores it in cloud and device will select any of the two power sources automatically according to power consumption of load, later Embedded device by communicating with Internet real time information about power consumption and controlling authority can be given to the legal person applications, wherein people communicate with data and vice versa,

including remote control to objects by humans, and objects. According to Liu Hua1, Zhang Junguo, Lin Fantao[3],implementation in the construction of smart grid which is depend on Internet of things are made, and the design and implementation in typical application links, including wind power estimation, condition monitoring of overhead transmission lines, power analysis, smart home and asset management are evaluated insistently.

The Melike Erol-Kantarci(Member, IEEE) and Hussein T. Mouftah defines the smart grid and WOT as:" Smart grid has restructured the way electricity is generated, transported, distributed, and consumed by integrating smart sensing, communicate ones, and control in the day-to-day operation of the grid. Electricity is a fundamental utility for the functioning of society and for the services provided by information and communication technologies (ICTs). Several conceptions of the smart grid, such as dynamic pricing, distributed generation, and demand managing, have significantly impacted the operation of ICT services, in particular, communication networks and data centers [4] S.Ramkrishan (2013) explores a method to facilitate management of electrical energy in the context of the evolving smart grid ideas that are consistent with sustainability practices. The strategy reflects a cyber-physical software system that incorporates web-enabled physical devices and REST full APIs to enable monitoring and controlling electrical appliance household [5]

The A. R. Al-Ali, Raafat Aburukba (2015) proposes a conceptual model for the smart grid inside the Internet of Things concept. The projected model is based on IPV6 as the backbone of the smart grid communications layer [6]

3. METHODOLOGY

Here we have used two different Energy sources, one is the main power which is supplied by MSEB and the other one is from Renewable energy source i.e. from photovoltaic cell and by making use of this renewable energy source provides the reliable power supplies to the consumers. As WoT architecture will switch between the two power sources according to the consumption by monitoring the power consumption by different loads at home. The power generated using renewable energy sources, i.e. photovoltaic (PV) solar panels, is variable. Depend upon the season and weather conditions of day. CT Coil current sensors are used to sense current flow of the individual supply which can be measured. This can effectively reduce power loss, low operating temperature, increase reliability

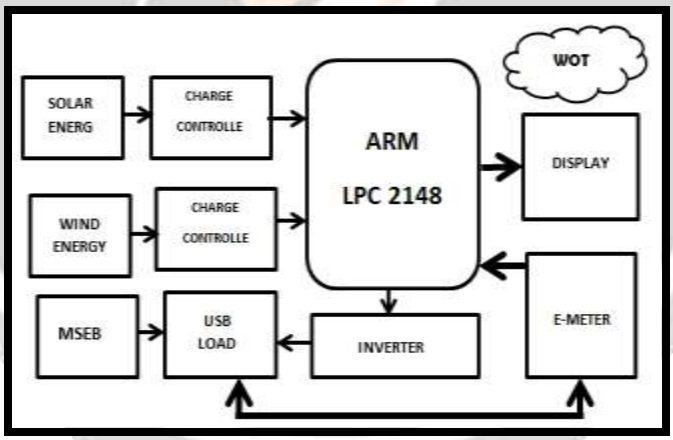

Figure3: Block Diagram of WoT and energy management system.

The data collected will regularly update in the cloud by the GPRS/GSM modem. Web of Things platform with initial applications tailored to building energy insight control. Once the data stored in the cloud using the Web service authenticated user can access data from anywhere in the world and can analyze the power consumption, he just need an internet connection for this and no any data. The status of his application processing can be tracked by the user on the login screen by WoT. One of benefit is there, options is to check for the average power Consumption of a particular home. The user gets help to track his energy needs and accordingly plan the scheduling of his power sources. The compared between consumption data and consumption data of other times by means of graphical representation of comparison of average consumption data. Based on the power consumption data, the user plans ahead how and when to use its energy sources.

The web services user to allow configure the switching of energy sources according to power availability. The billing of power consumption of MSEB is done online by IoT. The equipments which are carry on after we are not present at home is switch off using WoT. Thus monitoring and controlling of all operating devices is done through web page.

4. SYSTEM SPECIFICATION

Condition statement:: We have to provide a power to 100W load having Load back up time of 10 Hr and we have I/p Voltage (Battery): 12V

Solution:

- To find Battery Specification:

  Battery Backup (BB) = Output Load*Load Backup

  B.B = 100*10=1000

  Current = B.B/Input=1000/12=83A

  i.e. we need a Battery of 12V, 83A.

- To Calculate Solar Plate design:

  Current of System=83A

  Battery charging Hour: 7Hr (time during which sunrays will presents)

- To find Current of Solar Plate:83/7=12A

  Power=Current*Voltage

  P=12*12=144

  i.e. Solar Specification: 144W ,12A,12V

5. RESULT DISCUSSION:

5.1. Controlling and monitoring:

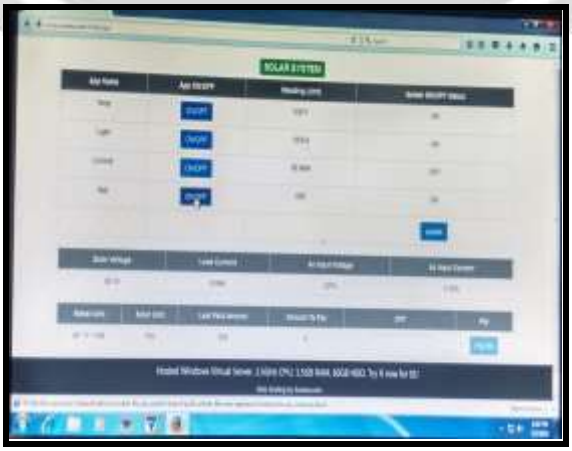

Figure 4: Web page for monitoring and controlling.

The controlling of 4 switches is done only through web page. The screen shot of window is shown in figure 4. Here, we provided a column for showing reading of various parameters viz. Temperature, light, current etc. The readings from sensors are continuously updates on web page after each 5 seconds. This gives monitoring of all sensor parameter. We also have provided a column to switch ON/OFF the device. These devices can ON/OFF by manual as well as automatically. Depending on set value, the devices operate automatically otherwise can be control through web page manually. The table below shows theoretical and practical observations:

Parameter	Voltage rating	Current rating	Backup time	Output load connection
Power from solar	Battery=12V	83A	7 Hrs	Yes
Power from MSEB	230 V AC	13A	1Hr	Yes

Table1: Theoretical observation table.

The above table gives idea about theoretical value and status of load connection. The following table gives practical readings and status of load connection. It shows above parameter for both sources i.e. solar power and power from MSEB i.e. mains.

Light sensor(LDR)			
Illumination	Transducer range	Display reading	Status of output device
Moderate	0 to 6.9 V	95 to 80 %	Device OFF
Dim	0.7 to 2.5 V	80 to 40 %	Device OFF
Dark	2.5 to 2 V	40 to 20 %	Device is ON

Table2: Practical observations for Light sensor

The above two table shows practical output of light and temperature sensor. To operate connected load automatically we have set the value and according to predefined value the system will operate automatically. The LDR will keep the device OFF till light is 40%, when light drops below 40% the device (bulb) will ON automatically.

Temperature sensor(LM35)		
Temperature range	LM 35 output	Status of output device
0^0C-15^0C	0.48V	Device OFF
15^0C-35^0C	0.75V-1.75V	Device OFF
35^0C-50^0C	1.0V-2.5V	Device ON

Table3: Practical observations for Temperature sensor.

Meanwhile we can make device ON/OFF by webpage. Also temperature sensor will control the other device. The device (Fan) will remains OFF from 00C to 100C and maintain ON above the temperature 350CHere the device will ON/OFF automatically due to sensor while make it ON/OFF manually with the help of web page.

6. CONCLUSION

The designed system is easy to implement and very customizable according to needs. It provides very efficient methods of monitoring and controlling our renewable energy resources which would otherwise have been underutilized. It ultimately saves the money and help to minimize pollutions because use of non-renewable energy will reduce a carbon emission footprint. Finally it gives a very effective solution for implementing green energy techniques on a larger scale.

7. REFERENCES

[1]. Saswat Mohanty, Bikash Narayan Panda "Implementation of a Web of Things based Smart Grid to remotely monitor and control Renewable Energy Sources,"volume: 2, *2014 IEEE Students' Conference on Electrical, Electronics and Computer Science.2014*

[2]. Mahesh Hiremth, Prof: Manoranjan Kumar, "Internet of things for energy management in the home power supply", *Volume: 1 Department of International Journal of Research In Science & Engineering (2012).*
[3]. Liu Hua1, Zhang Junguo*1, Lin Fantao a "Internet of Things Technology and its Applications in Smart Grid," *TELKOMNIKA Indonesian Journal of Electrical Engineering, Vol.12, No.2, February 2014, pp. 940 ~ 946.*
[4]. Melike Erol-Kantarci, Member, IEEE, and Hussein T. Mouftah, Fellow, IEEE "Energy-Efficient Information and Communication Infrastructures in the Smart Grid: A Survey on Interactions and Open Issues*" IEEE communication surveys & tutorials, vol. 17, no. 1, first quarter 2015.*
[5]. Sita Ramakrishnan, Subramania Ramakrishnan "WoT (Web of Things) for Energy Management in a Smart Grid-Connected Home*," Issues in Informing Science and Information Technology Volume 10, 2013*.
[6] Nomusa Dlodlo "Adopting the internet of things technologies in environmental management," *International Conference on Environment Science and Engineering IPCBEE vol.3 (2012)*
[7] A.R. Al-Ali, Raafat Aburukba "Role of Internet of Things in the Smart Grid Technology," *Journal of Computer and Communications, 2015, 3, 229-233. Published Online May 2015 in SciRes*
[8]. Ponmozhi.G, Mr.L.Bala kumar," Embedded System Based Remote Monitoring and Controlling Systems for Renewable Energy Source*," ISSN (Print) : 2320 – 3765*
ISSN (Online): 2278 – 8875 Vol. 3, Special Issue 2, April 2014.
[9]. Ravi Uttarkar, Prof. Raj Kulkarni," Internet of Things:Architecture and Security," *International Journal of Computer Application Issue 4, Volume 3 (May-June 2014)* .
[10]. A Fazeli†, M Sumner, E Christopher, M Johnson "Power Flow Control for Power and Voltage Management in

Future Smart Energy Communities*," University of Nottingham, Nottingham, NG7 2RD, UK,. ISSN (Print) : 2320*
[11].. Stamatis Karnoukos," The cooperative Internet of Things enabled Smart Grid", *SAP Research (www.sap.com) Vincenz-Priessnitz-Strasse 1, D-76131*
[12] Yong Ding, Christian Decker, Iana Vassileva, "A Smart Energy System: Distributed Resource Management, Control and Optimization*," Journal of Communications Vol. 9, No. 9, September 2014*.