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Web of Things Based Smart Grid Architecture to Monitor and Control Renewable Energy Sources

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ABSTRACT

This paper describes a Smart Grid architecture implemented with the help of Web of Things. The goal of the Smart Grid architecture using Web of Things (WoT) is to provide the reliable power supplies to the consumers by making maximum use of renewable energy sources. The Web of Things comprise of a set of Web services provide on top of a number of Internet enabled Embedded devices. The Web browser on any computer can act as an interface to the services provided by these Web if Things. The Embedded devices are PIC16F877A, Raspberry Pi with Internet capabilities. Raspbian Operating System is used for process control on each of these embedded devices. The Web interfaces provide us real time information on each of the energy meters that are installed on site and communicate to the Embedded Internet devices using ZigBee. The real time energy source scheduling, energy source selection, power connection and disconnection are some of the surfaces that are provided to an online authenticated user.

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I.INTODUCTION

Increasing energy demands, depletion of natural resources and rising costs make energy conservation a universal problem with tremendous environmental, political and social implications[2]. The future of energy in the world today is focusing more and more on alternative energy sources to remove the stain of fossil fuels which are becoming more and more costly and ageing distribution infrastructure is seriously endangering security of supply. A naturally replenished energy known as renewable energy is promising to become the future energy source around the world and National renewable energy markets are projected to continue to grow strongly in the coming decade. Also, they do not produce any adverse forms of pollution that affect the ecosystem. But these resources are climate and location dependant. Use of renewable energy sources in household electrification has always been the most effective method to minimise the amount of carbon emissions that we contribute towards the cumulative carbon emissions of these planet Earth.The use of alternatives like solar water heaters help to reduce individual carbon emission foot print upon the environment.Although power grid supplies to our homes will remain the primary source of energy the electrical circuitry reconfiguration of entire home is cumbersome process for end user. But inexpensive configuration of renewable energy circuitry along with power grid source will give reliable power consumptions for the end users also if renewable energy source generates more than the actual power consumptions, extra power generated can be redirect to the power grid house or can be stored in the power storages[4].The Web of Things comprise of a number of Internet enabled Embedded devices which provide such an interface to the user by means of Web services. The end user can access this through a web browser of any computer with an Internet connection.

II.RELATED WORK

As more and more devices are getting connected to the Internet, the next logical step is to use the World Wide Web and its associated technologies as a platform for smart things (i.e., sensor and actuator networks, embedded devices, electronic appliances and digitally enhanced everyday objects[6]. Instead of these heavyweight Web services (SOAP/WSDL, etc.), often referred to as WS-technologies, recent "Web of Things" projects have explored simple embedded Hypertext Transfer Protocol (HTTP) servers and Web 2.0 technology. So far, projects and initiatives, subsumed here under the umbrella term "Internet of Things", have focused mainly on establishing connectivity in a variety of challenging and constrained networking environments. A promising next step is tobuild scalable interaction models on top of this basic network connectivity and thus focus on the application layer. In the Web of Things concepts, smart things and their services are fully integrated in the Web by reusing ad adapting technologies and patterns commonly used for traditional Web content. More precisely, tine Web servers are embedded into smart things and the REST architectural style is applied to resources in the physical world.Since the end of 20th century, several factors have started to change the energy production scenario: then foreseen oil shortage brought research efforts for new and renewable energy sources to the forefront; the increasing demand for energy called for drastic efficiency improvement in the energy production and distribution processes, and new attention to the environment changed the behaviour of many energy players. A more "green", judicious use of energy resources is becoming a desirable and profitable attitude.Although in most power-generating systems, the main sourceof energy (the fuel) can be manipulated, this is not true for solar and wind energies. The main problem with these energy sources are cost and availability: wind and solar power are not always available where and when needed. Unlike conventional sources of electric power, these renewable sources are not "dispatchable" the power output cannot be controlled. Daily and seasonal effects and limited predictability result in intermittent generation. Smart grids promise to facilitate the integration of renewable energy and will provide other benefits as well. Industry must overcome a number of technicalissuesto deliver renewable energy in significant quantities. Control is one of the key enabling technologies for the deployment of renewable energy systems. Solar and wind power require effective use of advances control techniques. In addition, smart grids cannot be achieved without extensive use of control technologies at all levels.

The smart grid (SG) is the technological paradigm being proposed to satisfy the aforementioned needs: SGs are expected to spread the intelligence of the energy distribution and control system from central core to many peripheral nodes, thus enabling more accurate monitoring of energy losses as well as more precise control and adaptation. The concept and objectives of such intelligent nodes are also used in a smart home in Melbourne, Victoria, Australia[4], that has solar panels installed on the roof for local electricity generation and batteries for energy storage. The house has many electrical loads made up of light loads (lights, computers, radios etc.) and heavy loads (plasma television, fridge microwave cooker, washing machine, clothes dryer etc.). The architecture for the cyber-physical system considered in the context of a smart grid consists of three layers. Physical appliances and their sensing and control using LowPan smart plugs are included in Layer 1. The smart plugs communicate with a dual router which acts as the Gateway Layer. Application Layer enables householders to acquire relevant information from the web and visualize their power consumption in various formats on desktop or mobile devices. The smart home network is linked to a smart meter and smart grid.A wide range of industrial actors have been forming consortia in order to boost the development of flexible standards, suitable to address the novel SG communication paradigm. In particular, the ISPO, ZigBee and Homeplug appliances are working on the definition of weird and wireless interoperable profiles suitable for the SG. The academic interest toward SG is spinning up as well: IEEE recently introduced journals and conferences specifically addressing SG-related topics [7].

III.PROPOSED DESIGN

The proposed design will maintain energy consumption of different Renewable energy sources of different houses and also control the appliances. Generally Renewable energy sources are using effectively for household purpose the units of load consumption is transmitted through ETHERNET protocol. So that consumer can maintain data base in the web services. Hence consumer can know the indoor environment consumption units on web services and also we can control the home appliances from web services.

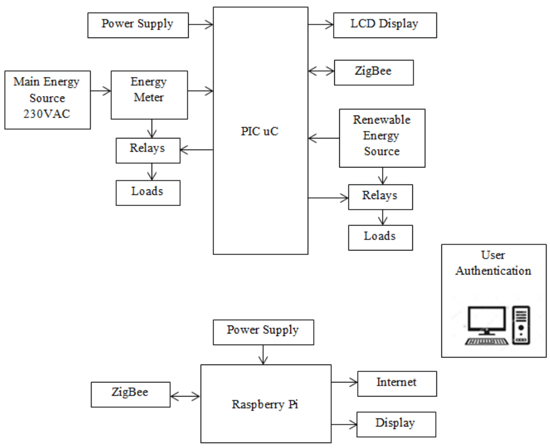

Fig. 1: Block diagram of proposed system

The Smart Grid architecture implemented has two kinds of energy sources. The first kind of energy sources used in non-renewable Energy Sources that leaves a significant carbon emission footprint on the environment. The second kind of energy sources that we used comprised of a number of Renewable energy sources that were environment friendly. Our goal was to maximize the utilization of the latter. But the final choice of the Energy Source that is used is taken by the implemented Web of Things architecture. This is depicted in Fig1.The Non-Renewable energy sources consist of Nuclear Power plants, Thermal Power plants etc. The Renewable energy sources consists of Wind turbines, Solar panels, Biogas plants and energy derived from Biofuel. The energy sources are connected to individual digital energy meters of industrial standards. Different parameters like current, voltage, power, frequency etc. are derived from each of these energy meters by means of RS 485 connections.

The collection meter readings are controlled by Internet enabled embedded devices which are in constant communication with the meters. The data that is collected from the meters is periodically updated into a server. This server provides the web services that make up the web of thing on top of these embedded system devices. The services provided by the server include display of meter information, location of the homes connected through smart grid, scheduling of the power sources for each individual home and remote control over the energy sources by switching the source controllers by means of the embedded devices. A user only needs a username and password to gain access to these services from any computer connected to the Internet. The controlling of the energy sources for each home is done by the help of source changers. These source changers are controlled by embedded devices. The embedded devices wait for the instruction from the server which is furthermore instructed by the authenticated user to switch the energy sources.

IV.OBJECTIVE OF PROPOSED DESIGN

The purpose of this paper is to promote smart grid architecture which actually maximise the use of renewable energy sources. Different methods of smart grid architecture have been reviewed in this paper. The choice of asmart grid architecture method in any study should be based on the particular demands of the application and also availability of energy sources. The renewable energy sources used in the smart grid are location climate dependant. The deciding factor in choosing renewable energy sources can be based on ease of availability of renewable energy source. The main goal of Web of Things based smart grid is control and monitor renewable energy sources is to operate all the appliances available in the home on renewable energy source. If it is not possible or enough power of renewable energy source is not available then all loads are switched on main energy source 230VAC. The switching of energy source is done automatically or manually through authenticated user. Also scheduling of energy sources, display of meter information etc. are some services provided to the authenticated user.

A GUI (Graphical User Interface) is provided to the user of the services through any web browser on any computer connected to the Internet. The user is authenticated as a bona fide user after he registers himself for a connection. This can be done by applying for a new connection on the login screen. The necessary documents a verified and after proper verification an installation is carried out by professional to include the home in the smart grid. The status of his application processing can be tracked by the user on the login screen. After the application has been processed, the user can print the application details on this page. The user after logging in enters an index page which gives him a couple of options. One of these options is to check for the average power consumption of a particular home. This helps the user to track his energy needs and accordingly plan the scheduling of his power sources. The user can track his consumption day-wise, month-wise or year-wise. The consumption data can be compared to consumption data of other times by means of graphical representation of compromise of average consumption data.

Based on the power consumption data, the user plans ahead how and when to use its energy sources using the web of things. The web services allow the user to configure the switching of energy sources according to a pre-planned schedule. The user can remotely configure this scheduling from any location at his ease. In case of emergency, the user has the privilege of reconfiguring the current energy source. Only one user is allowed to access at a time. This configuration has direct connection to the embedded boards through Internet. The control embedded boards change the source by controlling the source changers which are connected to the grid power supplies of individual homes. While remote configuring the sources the user can view all the parameters of each power source alongside which aids decision making.

V.CONCLUSION

The smart grid architecture is a good way to improve energy saving techniques by using the renewable energy sources which would otherwise have been underutilized. The integration of Web of Things power grid architecture will provide us numerous opportunities for improvement in our energy saving techniques. As most of the services are provided through the Web of Things, the procedure of operation can be remotely reconfigured depending on needs and user feedbacks. The Web of Services can be reconfigured from time to time when we need arise, which is the promising direction for further development. The smart grid also adds intelligence and bidirectional communication and energy flows to today's power grid in order to address the efficiency, stability and flexibility issues that plague the grid.

REFERENCES

[1] SaswatMohanty, Bikash Narayan Panda, Bhawnani Shankar Pattnaik, "Implementation of a Web of Things based Smart Grid to remotely monitorand control Renewable Energy Sources.", 2014 IEEE Students' Conference on Electrical, Electronics and Computer Science

[2] Andreas Kamilaris, YiannisTofis, ChakibBekara, Andreas Pitsillides and Elias Kyriakides "Integrating Web-Enabled Energy Aware Smart Homesto the Smart Grid", Department of Computer Science, Networks Research Laboratory, University of Cyprus, International Journal on Advances in Intelligent Systems, Vol. 5 no 1&2, year 2012.

[3] Mahesh Hiremth, Prof: Manoranjan Kumar, "INTERNET OF THINGS FOR ENERGY MANAGEMENT IN THE HOME POWER SUPPLY", International Journal of Research In Science and Engineering e-ISSN: 2394-8299 Volume: 1 Special Issue: 2 p-ISSN: 2394-8280

[4] 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

[5] N Bui, A.P Castellani, P. Casrani and M. Zorzi, "The internet of energy: a web-enabled smart grid

system," Network, IEEE,vol.26,no.4,pp.29,45,July-August2012

[6] Dominique Guinard, ValdTrifa and Erik Wilde, "A Resource Oriented Architecture for the Web of Things", Proc. Of IoT 2010 (IEEE International Conference on the Internet of Things), Tokyo, Japan Nov. 29 2010-Dec. 1 2010, ISBN:9781-4244-7413-4

[7] Nicola Bui, Angelo P., Michele Zorzi, "The Internet of Energy: A Web Enabled Smart Grid System", 0890-8044/12 2010 IEEE

[8] Dominique Guinard and Vlad Trufa, "Towardsthe Web of Things: Web Mashups for Embedded Devices", Proceedings of the International World Wide Web Conferences. Madrid, Spain.

[9] Dominique Guinard, ValdTrifa, FriedemannMattern, Erik Wilde "From the Internet of Things to the Web of Things: Resource Oriented Architecture and Best Practices", Institute for Pervasive Computing, ETH Zurich SAP Research, Zurich School of Information, UC Berkeley.

[10] Devika S., Rajesh Sola, Ananda Saravanan "Prototype of IoT Implementation Based on LwIP Stack Protocol & SWE Standard",International Journal of Engineering Development and Research 2015 IJEDR Volume 3, Issue 1 ISSN: 2321-9939

[11] Se Won OH, Hyeon Soo KIM, "Study on Access Permission Control for the Web of Things", Department of Computer Science and Engineering, CNU (Chungnum National University), Yuseong, Daejeon, 305-764, Korea ETRI (Electronics and Telecommunications Research Institute), Yuseong, Daejeon, 305-700, Korea, ICACT Transactions on Advanced communications Techonology (TACT) Vol. 4, Issue 1, January 2015

[12] Se Won OH, Hyeon Soo KIM, "Decentralized Access Permission Control Using Resource Oriented Architecture for the Web of Things", Department of Computer Science and Engineering, CNU (Chungnam National University), Yuseong, Daejeon, 305-764, Korea ETRI (Electronics and Telecommunications Reseach Institute), Yuseong, Daejeon, 305-700, Korea, ISBN 978-89-968650-3-2 February 16~19, 2014 ICACT2014