NETWORKING IN THE PHASE OF AN ENERGY-EFFICIENT METERING SYSTEM

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Abstract: Electrical Energy is the soul of resources. Energy is the backbone for an economic growth of a developing nation. This paper is the contribution for efficient use of energy in residential and commercial buildings at reliable and cost effective way. Arduino UNO controller helps in monitoring the energy from electronics sensing unit comprising of current and voltage sensors. It calculates the instantaneous power consumption, maximum power, and kilowatt-hours consumption. These data have been viewed through various interpretations in the cloud storage via IoT technology. The fault detection, error handling are additional features with an intimation of actions to the user. Additionally, the paper focuses on the renewable energy wealth of the country and utilizes it in this concept by providing connectivity to the home unit. When a case of low voltage occurs, the solar panel gets into the action.

Index Terms **- Arduino UNO, Solar PV panel, IoT and Efficient use of energy**

I. INTRODUCTION

Energy is the magnitude to enhance economic development. The industrialization with the economic development is all concern with power generation and consumption of energy. Energy is the value of Electricity, which indirectly talks about the cost of its process. The standard of living of citizens of any country depends on GDP (Gross Domestic Product) and other factors which are inclusive factors of GDP like per capita energy consumption etcetera. India with around 20% of world population consumes hardly 1% of total exergy consumption. The energy saving which is reducing the loss of energy to refer it as enhancement of energy efficiency is the solution dealing with the above challenge in this paper. Thus, monitoring of energy and targeting it to distinguish the immoderate energy use, instantaneous calculation of consumption and detail record of it for future work for planning the energy management. The grand design of our developing nation to developed stage includes various strategies, in which the paper helps in serving the vision that includes,

1. Deployment of renewable energy system

2. Investment in cost-effective energy efficiency standards with cutting edge technology.

Saudi Arabia of renewable resources is the recognition given to India. The proper utilization leads to the realization of India's complete power in energy. Conservation and alternative energy imbue this paper to do a comprehensive analysis of efficacy and cost control, based on IoT technology in this underpinning concept. The bleeding edge IoT technology is spreading its wings to leverage it as a leading technology which streamlines all kind of sectors. IoT is a set of technologies with integrated business enabling the interaction of the smart devices to optimize the collected data. The IoT demystify the resilience and utilization of asset by creating the opportunity to do an evaluation of this source of data. This paper focuses on designing the devices that have built-in capability to measure and report the energy use or receive control input over the network.

II. RELATED STUDIES

Innovation in energy conservation follows the arc of technology which has been leading to various studies in this sector. Chuyuan Wei and Yongzhen Li [1] combined the information technology and intelligent technology in perspective IoT technology to do monitoring and management of energy consumption in Building sectors. The paper is a comprehensive analysis of energy saving buildings. Hao Luan and Jianwei Leng [2] innovated a B/S (Browser and Server structure) secluded energy monitoring system, an IoT-based enterprise energy monitoring unit comprehend management scientifically using sensing units and the internet. Jinsoo Han et al. [3] analyzed HEMS (Home Energy Management System) then considered their work of

combining HEMS with PLC (Power Line Communication) that had been focusing the energy consumption cost and generation cost. HEMS implied on Zigbee and PLC based Renewable Energy Gateway (REG). Edoardo Patti and Andrea Acquaviva [4] visioned IoT drive smart city. They experiment the challenges like interoperability of heterogeneous equipment and application of integrated new standards through the IoT-based smart metering platform called DIMMER and FLEXMETER to succeed energy optimization at large scale. Ibrahim Mashal, Osama Alsaryrah, and Tein-Yaw Chung [5] formulated IoT Service Recommendation (IoTSRS) with hyper-graph-based recommendation algorithm it allowed the third party to provide services.

Damminda Alahakoon and Xinghuo Yu [6] surveyed smart energy concept. The paper examined the smart meter analytics with its existing process and revamped the procedure with latest advancements to succeed in the smart meter, smart grid, and smart energy which were all knotted to each other. Rohit Bhilare and Shital Mali [7] put forth the automation at home with the web of things. It was a straightforward approach to enhance the combination of embedded technology and IoT that achieved energy saving, comfort, and efficiency at the remote mode of work. Abd Elwahab Boualouache et al. [8] explained the IoT architecture phases known as the collection, transmission, and optimization. It focuses on the collection phase which operates to sense and collects data from physical devices. They prototyped Bluetooth Low Energy (BLE) based data collector system to forward the data to data gateways. Smartphone acts collector and the prototype functioned against challenges like heterogeneity, communication technology, and scalability with Arduino (Bluno) and Android. Asif Mohammad, Jurgen Stader, and Dirk Westhoff [9] explored a privacy-friendly cloud-based smart metering storage to foresee a privacy enhanced and space-efficient storage to access terabytes of tuned power consumptions. It demonstrated few - instance storage with SQL queries on them featured two axes to apply filter rules and storage efficient handling. Carmine Landi, Pietro Merola, and Giacomo Ianniello [10] served as a base for the improved energy-saving technology to implement in different buildings. It deciphers a technology which controls entire unit of consumption and cost reduction for the regulation of power flow, gas, and hot water through a domestic intelligent meter. Suman Deb, Pankaj Kumar Bhowmik, and Arik Paul [11] explicated a current-based technique in the smart energy meter in which test signal compared with the reference signal to unlock theft at the demand side.

The structure comprised of a smart meter, communication infrastructure, and control devices. Laila Salman et al. [12] showcased model kitchen via Multi physics simulation to leverage a complete automated smart home. Smarty city application fuels the urbanization and massive development. Salam Ismail Rasheed Khanji, Asad Masood Khattak, and Omar Alfandi [13] scrutinized Abu Dhabi 2030 vision of smart home application for demand side management. The paper surveyed the scenario of advanced metering infrastructure and initiated a Smartphone application at the client side as closed control system aided with the infrastructure of the smart meter. Basri Kul, Mehmet Sen, and Kubra Kas [14] saved the energy through smart measurement, and control systems with the support of ethernet cable under Wireless Local Area Network (WLAN). Kun-Lin Tsai, Fang-Yie Leu, and Ilsun You [15] simplified the conception of remote energy control by mean of the wireless smart socket with IoT technology. The paper implemented four control nodes as peak time control, energy-limit control, automatic control, and user control. It invoked neural network algorithm for automation.

Rahman et al. [16] innovated Smart Energy Meter with Arduino control supported GSM (global system for mobile communication) for an instinctive, best metering and billing system. Rodrigo j. Carbajales et al. [17] exploited an open IoT node infrastructure, and it resulted in an open IoT node infrastructure to promote flexibility to the users in term of privacy and cost. Long Cheng et al. [18] structured a web platform in term of B/S mode systemised with application layer with configuration and modification of sensing layer resulted in a software design in IoT. Sahana M N et al. [19] visualized the bleeding edge tech of smart energy at India and unleashed it's power to achieve the goal. An open platform based on IEEE standard approach alike 6LWPAN, RPL, CoAP. It included IPv6 connectivity to PV panel subscription and CC2538 WIFI module to interface energy meter. Luis M.L. Oliveira et al. [20] distinguished the wireless sensor networks and protocol IEEE 802.15.4 and deployed a power energy monitoring and actuating system for a home environment bursting the issue for achieving heterogeneity interoperable by 6LoWPAN connectivity. Subramanian et.al [21] A Novel TANAN's Algorithm to solve Economic Power Dispatch with Generator Constraints and Transmission Losses. Sivagnanam et.al [22] proposed Reactive Power Compensation in Power Transmission

Network using FACTS devices. Chandragupta Mauryan [23] explained Phasor Measurement Units in Power System Networks.

3. PROPOSED SYSTEM

Energy consumption patterns are the key to identify the odds of energy savings. By understanding the issues and challenges of a connected world, internet of things (IoT) is considered to be one of best proposed method used to enhance the energy monitoring in an effective way. IoT also referred as connected devices will bridge the gap between physical and digital world. IoT platform allows interplay of various devices for real time data collection from different sensors to provide actual information, to enable data exchanges with storage access. Decision making using internet of things (IoT) is the main focus target, which help consumers to monitor their own usage and adjust behaviors according to their needs. The main objective of this proposed method is to reduce power consumption or wastage of power, to make energy monitoring easy with intelligent and automated real time data monitoring decision at the consumer end.

The figure 1 describes the block diagram of the proposed system. The electric power consumed by each devices are able to be measured by power meters during time periods, further will also able to send data via Ethernet to web server. The voltage and current sensors are used to measure the power consumed by the equipment, given to the controller having interconnection with WiFi module. Arduino Uno based on ATmega328 is used with WiFi module ESP8266. To maximize performance and parallelism Uno provide all support needed for microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. The reference versions of Arduino will be Uno and version 1.0, moving forward. The Uno is the latest in a series of USB Arduino boards.

The load is energized with the aid of an input A.C power source. A relay DPST (double pole single throw) is placed across the transmission line, which is normally closed when a supply is given at the input side. Voltage and current sensors are used to measure the voltage and current flowing toward the load and given as a feedback to a controller (Arduino Uno ATmega328). The data's are accumulated and step inside the controller, fetch the information to the cloud via WiFi module ESP8266, a low power consumption device. Simultaneously, the data's are made to interface with the inverter and relay device to control uninterrupted power flow to the load or consumer side.

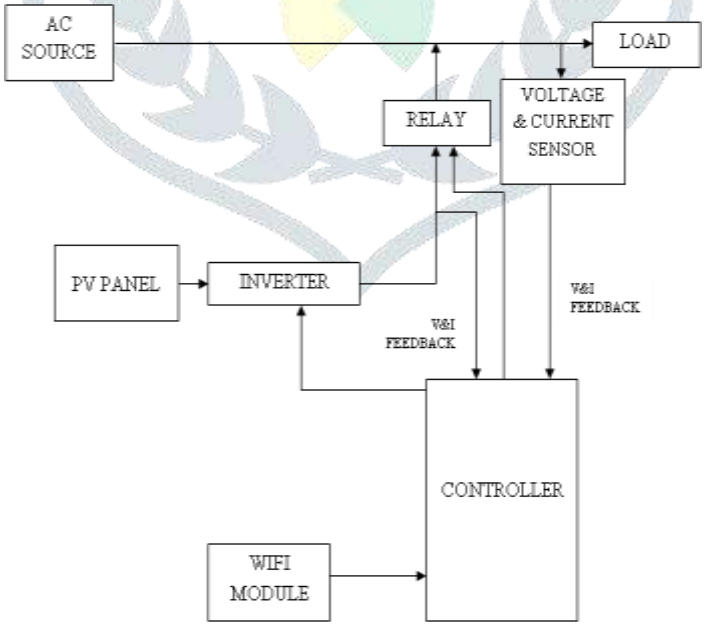

Figure 1. Energy monitoring block diagram

Whenever the power flow is interrupted or a low voltage is detected on the line by the sensors, the controller sends a signal to the relay switch to make it open and also to inverter, signaling to deliver energy at the consumer end with the help of PV panel and closing of relay switch. In order to yield continuous energy monitoring, an external PV panel with inverter is used to boost up the line voltage with uninterrupted supply

in the circuit. Herewith, materials are communicated with devices and energy is tracked to meet the demand and to put the brakes on the high electricity bills.

4. RESULT ANALYSIS

The efficient usage of energy is a national concern and a growing concern for enhancing the environmental quality and national security. The prototype calculates the unabating power which has stored in the private cloud. The data get updated for every 15 seconds in term of free cost. For practical use, business approach cloud can be used to update less than 15 seconds. The cost-based energy efficient technology provides services to the modern life satisfying the demand. The figure 2 shows a prototype model of our proposed system.

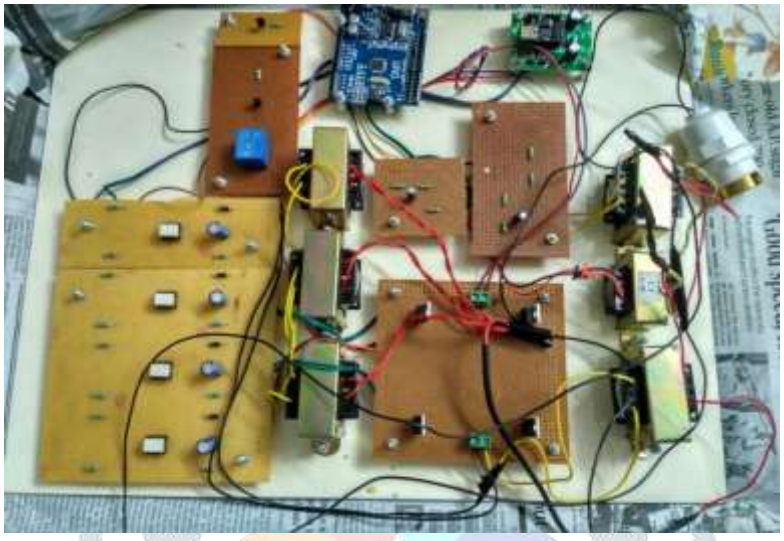

Figure 2. Prototype Model

The figure 3 shows the supply voltage to the load has been continuously recorded via the controller. The data get loaded to the cloud through WiFi and intimates it to both ends (supplier and consumer). The figure 4 describes power consumed by 2 watts Led bulb has graphed. The update time, channels are features of the information. In this way, conventional metering infrastructure shall be leverage to reach advanced metering infrastructure.

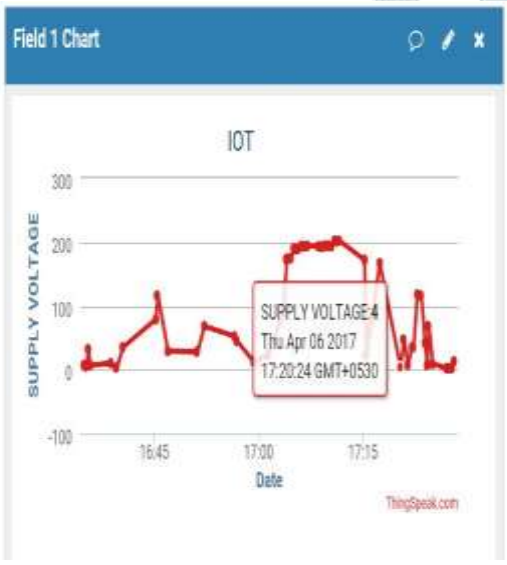

Figure 3. Supply Voltage to load

Figure 4. Power consumed by Load

5. Conclusion

The logic behind the lack of interest in using the superior edge of cost-effective and energy efficiency usage models are complicated. The factors impeding the efficiency technology are limiting the vision to cost saving rather than fuel economy, small investments have given less priority. The analysis process is workable in these technologies. Fist investment is given focus than life-cycle savings hence such kinds of barriers speed break the adoption of techniques. The paper aims at the scope of networking the monitoring of individual homes promote the renewable energy awareness at cost-effective breakthrough to enhance the development by facilitating data to the government and users. Considerable time and effort are needed to retrofit the long-lived procedures.

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