Internet of Things for Energy Management in the Home Power Supply

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Abstract: **This paper describes the architecture of an Energy management in the power system of the home using Internet of things. The goal of the Energy management using Internet of Things (IoT) is to provide the reliable power supplies to the consumers by making maximum use of renewable energy sources. The embedded device with GPRS facility connected to the smart meter receive data from current sensors and stores it in cloud and device will switch any of the two power supplies automatically according to power consumption of load, later Embedded device by communicating with Internet real time information about power consumption and controlling access can be given to the authorized person. Authenticated user has the capability` to set threshold voltage for power consumption, connecting and disconnecting of the supply and various loads. Internet of Things (IoT) refers to the network of internet-enabled physical objects which can communicate other internet-enabled devices and systems. So this energy management technology that makes it possible to data acquisition and control the action.**

Keywords---Internet of Things; Energy management; Renewable energy source; Current Sensors; Cloud storage.

I.INTRODUCTION

The future of energy in the world today is focusing more and more on alternative energy sources to remove the strain 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 dependent. And Internet of Things (IoT) [1] explains about the Things having same identities and relevant virtual personalities operating in smart spaces using intelligent interfaces to connect and communicate within environmental, social and user contexts.

Although power grid supplies to our homes will remains 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 consumption for the end users also if renewable energy source generates more than the actual power consumption, extra power generated can be redirect to the power grid house or can be stored in the power storages. [2]

We focus here on the enabling aspects of cooperation between the real world such as the Internet of Things and its interactions in the smart house. This paper is organized in different sections. Section II gives brief description about of System Architecture with Internet of Things. In section III author discuss about the implementation of hardware components used in Energy supply management, like sensors, controller, GPRS module and for data acquisition and Internet connectivity for communication within modules. In section IV web service analysis will be done like user authentication, power usage of different power supplies.

II.SYSTEM ARCHITECTURE

In this architecture author describes the use of two different Energy sources. First one is the main power supply from grid and the other one is environment friendly Renewable energy supply and by making use of this renewable energy source provides the reliable power supplies to the consumers.

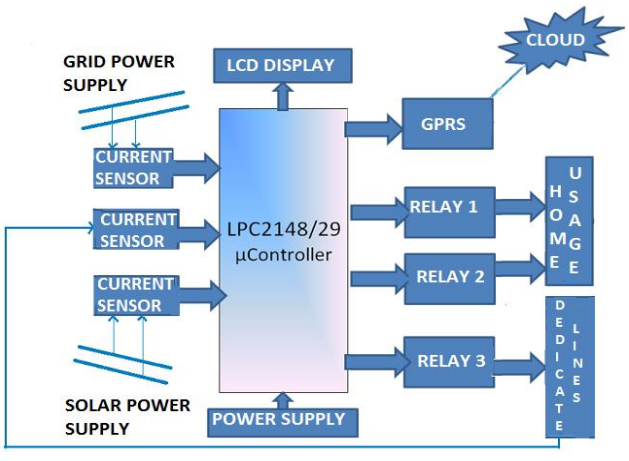

Fig1: Block diagram Energy management system

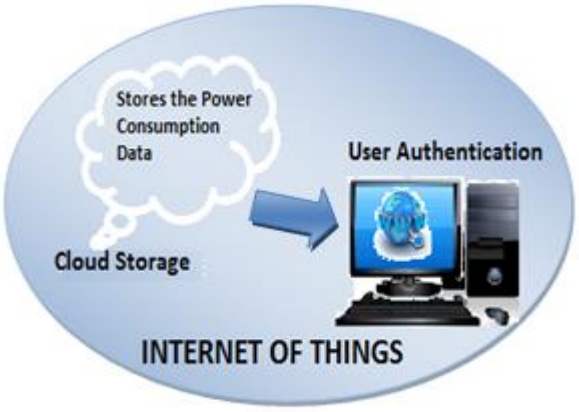

Fig2: Internet of Thing that controls Energy management

But embedded system architecture will switch between the two power sources automatically according to the consumption by monitoring the power consumption by different loads

Several geographically distributed power generators need to be integrated into the smart grid, recognizing the varying capacities, characteristics and technologies associated with generators. Electricity generated using renewable energy sources, such as photovoltaic (PV) solar panels and wind turbines, is variable depending upon the season, weather conditions and the period of any given day. This variability has a strong influence on the delivery of reliable power to consumers. Storage of electrical energy to dampen the effects of variability in the power from renewable is therefore an important aspect of the smart grid. Various types of energy storage: pumped hydro storage, batteries, fuel cells, flywheels etc. need to be integrated into a smart grid. Such distributed energy storages in the grid may serve different networks within the grid so that they continue to operate as self-powered islands during outages resulting from natural causes or system faults [5].

Internet of Things (IoT) [1] explains about the Things having same identities and relevant virtual personalities operating in smart spaces using intelligent interfaces to connect and communicate within environmental, social and user contexts. Everywhere computing which was thought a difficult task has nowadays become a reality due to advancement in the relevant fields like Wireless communication, Automatic Identification, Distributed computation process and fast internet speed. General overview of internet evolution with many IoT services with the use of RFID tags, mobile phones, sensors, smart embedded devices, actuators, etc. which, through unique addressing schemes, are able to efficiently communicate and interact with one another and work together to make the system easier to operate and utilize. The objects that will be connected will be adaptive, intelligent, and responsive [1].

Using the WCS2702 Hall effect current sensors [7], current flow of the individual supply can be measured. This is extremely low resistance device can effectively reduce power loss, low operating temperature, increase reliability. Power supplies current flow connected this device generates magnetic field which is sensed by the WCS2702 Hall Effect current sensor converted into its proportional voltage.
This converted proportional voltage by sensor is in the analog form and it will be compared with the Reference voltage (Vref) of the Internet enabled Embedded device and converting it to the Digital data through the ADC channel of Embedded device.

The data collected will regularly update in the cloud by the NeowayM660 GPRS modem through Wi-Fi or 3G. Here 3G based Internet 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 he also has the facility to control the load switching and power source supply through the internet. GPRS module is monitoring continuously on power consumption of loads and periodically updating in the cloud and also receives the SMS warnings from Net Things system.

III. HARDWARE IMPLEMENTATION

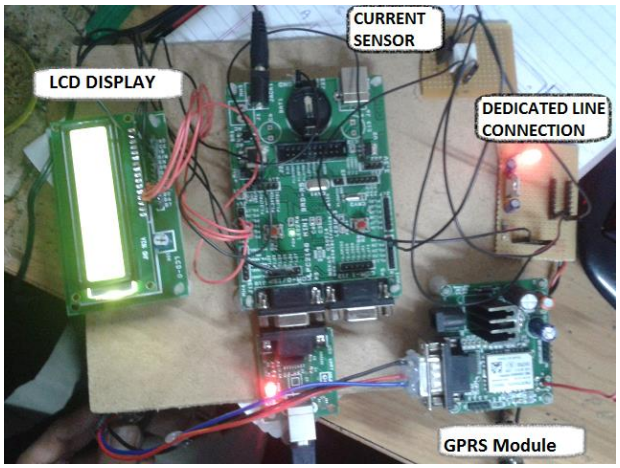

Fig3: ARM processor based Embedded device.

This section describes the Internet enabled Embedded system for data acquisition from current sensors and transmission of data to the GPRS module. LPC2148 microcontroller embedded system with ARM7TDMI-S 32bit processor[3], 2UARTs, 2 10bit ADC(ADC0 with 6 channels ADC1 with 8 channels) which is interfaced LCD display for displaying power consumption and a RS 232 serial communication cable for transmission of data.
Controller offers high performance and very low power consumption and provides high instruction throughput and impressive real-time interrupt response from a small and cost-effective processor core.

A. Data Acquisition

For data acquisition WCS2702 Hall Effect current sensors are connected to both renewable and non-renewable power supplies which will measure the current flow of the individual supply.

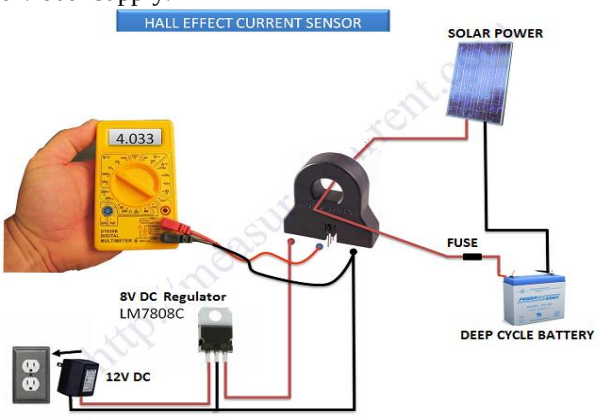

Fig4: Measure of AC/DC current from the Hall effect current sensor.

This is extremely low resistance can effectively reduce power loss, operating temperature increase reliability. Power supplies current flow connected to this device generates magnetic field results in asymmetric distribution of charge density across Hall element which is sensed by the WCS2702 Hall Effect current sensor and transverse into its proportional voltage. The Hall Effect sensor leads electrically isolates the conductive path terminal this will help in avoiding the use of isolating techniques which reduces the cost of the system.

This sensor voltage is compared with the Reference voltage of the embedded system and which is given to the ADC channels of the Microcontroller which will convert this analog voltage data into digital and displayed in LCD display and also transmit to the GPRS module through RS 232 serial communication cable connected UART port.

B. Data Storage in Cloud

Here NeowayM660 GPRS wireless module[4] with high quality voice, SMS, data service which has wide industrial applications which is used to support the TCP/IP protocol to connect with internet.
The GPRS module with 3G data service facilitated SIM card for network communication transmits converted digital voltage data into the cloud through the RS232 serial communication cable connected UART of Controller. This data will collect the data from controller and stored into the cloud by Cellular communication GPRS module.

C. Dedicated Lines

Once power is generated by solar supply and if generated power is more than the power consumption by the load generated power will supplied to the dedicated which further can be stored in the power storages (batteries) or it can be redirect to power generating grid. This makes all possible effective usage of the renewable energy resources.

Software Development.

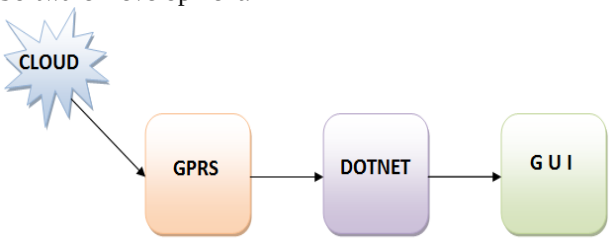

Fig5: Software development model

For user access a GUI (Graphical User Interface) is provided by using any web browser through Internet connected computer Authenticated user can login and analyze average power consumption data. 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. 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 comparison 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 allows the user to control the power source switching remotely by just logging in from anywhere with ease.

But 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. This scenario fits when a community of people is driving their own grid. As each are consumer as well as in maintenance.

IV. LIMITATIONS AND CONSTRAINTS

As we are using low power consumption devices and its difficult implement for the large scale applications like industries. Use of Relays makes it difficult to maintain

system as power supplies switches among them continuously and it needs high and constant DC supply. But it can overcome by using high power sustainable DC regulators and high DC power supplies for continuous back-up the relays.

V. CONCLUSION

In one sentence we can say it is simple install and easily scalable, that is system implementation is very easy and low power consuming and cost effective. This technique makes the effective use of renewable energy resources. Internet of Things (IoT) refers to the network of internet-enabled physical objects which can communicate other internet-enabled devices and systems. So this energy management technology that makes it possible to data acquisition and control the action.

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