IOT Based Power Converter For Monitoring System In Smart Grid Application

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Abstract- *In India, plug load devices in building sectors are consuming close to 40 percent of the total electricity consumption. Though the share of plug load in building energy is increasing, very few studies exist on the plug level energy usage a consumption. In order to address the growing energy use of miscellaneous electronic load some measures need to be taken. Hence identifying needs, this project focus song the devices that have built-in capability to measure and report the energy use or receive control input over the network. This project will help in creating energy awareness devices. Current sensor measures the current flowing through device then controller performs necessary calculations on the data and puts that data on the internet. By measuring current and voltage, we can analyze energy consumption, make the world smarter place and make better decisions using IOT. Based on this data, the consumer and electric power companies in the SG paradigm can better manage their consumption to reduce billing costs.*

Keywords- Smart homes, Power monitoring, IoT aided SG, Thing Speak.

I. INTRODUCTION

The Smart Grid "market" has many moving parts. There are hundreds of vendors, large and small, providing software, hardware and solutions at every layer of the market, from the physical power infrastructure layer to the communications layer, up to the applications and services layer. Power providers are planning and implementing varying systems architectures. Government policies are shaping the landscape at state and central government levels. Investments, private and public are driving innovation ata scale large enough to match that of the problem itself. Consumer adoption for a new wave of energy services is unknown[1]. Definitions as seemingly simple as what a Smart Grid is or should be are inconsistent and often debated. In a nutshell, it's overwhelming and often confusing. The major products of Smart Grid are Solar and Wind Power plants in Generation segment, Flexible AC Transmission Systems (FACTS), High Voltage DC (HVDC) Transmission, Wide Area Measurement Systems (WAMs) in Transmission segment and Smart meters with associated communication infrastructure in Distribution segment [2]. In Indian perspective, the Smart Grid requirements may specifically related to the Distribution Management System (DMS) with smart meters interfaced with IT & Communication system.

II. IOT NETWORK

Collars, are the main data gathering interface, collecting data from sensors, being as well responsible for the supervision of behavior and location [3]. As these devices own processing abilities and because it is not suitable to wait for a decision to be handled and transmitted by a central node with more processing power [4].

Due to the delay associated, the posture control algorithm runs locally, analyzing and applying corrective stimuli (e.g. electrostatic and auditory cues). Thereafter, the relevant data for the user is transmitted to an infrastructural network composed by fixed beacons. These devices are installed accordingly to the intended grazing areas implement a periodical and synchronized beaconing signal emission all over the network that allow collars to evaluate their location through the use of RSSI – based localization techniques, and the network to trace back animal location [5].

To maintain the power consumption as low as possible, the system follows a Time Division Multiple Access mechanism [6]. The Gateway works as an aggregator element, interconnecting the local network to the Internet. It implements a beacon that communicates with the remaining beacons,and connects the local network to the Internet through a wide band connection [7]. Moreover, the Gateway acts as a local network manager, coordinating local nodes, aggregating sensory information and implementing a local alarm generator for critical situations (e.g. fence violation, panic detection).

III. THE SMART GRID

Smart grid development tends to be driven by one of two principal visions for enhancing electric power interactions for both utilities and their customers: the European Union and U.S. models. The European Union vision seems to be driven primarily by environmental concerns, whereas U.S. planning for the smart grid has been motivated primarily by a desire for reliability improvements. In the United States, desirable characteristics of the smart grid include self-healing transmission and distribution power architectures that will be resistant to intentional attacks and natural disasters and very high power quality levels along a broad range of metrics that go well beyond outage statistics [8]. One of the key goals of model smart grids, such as the one being developed by the Pecan Street Project in Austin, Texas, is to promote active customer participation and decision making and thus to create a new grid operational environment in which both utilities and electricity users influence each other (Fig. 3.1)

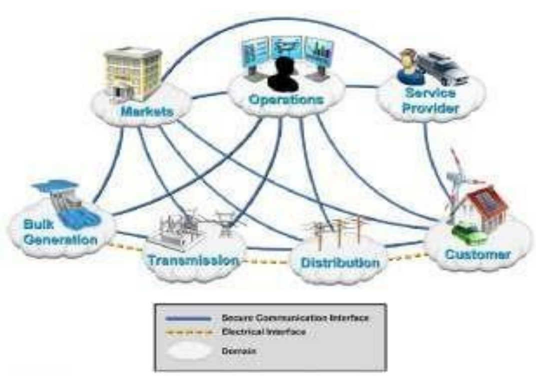

Fig. 3.1 Smart grid conceptual model.

IV. ENERGY METER

Energy meter is an instrument which measures amount of electrical energy used by the consumers. Utilities install these instruments at every place like homes, industries, organizations to charge the electricity consumption by loads such as lights, fans and other appliances. When energy savings during certain periods are desired, some meters may measure demand, the maximum use of power in some interval. “Time of day” metering allows electric rates to be changed during a day, to record usage during peak high - cost periods and off-peak, lower-cost, periods. Also, in some areas meters have relays for demand response load shedding during peak load periods [9]. Most interesting type are used a prepaid electricity meters. Types of energy meter are given below with explanation. (Fig.4.1)

Fig. 4.1 Energy Meter

Basic unit of power is watts. One thousand watts is one kilowatt. If we use one kilowatt in one hour, it is considered as one unit of energy consumed. These meters measure the instantaneous voltage and currents, calculate its product and gives instantaneous power. This power is integrated a period which gives the energy utilized over that time period.

V. VOLTAGE SENSOR

This sensor is used to monitor, calculate and determine the voltage supply. This sensor can determine the AC or DC voltage level. The input of this sensor can be the voltage whereas the output is the switches, analog voltage signal, a current signal, an audible signal, etc. Some sensors provide sine waveforms or pulse waveforms like output & others can generate outputs like AM (Amplitude Modulation), PWM (Pulse Width Modulation) or FM (Frequency Modulation). The measurement of these sensors can depend on the voltage divider (Fig. 5.1).

Fig. 5.1voltage-sensor.

VI. CURRENT SENSOR

Current flowing through a conductor causes a voltage drop. The relation between current and voltage is given by Ohm’s law. In electronic devices, an increase in the amount of current above its requirement leads to overload and can damage the device. Measurement of current is necessary for the proper working of devices [10]. Measurement of voltage is Passive task and it can be done without affecting the system. Whereas measurement of current is an Intrusive task which cannot be detected directly as voltage (Fig. 6.1).

Fig. 6.1 Current Sensor

VII. FULL WAVE RECTIFIER

The circuits which convert alternating current (AC) into direct current (DC) are known as rectifiers [11]. If such rectifiers rectify both the positive and negative half cycles of an input alternating waveform, the rectifiers are referred as full wave rectifiers. A full wave rectifier converts both halves of each cycle of an alternating wave (AC signal) into pulsating DC signal (Fig 7.3). We can further classify full wave rectifiers into

1. Center – tapped Full Wave Rectifier (Fig. 7.1)
2. Full Wave Bridge Rectifier (Fig. 7.2)

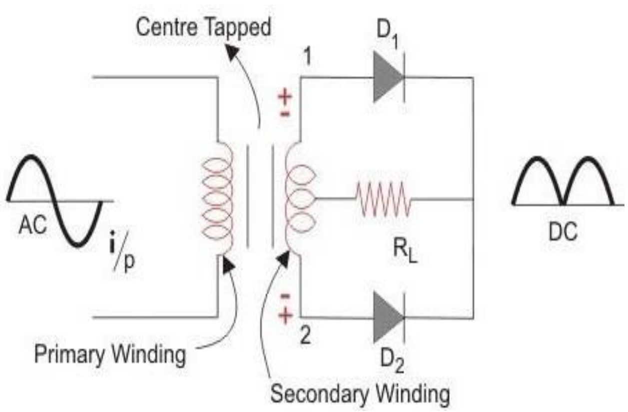

Fig. 7.1 Centre tapped full wave Rectifier

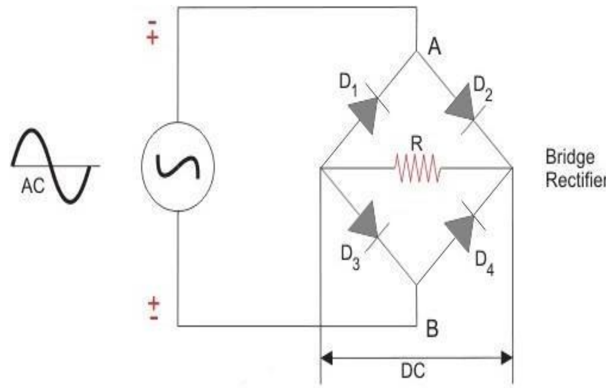

Fig. 7.2Bridge wave Rectifier

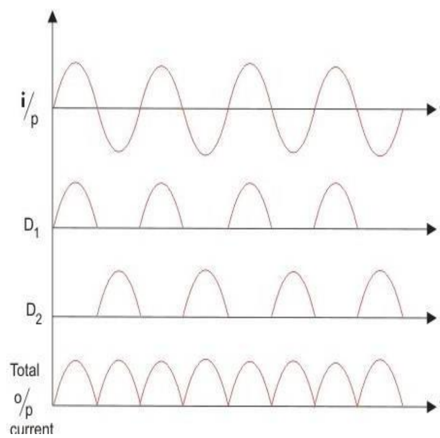

Fig. 7.3Output Waveforms

VIII. VOLTAGE REGULATION

Voltage regulators produce fixed DC output voltage from variable DC (a small amount of AC on it). Fixed output is obtained by connecting the voltage regulator at the output of the filtered DC [12].

A. 16x2 LCD MODULE

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits [13]. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special& even custom characters (unlike in seven segments), animations and so on (Fig 8.1).

Fig. 8.1 LCD Display

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc.

The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. Click to learn more about internal structure of an LCD.

XI. ARDUINO

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has14 digital input / output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a 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. Revision of the board has the following new features:

PINOUT**:** added SDA and SCL pins that are near to the AREF pin and two other new pins placed near to the RESET pin, the IOREF that allow the shields to adapt to the voltage provided from the board. In future, shields will be compatible with both the board that uses the AVR, which operates with 5V and with the Arduino Due that operates with 3.3V [14]. The second one is a not connected pin, that is reserved for future purposes.
Stronger RESETcircuit.
At mega 16U2 replace the 8U2

"Uno" means one in Italian and is named to mark the upcoming release of Arduino. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform.

Fig. 9.1 Arduino Microcontroller

X. PCB DESINGING

Depend on printed circuit board manufacturer, there are numerous ways available for designing PCBs. This circuit board design can be manufactured as bulk using several machines in PCB fabrication industries including drilling, punching, plating and final fabrication processes that are performed through highly automated machines [15]. Laser drilling with CNC machines, automatic plating machines, strip etching machines, and use of optical inspection equipment, flying probe testers for electrical testing of printed circuit board process result in high - quality PCBs (with a greater production shield). For a reader to understand this concept at the basic level of printed circuit board design, the following step - by-step procedures of designing a PCB board at various levels will help and guide diligently (Fig. 10.1 & 10.2).

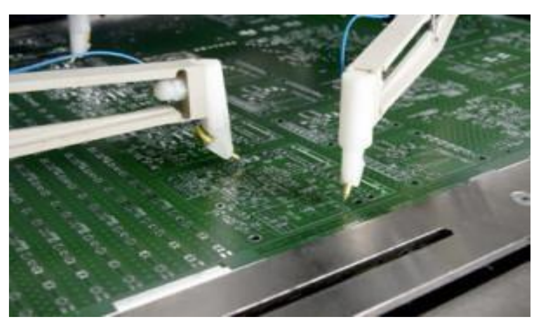

Fig. 10.1 Testing

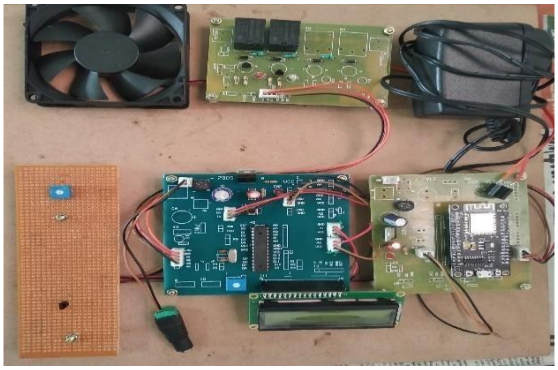

Fig. 10.2Hard ware Kit

XI. CONCLUSION

Energy Monitoring using IOT is an innovative application of internet of things developed to control home appliances remotely over the cloud from anywhere in the world [16]. In the proposed project current sensor is used to sense the current and display it on internet using IoT [17]. The system updates the information in every 1 to 2 seconds on the internet using public cloud THINGSPEAK.

In the present system, energy load consumption is accessed using Wi-Fi and it will help consumers to avoid unwanted use of electricity. IoT system where a user can monitor energy consumption and pay the bill Online can be made. Also, a system where a user can receive SMS, when he/she crosses threshold of electricity usage slab can be equipped. We can make a system which can send SMS to the concerned meter reading man of that area when theft is detected at consumer end. Also using cloud analytics we can predict future energy consumptions.

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