Design of IoT Based Real Time Energy Metering System

S. Sheeba Rani, K.C. Ramya, V. Gomathy, G. Radhakrishnan, S.R. Boselin Prabhu

Abstract— Now days, the usage of electrical appliances both in houses / offices becomes more inevitable one.Thus the usage of these electrical appliances leads to have unnecessary power consumption also. Hence in order to avoid this unnecessary power consumption, this work proposes a Smart Power Management System (SPMS). The system is designed using a wireless network topology. Thus the wireless network performs IoT process. It sends an energy consumption of the device to the webpage and it can be read using an id allotted to that device device. As a result of this, a consumer can easily manage their powerby knowing their time-time energy consumption and is carried out with the help Arduino controller. From the results, it is observed that the proposed design saves up to10% of energy.

Index Terms—Internet of things (IoT), Smart Power Management System (SPMS), Arduino controller

1. INTRODUCTION

Now a days**,** the electrical energy supplied by the power stations is utilized for numerous fields of applications such agriculture, industries/ household purposes etc., leads to have higher energy consumption on the consumer side. At the same time, due to reduction of fossil fuels, the energy supplied by the power station also gets reduced. Hence, it necessitates electrical energy saving. It can be carried out via many SPMS [1,3-5]. Among those, the vast development in IoT based system facilitates the concept of interconnection of devices via internet. Hence, the devices which are connected via IoT can be controlled/ analysed remotely [2,6]. Thus the IoT based technologies have created an opportunity to connect physical world with the computers. Hence it is gaining more importance and increasing swiftly all over the market [7,8].

The hardware devices are connected to the internet via a device called ESP 8266 Wi-Fi module.Landi et al 2011 introduced a real-time ARM-based EMS. It manages the total power plant. It collects a details of power consumptions consumed by the consumers using web server. Simultaneously, it also maintains the power quality.Garrab et al 2012 developed a Smart Meters for the Smart Grid system. It is designed using a MSP430FE423A controller and the Power Line Communication standards.

B. S. Koay et al 2012 introduced Bluetooth-enabled energy meter for PMS. Darshan Iyer et al proposed a PIC18F46k22 Microcontroller based energy meter using IoT concept. However, many topologies of SMPS discussed so far are higher in cost and bulky nature. Keeping this in view, the proposed topology introduced a new concept ofSPMS using IoT which is simple in structure and lower in cost. Thus the main aim of the topology is the power wastage reduction. Hence, to attain its objective, the system is designed in such a way to provide immediate automatic energy reading to the consumer. Correspondingly, apart from energy consumption, this device can also inform about the human hazard, billing status etc., via SMS. As a result of this, the user can controls their residence electrical loads over worldwide.

2. ORGANIZATION OF SPMS

A SPMS comprises alow-power MCU/ Energy Meter/ receiver and transmitter section and are shown in Fig.1.

2.1 ARDUINO UNO (ATMEGA 328):

The Arduino controller implemented in this system is based on AT mega 328P. It includes 14 I/O pins (digital) and 6 input pins (analog) and a crystal oscillator at 16 MHz frequency. Fig. 2 depicts the arduino board used in the project.

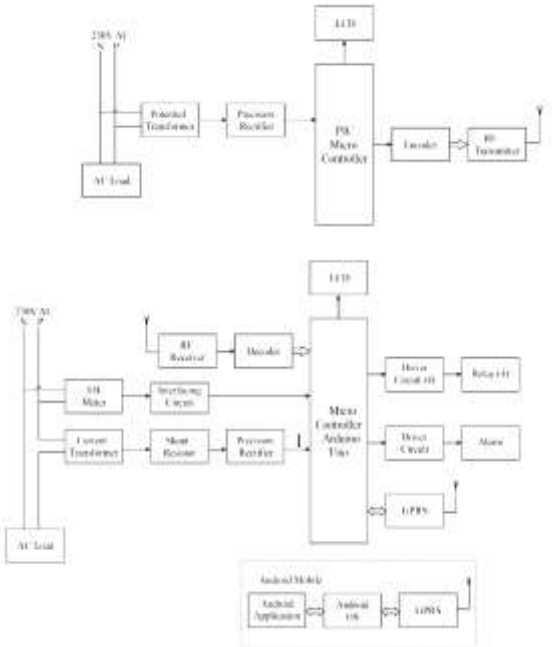

Fig.1: General Arrangement of proposed SMPS

Revised Version Manuscript Received on 12 April, 2019.

S. Sheeba Rani, Associate Professor, EEE Department, Sri Krishna College of Engineering and Technology, Coimbatore, India (E-mail: sheebaranis@skcet.sc.in)

K.C. Ramya, Associate Professor, EEE Department, Sri Krishna College of Engineering and Technology, Coimbatore, India (E-mail: ramyakc@skcet.ac.in)

V.Gomathy, Associate Professor, EEE Department, Sri Krishna College of Engineering and Technology, Coimbatore, India (E-mail: gomathyv@skcet.ac.in)

G.Radhakrishnan, Assistant Professor, EEE Department, Sri Krishna College of Engineering and Technology, Coimbatore, India (E-mail: radhakrishnang@skcet.ac.in)

S.R. Boselin Prabhu, Associate Professor, ECE Department, Surya Engineering College, Erode, India.(E-mail: eben4uever@gmail.com)

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

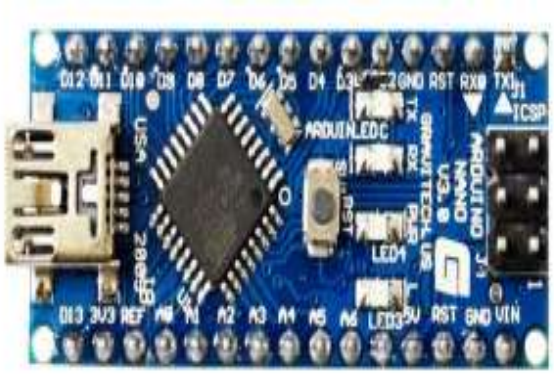

Fig.2: Arduino board

2.2 Wi-Fi MODULE (ESP8266):

It isthe heart of IoT. It has the operated upto 2.4GHz range. It comprises a 32 bit RISC CPU at 80 MHz. It works on the basis of TCP/IP protocol. It sends the energy meter reading to webpage and it can be call up using IP address.

Fig. 3: ESP 8266 module

3. RESULTS & DISCUSSIONS

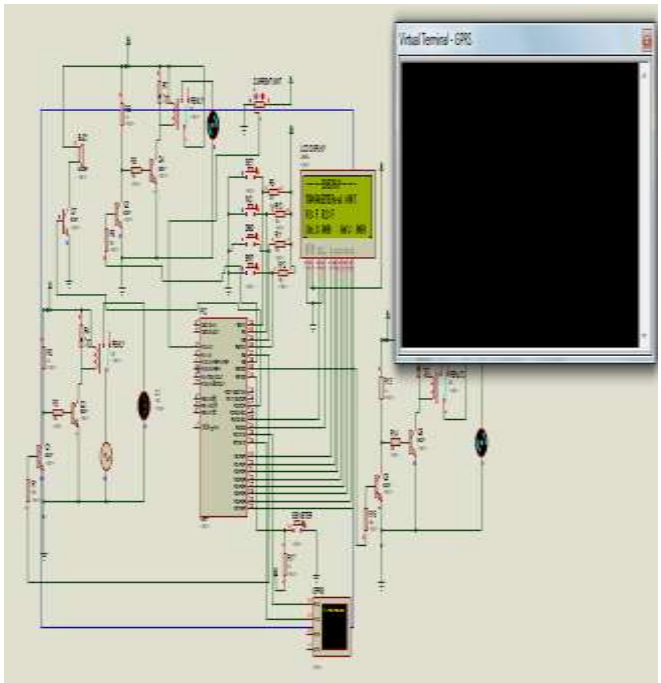

Fig .4 :Schematic Diagram

Fig.4 shows the schematic diagram of the proposed system. Thus the function of this system is mainly divided into two parts,

- ✓ Transmission Panel
- ✓ Receiver Panel

3.1 Transmission Panel:

Transmission section is fitted in customer's house. In this section the Energy Meter is interfaced with microcontroller. Now microcontroller performs the action of recording and storing energy meter reading in its memory location. Digital Energy Meter generates a pulse whenever a unit is consumed or energy is recorded in pulsating signal. This pulse is given to microcontroller. Then this analog data which is in form of electrical pulses is converted to digital output through ADC operation performed by controller itself. The generated digital output is then transmitted by using RF technique. To perform such operation controller needs required supply which is suitably provided through power supply unit. LED is used as indicator to check whether trans-receiver transfer is proper. Microcontroller is also connected to display unit which continuously shows energy reading.

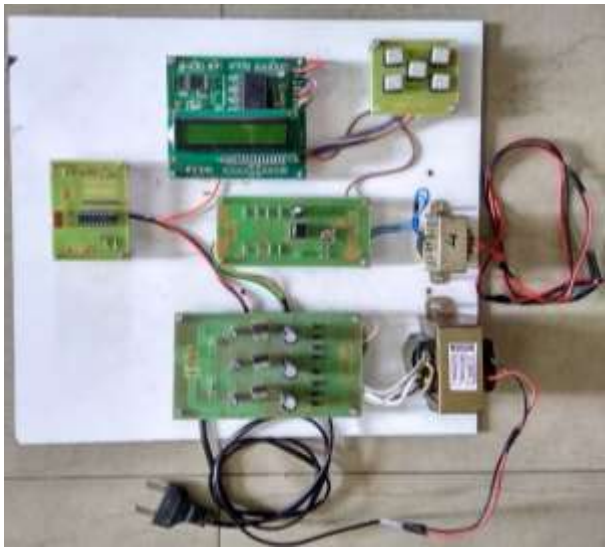

Fig .5 : Hardware Transmitter section

3.2. Receiver Panel:

Receiver section is mobile i.e. it can be taken wherever required. It's main purpose is to collect Energy Meter readings from all customers hence it is for electricity distribution utility. Basic architecture of receiver panel is similar to that of transmission panel. Receiver generates all ranges of frequencies to collect data from customer panels. After receiving readings, this digital data is again converted back to analog form by microcontroller application through DAC. Charge per unit of consumption is already programmed in receiver panel microcontroller. So energy bill is generated by same microcontroller by performing simple arithmetic operations.Finally, the Node MCU is implemented to interconnect internet along with the hardware unit. Hence the power consumed by a load is presented in the cloud. Thus it shows the time to time power consumed by the load connected with this designed system.

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

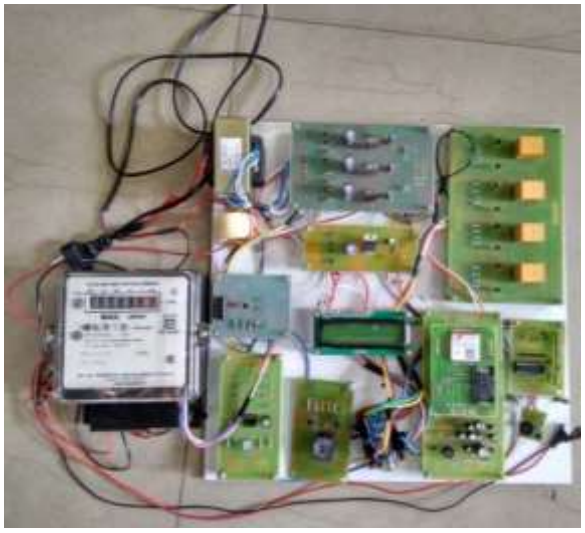

Fig .6 : Hardware Receiver section

4. CONCLUSION

SMPS using IoT is an innovative system which can able to control the electrical appliances using internet. In the proposed topology, the monitoring energy consumed by the load via Wi-Fi topology helps in reduction of unwanted usage of electricity. With the help of IoT system, the consumer can able to monitor energy consumed in their houses and can be able to ay the bill through Online. Simultaneously, the electrical hazards in the houses/offices can also intimated to the owner via SMS. Hence, from the performance of the proposed topology, it is predicted that it is a multi-objective device which can be able to save electricity from 3-10%.

REFERENCES

1. Myilsamy K., "Automated wireless reading system for controlling power consumption", The International Journal of Engineering andScience(IJES), April-2015, ISSN(e): 2319-1813 ISSN(p): 2319-1805.
2. S.Balakrishnan, S.Sheeba Rani, K.C.Ramya. (2019) "Design and Development of IoT Based Smart Aquaculture System in a Cloud Environment" in International Journal of Oceans and Oceanography, 13(1), 121-127.
3. V. Preethi, G. Harish, "Design and Implementation of Smart Energy Meter", IEEE Conference 26-27th August, 2016, Coimbatore.
4. Markus Weiss, Friedmann Mattern, Tobias Graml, ThortenStaake, Elgar Fleisch, "Handy feedback: Connecting Smart Meters with Mobile Phones", Proceeding MUM '09 Proceedings of the 8th International Conference on Mobile and Ubiquitous Multimedia Article no. 15, November 22-25 2009, Cambridge, UK.
5. Afrin Hossain, Tajrin Jahan Rumky, Nursadul Mamun, "Implementaion of Smart Energy Meter with two way communication using GSM Techinolgy", International Journal of Scientific & Engineering Research(IJSER), Volume 4, Issue 7, June 2013, ISSBN-2229-5518.
6. Karthick, Stalin, Prithvi Rajan, Lourdhu Shelton, AnithaThulasi, "IoT based Smart Energy Meter by using PLCC", International Journal of Advanced Reaearch in basic Engineering and Technology(IJARBEST), Volume 3, Special Issue 29, March 2017, ISSN-(Online0-2456-5717.
7. KaziAgharuddin, Mrinal KantiParla, SubhajitDevnath, ParitoshMalakr, Dipanjan Dutta, "Low Digital Cost Energy Meter With Energy100 Unit Alarming System", International Journal of Scientific & Engineering Research, Volume 7, Issue 4, April-2016, ISSN-2229-5518.
8. K.C.Ramya, K.Vinoth Kumar, S. Sheeba Rani, G.Radhakrishnan. (2018) "Design and Analysis of Fractional PID Controller for Isolated Bidirectional DC-DC Converter" in International Journal of Engineering and Technology, 7(14.9), 182-185.
9. Landi, C.; Dipt. di Ing. dell"Inf., Seconda Univ. di Napoli, Aversa, Italy ; Merola, P. ; Ianniello, G, "ARM-based energy management system using smart meter and Web server", IEEE Instrumentation and Measurement Technology Conference Binjiang, pp. 1 – 5, May 2011.
10. S.Sheeba Rani., et al.,. "Iot driven vehicle license plate extraction approach" in International Journal of Engineering and Technology(IJET) , Volume.7, 2018, pp 457-459, April 2018(Scopus Indexed).
11. Darshan Iyer N, Dr. KA Radhakrishnan Rao, "IoT Based Enery Meter Reading, Theft Detection & disconnection using PLC modem and Power optimization ",IRJET, (2015)
12. K.C.Ramya, S.Sheeba Rani. (2018) "Intelligent Energy Telemetry Unit for Monitoring using RFID", Application Number - 201841045376 A / Journal No:49/2018 published in IPR - Patent.
13. S.Sheeba Rani, K.C.Ramya. (2019) "Internet of things based Controller design for Hybrid Autotronic Applications", Application Number - 201941004996 A / Journal No:07/2019 published in IPR - Patent.