# Energy Monitoring and Control System using IOT

AparnaBalan[1], PraseethaFrancis[2],Sandra S[3] ,Ramesh R[4], DivyaG[5], AnaswaraJayan[6], and Rosemary Varghese[7]

[4, 5,6,7]*Assistant Professor, Department of Computer Science and Engineering*

[1,2,3]*Student, Department of Information Technology*

*AdiShankara Institute of Engineering and Technology*

*Kalady, Ernakulam, Kerala, India*

**Abstract—The implementation is done by IOT. These resources are then used by the mobile web application for displaying real time and historical energy reading. To develop an energy monitoring system using IOT which enable us to view the energy consumptionofeachandeveryelectricdevicesorhomeappliance individually in units or watts. It also provides a controlling system which enable as to control the devices when the consumption rate exceeds the threshold value. The problem with the existing system is there is no energy controlling when it exceeds the threshold value and also the electricity bill is received at the end of the month which does not give an idea how much energy is consumed by individual devices. The proposed system is a power management system that allows consumers to monitor and control the electrical devices via Internet-of-Things(IOT) enabling devices(E.g mobile applications).In addiction to real time energy monitoring and budget control, the system allow clients to control devices using turn on/off buttons(By voice or manually),The hardware part of the system consists of the micro-controller interface( in this case, Arduino) ie, the client unit, is responsible for reading information from the sensor .The sensed data is then sent to the central units database. Additionally the micro-controller interface is used for controlling electrical devices .We use non invasive current sensor to measure the current. Secondly the system includes a mobile application that is build using java with PHP and MYSQL .The application allows the authorized utility clients to remotely make use of different features, such as real time consumption as gauge chart, manual device control ,system setup etc. The main difference between the existing and proposed system is,in the existing system they are usingsmartmeterwhereintheproposedsystemweareusing non invasive current sensor to measure the amount of current. Also in the proposed system we are including about the prediction details, that is giving the current status about the device. The outcome of the proposed paper is IOT based monitoring system which measures the current of individual electric devices and control the device when it exceeds the threshold value and in additiontoitenabletopredictthedevicestatus.**

**IndexTerms—IoT, LoRa, WSN, Landslide**

## I. INTRODUCTION

Energy consumption is residential households is veryimportant to consumers. The rise in electricity prices have demandto consumers the need to consumers, the need to conserve energy with less to know information on their energy consumption pattern. Asteptowardenergyconsumptionisarealtimeenergy monitoring system which provides feedback toconsumers, thus the consumers will be able to identify the opportunity to adjust and identify how to conserve energy. Our project represent a realtimemonitoringsystemthatiscosteffectiveandreliable, it can be used to analyze and valuate output voltage or generated energyfromeachindividualhouseholdappliance.

## II. LITERATURESURVEY

### *A. Mobile Web Energy Monitoring System Using DFRduino Uno*

The system architecture is the conceptual model of the proposed energy monitoring system. The structure of the sys- tem is connected from 2 power household appliance),1 micro controller is connected to it and the sensor is connected to a micro controller to activate data gathering of the sensor. There is a LCD display connected to the micro controller to show how much power was generated by the power supply. The data gathered will be sent through SMS from the GSM module through a SMS server. The SMS data is paused to the cloud RESserverandstoredonadatabase, thesedataarethen pushed to the mobile Web GUL. Users will be able to see the real time data of the power generated by the household appliance online throughthemobilewebuserinterface.

Disadvantages:

- Nottestedinhighervoltagehome

### *B. Energy Monitoring and Control Using Internet of Things(IOT)*

A small programmable specialized computing device, the Raspberry Pi v3, was used for preliminary testing. The

Rasp- berry Pi v3 was chosen due to familiarity and its built-in capabilities for all aspects of the project, including general purpose pins and Wi-Fi capabilities. The Raspberry Pi v3 also had a variety of external attachments for monitoring and control purposes. The monitoring aspect involved a Current Transformer (CT) clamp, which uses a magnetic field to measure the current traveling through a wire. The analog signal output from the CT clamp was converted to digital signal by attaching it to a breadboard and then through a 4-channel Analog-to-Digital-Converter (ADS1115).The smart nodes were designed to communicate with the various hard- ware components for the intention of sending energy data in hourly intervals to a MySQL relational database . Once the data is inserted and stored in the database, it can then be read from the iOS application. Additionally, the iOS application has the functionality of sending data to the database to change a device's status(e.g., On/Off), which the smart nodes can then interpret and respond in order to satisfy the request.

Disadvantages:

- Require internet all thetime

### C. *Design And Implementation of an IOT-Based Energy MonitoringSystemforManagingSmartHomes*

Non invasive current sensor used to read the electricity consumption from any electrical device. The data is then send to the central unit through Arduino. Java programming language for building an android application for the send users.Pythonfor Raspberry pi.C/C++ for arduino. MYSQL database used to store allinformation.

## III. COMPONENT DESCRIPTION

### A. *Arduinodisplay*

The Nokia 5110 display module displays the power con- sumedbytheloadinKiloWatthours.FurthertheWiFimodule requires 3.3V to power up, so a 9V to 3.3V buck is required for smooth functioning of WiFi module. The information of power consumed is transferred from WiFi module todedicated website which keeps track of all device power consumptions etc.

### B. *Real timeclock*

Any real time monitoring system has its timer as a critical part of the circuit. RTC DS3231(Real Time Clock) is used to keep the track of time. This module has internal oscillator and it uses I2C port to communicate with Arduino Nano. Keeping track of the monthly power consumption is accomplished by this module. Subsequently, it resets the value of power consumed in units (kwh), which is to be displayed to zero, on monthly basis.The purpose of using RTC is to keep track of time even if it is not powered so that even if the electricity is down,apropertrackoftimeistaken

### C. *currentsensor*

The current sensor SCT-013-030 is the main part of the circuit.Thecurrentvaluesaresensedonrealtimebasisandare transmitted wirelessly to the server through the Wi-Fi module ESP8266whichisconnectedtoArduinoNano

### D. *Arduinonano*

Arduino Nano is one type of microcontroller board, and it is designed by Arduino. This microcontroller is also used in Arduino UNO. It is a small size board and also flexible with a wide variety of applications. This board has many functions and features like an ArduinoDuemilanove board. However, this Nano board is different in packaging. It doesn't have any DC jack so that the power supply can be given using a small USB port otherwise straightly connected to the pins like VCC GND. This board can be supplied with 6 to 20volts using a miniUSBportontheboard.

### E. *Wi-Fimodule*

ESP8266 is a low cost WiFi module which works on 802.11b/g/n protocol. In order to send the power values, the ESP module is linked to the server and then values are sent usingGETrequestbygivingATcommandstotheESPmodule.

## IV. IMPLEMENTATION

This paper proposes a novel smart home energy system which senses the current values on real time basis, computes the instantaneous power and uploads the values to the cloud

[8] using the Wi-Fi module. The block diagram of this system is as shown in Fig1.

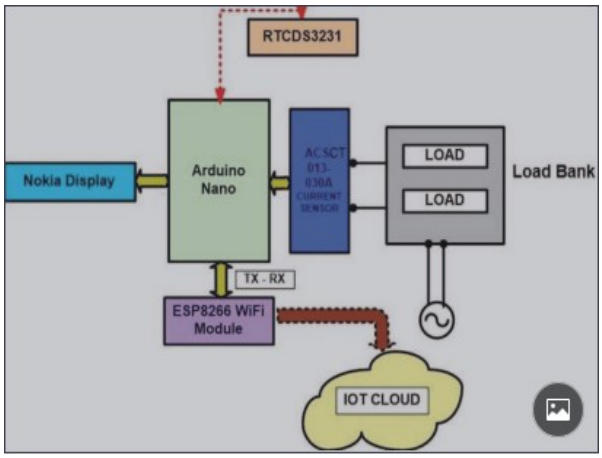


Fig. . Block diagram of Home Energy Monitoring System

The current sensor SCT-013-030 is the main part of thecircuit. The current values are sensed on real time basis and are transmitted wirelessly to the server through the Wi-Fi module ESP 8266 which is connected to Arduino Nano. The user display is implemented through android phone display module and Real Time Clock(RTC) module.
TheSplitCoreCurrentTransformersensorSCT-013-030
[5] has a capacity to sense a maximum current of 30A and gives an output voltage of 1V peak to peak for this current. The output voltage thus produced is then given to the microcontroller Arduino Nano through the Analog to Digital Converter (ADC) input. This voltage waveform is shifted upwardsby2.5Vdcwiththehelpofthecircuitshownin Fig 2.Therms value of the output signal is computed and the power is calculated in the program.

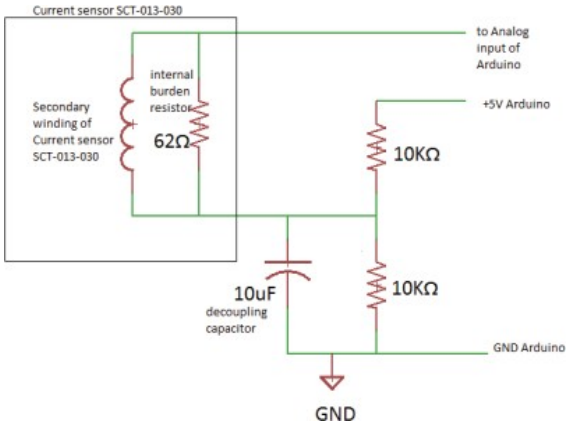


Fig. . Circuit for current sensing

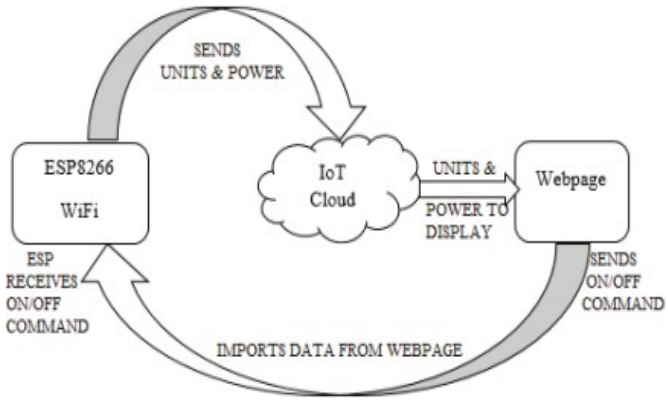


Fig. . Implementation of IoT based energy monitoring

This shifted voltage signal is then sampled at 3kHz. Sensing of this signal happens at every 20ms (1/50Hz). Thus the extraction and calliberation of rms value of current [6] is done in the followingways.

An AC voltage signal, proportional to the current sensed by current sensor, which is sensed varies between 2.5V to 5V. Samples are filtered, blocking low frequency values thereby blocking noise. V-filtered in (1) refers to the previously com- puted V-filter value,sample is the present sample while prev- sample is the previous sample value. Here k is the constant which was found out to be 0.995. The rms of the input voltage signal is computed using (2).

$$V_filter = K * V_filtered + sample - prev - sample) (1)$$

$$v_rms = \sqrt{\frac{V_filter^2}{numberofsamples}} (2)$$

$$Iratio = \frac{CT - TURNS}{CT_Burden - resistor * 5 * (Numberofsamples)} (3$$

The ratio which converts $V_rmstoisgivenby(4) Irms = Iratio\sqrt{v_rms}(4)$

Where CT-TURN represents the number of turns of secondary coil of CT which is 1800 and internal burden resistor of SCT-013-030, i.e. CT-Burden-resistor=62.Here Number of amples =1024, as Arduinonano is being used which is having 10bit ADC, i.e. having 1024 (210)samples: Rms value of the current sensed by the current sensor is computed using (4). Finally the power consumed is calculated by

$$p = 230.Irms (5)$$

The webpage was designed using HTML, PHP, CSS and JavaScript. HTML was used for designing the webpage which includes positioning the objects on the screen which includes text. Font, style, color and formatting of the text was done using CSS which is very handy as compared to HTML as far asformattingisconcerned.Fig3illustratesthe implementation of IOT based energy monitoring. PHP script is used for im- porting data from cloud reverse process i.e sending ON/OFF commands to cloud is also done by same. JavaScript is used to represent the data graphically. User can switch the operation mode of a device by choosing ON or OFF respectively on a webpage. ESP module polls for the change in the status i.e. from ON to OFF and vice versa. After sensing the change it actuates the relay, with the help of Arduino to turn ON or turn OFF the device, depending upon the current status. Login page was also created so as to provide secured environment to the user thereby providing secured access of data from the webpage.

## V. CONCLUSION

Minimal power consumption is the main design aspect of any appliance. A survey into the power consumed by common domestic loads provides an awareness to the common customers which helps further in energy conservation. This paper presents the implementation of a portable energy meter which can monitor the power consumption at device level as well as for a residence. The energy device which is currently implemented assumes the voltage to be 230Vrms and subsequently computes the power consumed by means of current sensing only. Including voltage sensing into the hardware as well as processing it to calculate power can improve the accuracy of this device.

## REFERENCES


[1] Mobile Web Energy Monitoring System Using DFRduino Uno kristine Mae E. Galera,Orven E. LIantos 4th Information System International Conference 2017,ISICO 2017, 6-8 November 2017,Bali,Indonesia

[2] Wesley “Tyler” Hartman, Alexander Hansen, Erik Vasquez, Samy El- Tawab, Karim Altaii James Madison University, hartmawt, hansenar, vasqueer@dukes.jmu.edu, eltawass, altaiikx@jmu.edu

[3] Michael OpokuAgyemen,Zainab Al-Waisi and IglaHoxha Department of Computing,University of Northampton. Email: Michael.OpokuAgyeman@northampton.ac.uk

[4] Cisco, “Bringing the smart grid into the home: The value of home energy management for utilities,” Cisco Syst. Inc., San Jose, CA, USA, White Paper C11-606976-00.