Monitoring of Electrical Energy Using IOT

Alfoni Jose Kezhiyur[1], P. Prasanna Kumar[2], S. Banu[2], G. Rajesh[2]
[1]Assistant Professor,Dadi Institute of Engineering & Technology, Anakapalle
alfonibipin@diet.edu.in
[2]Student,Dadi Institute of Engineering & Technology, Anakapalle

Abstract: Energy consumption refers to the amount of energy consumed by an individual or organization which has been taken for granted in daily life by consumers especially at home.A circuit is designed to take care of electrical energy consumption which helps the consumers to focus on the extra charges incurred due to minor changes in slab categories which affect the consumer's bill severely. This system utilizes a sensor module that is connected with ARDUINO along with GSM, ESP 8266, and energy meter to measure the power consumption at the home.The main aim of this paper is to make consumers aware of the power consumption and to control the excess power consumption, by using a IOT Based Electrical Energy Consumptıon Live Monitoring & Controlling System.The power consumption data is collected and stored in to IOT cloud services. Daily usage is updated to the consumer periodically through a mobile application which helps to reduce over usage of power.

Keywords: Energy consumption, ARDUINO, IOT cloud services

1 Introduction

The energy consumption can be monitored by using an electric device called an energy meter. The cost and the regular usage of power consumption are informed to the user to overcome high bill usage. The energy meter shows the amount of units consumed and transfers the data to both the customer and to the electrical board so this helps in reducing man-power. The user can check their power usage from anywhere and at any time interval. The IOT is used to turn on/turn off the household appliances using relay and Arduino interfacing. The objective of this system is to monitor the amount of electricity consumed.

The development of Internet of Things (IoT), smart power meters and smart electrical appliances are used by the consumers to closely monitor the energy consumed and to determine their consumption. This is made probable to capture and analyse sensor data in real time. The proposed system uses IoT infrastructure to monitor, smartly measure and schedule the consumption of electricity resources in real time. Energy management platform is a great example of using Internet of Things for energy monitoring and management. This solution transforms the way people and companies use and control electricity, electrical devices, loads and power storage. It consists of a smart hardware, software and data tools. Once equipped with this system, a house, office building or any other facility turns into a smart space with a rich set of features and capabilities for power consumption monitoring and control.

1.2 Objective

The main objective of the paper is to monitor the energy and control the electrical appliances by using microcontrollers and Arduino. The experimental study is carried out by performing load test using different domestic loads and observed.

2 Overview

Awareness of electricity consumption in the home or building is a first step towards saving energy. The combination of alternative energy and pervasive technologies for monitoring and controlling energy consumption is a powerful vehicle for reducing energy demand. With effective feedback about energy consumption and control of household appliances, users can be motivated and encouraged to change their behaviour on energy use such as turning off lights or reducing heat. These small changes in behaviour can lead to significant energy savings.

The proposed system can monitor and measure electricity usage in real-time. With the proposed system, users can remotely control real-time electricity usage through web and other mobile devices such as smart phones or smart pads.

2.1 Advantages:

The following are the advantages of energy consumption monitoring and controlling are:

- Managing all of home devices from a remote place.
- Maximizing home security.
- Increased energy efficiency.
- Save Energy with Smart Energy Consumption.
- Customize as per your Convenience.
- Ease of using smart home technology.

2.2 Limitations:

The following are the disadvantages of energy consumption monitoring and controlling are:

- Significant installation costs
- Reliable internet connection is crucial
- Security issues
- Technological problems in connected homes
- Maintenance and repair issues.

3 Methodology

The smart energy meter monitoring system is shown in figure 1. The block diagram consists of Arduino, energy meter, WIFI module and IoT, Relay and transformer. Energy meter used here is clamp energy meter.

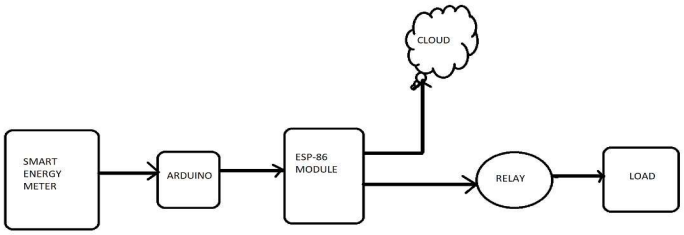

Fig 1: Block Diagram for Real Time Monitoring System

A 230V AC main is the input given to the transformer and AC mains is converted to low voltage by using step down transformer. Bridge rectifier is used to convert the 12V AC to 12V DC. Arduino is a microcontroller which controls the loads and sends the signals to the cloud devices like(mobiles phones, laptop, tabs). The relay receives the signal from cloud device and control loads.

3.1 Real -time home automation monitoring:

In home network the various electrical and electronics appliances are connected through internet to the home server. The measured data from the devices has to be stored and the storage function is carried out by server for analysis purpose. The gadgets may be a wearable for aged or elderly people where the device monitors the persons residing at home. The actuators are bridged to these devices with the support of technology such as Zigbee, Z-wave etc. to send signals to the web server to execute required actions.

Thus, actuators send instructions based on its location of server using either Zigbee or Bluetooth. The electronic devices are made to perform specific task when even the user presence is unavailable at home location by accessing the home server using different data network.

3.2 INTERNET OF THINGS (IOT)

The concept of the Internet of Things was invented by and term coined by Peter T. Lewis in September 1985 in a speech he delivered at a U.S. Federal Communications Commission (FCC) supported session at the Congressional Black Caucus 15th Legislative Conference. Internet of Things (IoT) is the inter-networking of physical devices, vehicles (also referred to as "connected devices" and "smart devices"), buildings, and other items embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data. In 2013 the Global Standards Initiative on Internet of Things (IoT-GSI) defined the IoT as "the infrastructure of the information society".

4. Hardware Description

4.1 Equivalent Circuit Model:

An approximated model of IoT based electrical energy consumption live monitoring and controlling has been done in live. The electrical equivalent circuit of this model is as shown in the figure 2

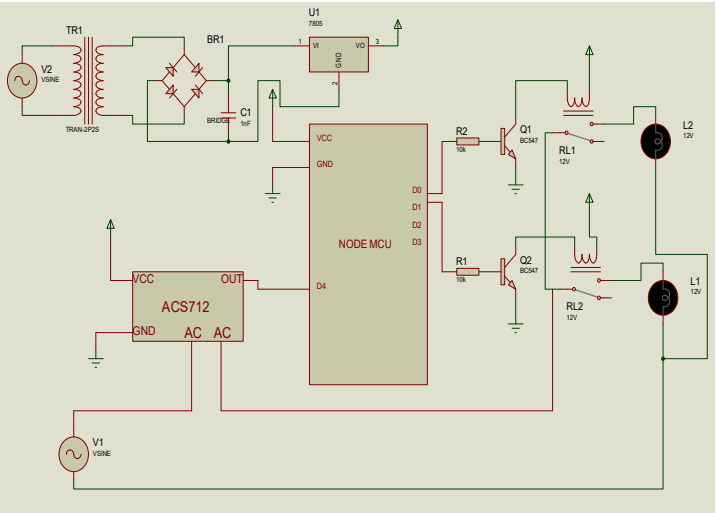

Fig 4.1: Equivalent Circuit Model

The output of this model is to control the appliances and monitor the appliances consumption units and charges how much it consumes. Firstly, AC signal of 230 V is step down to 12V by using rectifier circuit AC signal is converted to DC signal for input supply of Arduino. The capacitive filter is used to reduce ripple in the signal. Voltage regulator is used to maintain constant 12V DC signal to Arduino.

4.2 Hardware Developed:

The below figure shows developed system for monitoring power.

Fig 4.2: Hardware Developed

Under initial conditions the reference value of system is set as 230W. Hence power consumption of that particular area will be in the range of (0-230KW) but not more than the final limit. On placing the 3 bulbs means power consumption of 3 houses will be calculate. The bulbs are placed in a single board.

4.3 Case Study:

Case 1: Two lighting loads are used-

When two bulbs of 15W are placed & power supply of the system is turned on then current starts flowing. When bulbs of load 1 and load 2 are switched on then load is varied & the consumption can see by cloud device.

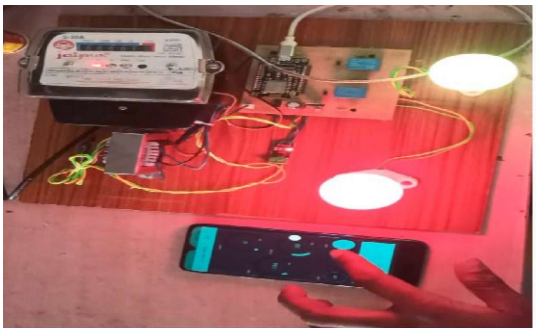

Fig 4.3: **Two lighting loads are used**

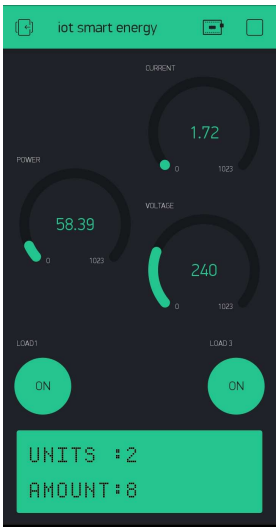

Fig 4.4:

The figure 4.4 shows the output of two lighting loads for 4hr.The units consumed of two lighting loads is 2 kw/ hr.

Case 2: One lighting load and One Suction Motor

When one bulb of 15W and motor of 18W is placed in home model & power supply of the system is turned on of load 1 and load 2 are switch on then load is vary.

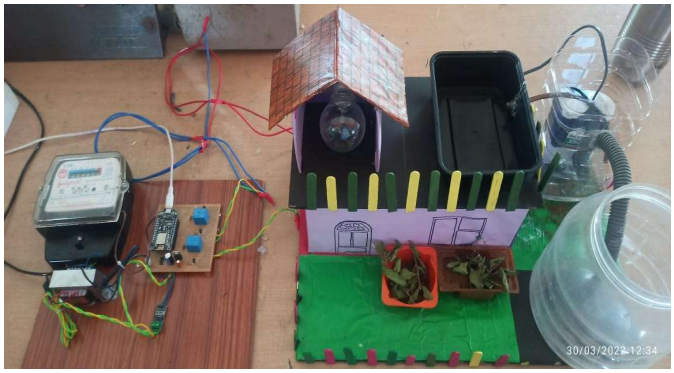

Fig 4.5: **One lighting load and One Suction Motor**

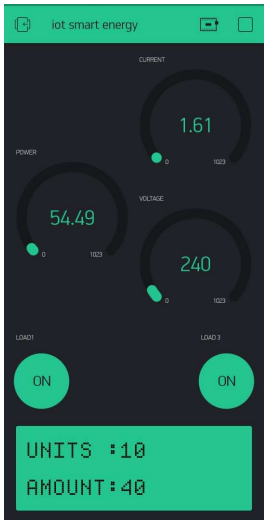

Fig 4.6:

The figure 4.6hows the output of two lighting loads for 2hr. The units consumed of two lighting loads is 10 kw/ hr.

5. Conclusion

Design of piezoelectric energy harvester is presented in this project. A piezoelectric energy harvester is to be simulated, designed and implemented experimentally. A constantly increasing impulse strain is applied every time to the entire unit. unit. It is observed that the output increases initially and after sometimes it saturates at some particular value. It has been a great experience to harvest the electrical energy from mechanical strain. The equivalent circuit model is developed in MATLAB and the expected result is obtained. The developed energy harvester can be applied to supply low powered electronics like wireless sensors, bugging devices, weather monitoring devices, aircraft power supply and many more low powered MEMS(Micro electro mechanical systems) devices. There is a wide scope of improvement of this type harvesting technique because of increased demand of portable micro powered electronics. The all round development of self powered electronics depends upon the highly efficient energy harvesting systems. Some improvements have been done in this model to reduce the voltage drop at rectifier stage using dedicated IC. Further improvements may be done to minimize the loss and to accumulate the optimum power.

6. Future Scope

Our future work will focus on expanding the current system to include the following functionalities:

•Automatic home appliance detection and context inference. The automatic identification of appliances and detection of the location of appliances are important for developing efficient energy management systems.

•Automatic detection of appliances can offer easy and usable services and information on the location of appliances is used for providing various context-await.

• A user's behaviour, based on data from electricity consumption, can be used to infer the current or future context of users.

References

1. Elamvazuthi, 2M K. A., Ahamed Khan , 3Syajiq Basri BinShaari, 4Rajendran Sinnadurai and 5M Amudha. October 2012 Electrical Power Consumption Monitoring using a Real-time System. 2012 IEEE Conference on Sustainable Utilization and Development in Engineering and Technology (STUDENT) University Tunku Abdul Rahman, Kuala Lumpur, Malaysia.

2. ZigBee Sensor Networks Woong Hee Kim, Sunyoung Lee, Jongwoon Hwang. Real-time Energy Monitoring and Controlling System. International Symposium on Intelligent Systems Techniques for Ad hoc and Wireless Sensor Networks (IST-AWSN).

3. V.Subbulakshmi, D.Aiswarya, A.R.Arulselvi. Monitoring and Controlling Energy Consumption Using IOT and Blockchain. Special Issue Published in Int. Jnl. Of Advanced Networking & Applications (IJANA)002E

4. Harsha Khandel1, Suchitra Pandey2 and D. Reynolds3. IoT BASED POWER CONSUMPTION MONITORING AND CONTROLLING SYSTEM. International Research Journal of
Engineering and Technology (IRJET).

5. Jaichandran R, Rajaprakash S, Shunmuganathan K.L, Usha Kiruthika, Muthuselvan S. August, 2019.Prototype for Monitoring and Accessing Electricity Usage Details in Cloud using IoT Energy Meter. International Journal of

Engineering and Advanced Technology (IJEAT) ISSN: 2249-8958 (Online), Volume-8 Issue-6.

6. Ramón Octavio Jiménez Betancourt 1,* , Juan Miguel González López 1 , Emilio Barocio Espejo 2 , Antonio Concha Sánchez 3 , Efraín Villalvazo Laureano 1 , Sergio Sandoval Pérez 4 and Luis Contreras Aguilar 3. IoT-Based Electricity Bill for Domestic Applications. School of Electromechanical Engineering, Universidad de Colima, Manzanillo 28860, Mexico.

7. Hnin Nu Thaung, Zaw Myo Tun, Hla Myo Tun. JUNE 2016. Automatic Energy Control And Monitoring System For Building. INTERNATIONAL JOURNAL OF SCIENTIFIC & TECHNOLOGY RESEARCH VOLUME 5, ISSUE 06.