



## A SURVEY ON REAL-TIME POWER MONITORING FOR HOUSEHOLD APPLIANCES

### Computer Science

<b>M. Lakshmanan</b>	Assistant Professor, Department of Computer Science and Engineering, Easwari Engineering College, Chennai, India
<b>R. Manoj Kumaran</b>	UG Students, Department of Computer Science and Engineering, Easwari Engineering College, Chennai, India
<b>V. I Ajith</b>	UG Students, Department of Computer Science and Engineering, Easwari Engineering College, Chennai, India
<b>G. R Aravind Karthik</b>	UG Students, Department of Computer Science and Engineering, Easwari Engineering College, Chennai, India
<b>S. Sivaraj</b>	UG Students, Department of Computer Science and Engineering, Easwari Engineering College, Chennai, India

### ABSTRACT

The Internet of Things (IoT) has allowed objects to be sensed and controlled remotely across existing networks by augmenting with sensors and actuators. IOT monitors physical, electrical & environment parameters. Electrical power is one such important parameter to be monitored. Monitoring such a parameter tends to be a challenge. We have proposed a simple, feasible, user-friendly, low-cost power monitor system with Wi-Fi capability connected across appliances fitted with sensitive sensors. This is facilitated by an Android mobile application which displays accurate household power consumption, consumption by individual appliances, billing cost estimations and usage alerts in real time. The survey is essential to an endeavour to replicate the development in this area and also points out the techniques in power monitoring schemes in various sectors.

### KEYWORDS

smart grid, sensing systems, Internet of things and power monitor etc...

### INTRODUCTION

Internet of Things (IoT) is a current innovative expertise which consists of sensing and communication capabilities to everyday common things, in order to collect practical data. Such IoT enabled devices can be used to monitor a variety of significant parameters. This, in turn, used to evaluate, categorize and solve different problems related to daily life. Power management for efficient use of electricity is one such important problem. IoT enabled power monitoring devices can resolve this problem about electricity utilization.

In current scenario conservative electric meters supplied by electricity suppliers calculate the power consumption of the entire building. The consumer has no way to check power consumption of individual appliances. These meters also be short of storage feature as well as an alternative to scrutinize data. Due to lack of any communication facility in the meter, power utilization has to be noted down physically at each meter position for billing point. This procedure itself is lying on your front to human fault.

Using the smart power meters, the power utilization by a range of electrical appliance can be automatically calculated, logged and analyzed. This will also help in detection of major power patrons and be promoting awareness in the general public. This power expenditure data can transits to the electricity provider, to pass up manual billing as well as human error. This will help in r diminishing electricity losses from the point of view of electricity provider as well as end-user.

Smart power meters have communication abilities. However, these designs have many drawbacks like pathetic security, high price tag, huge size, setting up complexity, etc. We have addressed these issues. Using the smart power meters, the power utilization by a variety of electrical appliance can be automatically calculated, logged and analyzed. This will also help in detection of key power consumers and be promoting energy responsiveness in the society.

#### 1. Research trend in power monitoring

The Energy Statistics 2013 of India's National Statistical Organisation (NSO) shows electricity accounted for more than 57 percent of the total energy consumption during 2011-12 in India, and building sector is already consuming close to 40 percent of the electricity. This is expected to increase to 76 percent by 2040. A large quantity of incremental electricity demand will come from the residential sector in India [6].

The increase in electricity consumption is 11.26% from 2010-11 (6, 94,392GWh) to 2011- 12 (7, 72,603 GWh). The total electricity sales in 2011-12, industry sector accounted for the largest share (44.84%), followed by domestic (22.01%), agriculture (17.30%) and commercial sector (8.97%). The electric power utilization in the household sector and agriculture sector has enlarged at a much faster pace compared to other sectors during 1970-71 to 2011-12, with CAGRs of 9.44% and 8.43% respectively. Loss of electricity due to transmission has increased from 17.55% during 1970-71 to 32.86% during 2000-01 and it has decreased since then to around 24% during 2011-12.

#### 1.1 Electricity consumption in the residential sector

The residential building sector is one of the largest consumers of electricity in India. Continuous urbanization and the growth of population result in increased power consumption in buildings [9]. The energy is used in residential sectors for electronic appliances and also controlling the climate of the building. In other sectors, some parts consume energy for purposes similar to that in the buildings. These small parts include the administration buildings in the industrial, agriculture sector. Energy is used in residential buildings for various purposes: Lighting, Air conditioning, Fans, Refrigerator, Television and other installed equipment. The other installed equipment includes oven, toaster, laptops, set-top box, home audio, computer monitors etc.

#### 1.2 Electricity Consumption in business Sector

The areas where electricity consumption occurs in business sectors are non-residential and non-industrial areas such as offices, hospitals, hotels, retail outlets, education institution, etc. These account for around nine percent of electric power utilization through utilities, growing at 11% percent in the previous decade.

The electricity consumption by the commercial sectors seems to be small compared to other sectors, over the past few years the commercial sector is growing rapidly. Energy is used in commercial buildings for various purposes: lighting, HVAC load (Heating, Ventilation, and Air-conditioning) and plug load. The plug load devices range is diverse and their usage and consumption are very difficult to understand.

#### 2. Literature Survey

Electric power monitoring devices with wireless technology (Wi-Fi) have been developed previously. In these powers measurement and communication modules are interfaced with an individual

microcontroller platform. The microcontroller platforms like Arduino boards and ATMEGA microcontroller board [7] increase size, price, and complication of the total system. To transmits the measured power data, wireless communication standards like IEEE 802.11(WiFi), IEEE 802.15.4(ZigBee), IEEE 802.15.1(Bluetooth), etc. have been recommended for IoT devices.

WiFi provides longer extent and higher data rate at the expenditure of additional power consumption. When compared to WiFi, ZigBee and Bluetooth have much lower power consumption. ZigBee have need of additional hardware deployment in the form of receiver and gateways. Bluetooth technology had low data rates and it covers a small area. Among all these wireless technologies (WiFi) is chosen due to its extensive availability and easiness of access with aid of smartphones and laptops.

The branch-circuit metering method measures energy use at branch circuit level. Branch circuit metering in the individual building can be used to identify large individual loads, for example, refrigerator or aggregates for a large number of smaller loads. Circuit level metering is expensive to install, and this limits studies to a relatively small number of circuits.

The device-level metering method measures energy use of each device. The data is collected through these studies have significantly improved the knowledge of plug loads energy use in U. S. building. These are software and hardware infrastructure that facilitate communication between the end-user monitor and the central entity. The embedded systems are programmed to gather data from the energy monitor and communicate this information over the network layer to the data server. A user dashboard would be located on a mobile device or PC, which allows control and monitoring via the data server.

### 2.1 Arduino-based smart metering board

Introduced the concept of the communicating power supply (CPS) that adds electricity metering, computation, and communication to electronic devices [1]. It presented an Internet-connected system of CPSs that enables improved energy awareness of devices and users. CPS technology is the future of energy monitoring for plug loads, and that all energy-using devices will one day be aware of their identity and share energy information over IP networks.

### 2.2 Design and building of a cheap smart meter

This design, explain how to quantify different aspects of the metering, such as the number of devices to inventory and meter, how long to collect meter data, sampling rate and so on. The study was designed to look at the methodology for collecting accurate energy information on annual energy use, usage patterns, and energy savings opportunities of representative plug loads in a typical office building [2].

### 2.3 Synergetic Use of Smart Meters

The power quality monitoring, investigate the use ON/OFF events, which can control individual electronic appliances [3]. To improve the accuracy of disaggregation algorithm that uses such events along with smart meter data to estimate the consumption of single appliances.

### 2.4A smart Power Monitor to monitor energy flow in smart grids

Energy flow in, an innovative Energy-Neutral and Nonintrusive Wireless Energy Meter (NIWEM) is presented, with self-power capability for smart metering applications [4]. The user can monitor this stored data in real time and control the device.

### 2.5 Design and implementation of energy data collection system

The design and implementation of energy data collection system which involves using a step-down transformer source to monitor readings of household devices [5]. It uses Wi-Fi, a step-down transformer, and shortest path algorithm.

### 2.6 Energy monitoring prototype for the Internet of Things

Energy monitoring prototype which involves creating an interface to support power monitoring [6]. It uses Arduino, ZigBee connections and involves Gibbs sampling algorithm.

### 2.7 Arduino-based Visualization Platform for IoT

IoT for non-invasive calculations is based on recent transformer measurements and works fit values of alternating current up to 30 A with an addition to 100A which considerably increases the impact of smart grid use-cases. Handing out of calculated data is done within the

utilized Arduino board [7]. The readings can be displayed on attached LCD panel or sent to web server application.

### 2.8 Internet of Things for Smart Cities

IoT for Smart Cities which involves an Internet-connected system of CPSs that enables improved energy awareness of devices and users. CPS technology is the future of energy monitoring for plug loads, and that all energy-using devices will one day be aware of their identity and share energy information over IP networks [8].

### 2.9 IoT Enabled Smart and Secure Power Monitor

Smart and Secure Power Monitor control of individual electronic appliances to improve the accuracy of disaggregation algorithm that uses such events along with smart meter data to estimate the consumption [9].

## 3. CONCLUSIONS

In this paper, a literature review of various methods of energy monitoring and control systems is presented. Out of the presented techniques, device-level monitoring over the internet was selected. This method combines advantages of connection to the internet and load monitoring and controlling individual electronic appliances. The future of internet of things will be that the devices connected to the network will be able to communicate and share data through individual IP network. Thus providing users with the control of things and information about the status of things.

The potential functions of failure prediction, deflection identification, and life estimation bring a series of advantage for utility companies: reducing maintenance cost, lengthening equipment's life, enhancing the safety of operators, The development of power monitors for power transformers, generators, and induction motors are now at different stages. However, monitoring and data analysis methods are not satisfied for special problems such as partial discharge, hotspot temperature, and OLTC.

Online diagnosis of all the measured quantities is still under development. Great efforts are focused on the use of PD online monitoring system for generators, while more work has been carried out on vibration signal analysis and the implementation of current monitoring. Research in recent years clearly shows that advanced signal processing techniques and artificial intelligence techniques are indispensable in developing novel systems. Benefiting from the development of computer techniques and communication techniques, signal processing, and AI have become the most powerful tools to make next-generation monitors equipped with high level of sensitivity, reliability, intelligence.

## REFERENCES:

- Christoph Klemenjak, Dominik Egarter, and Wilfried Elmenreich "YoMo - The Arduino-based Smart Metering Board, arXiv:1409.3404v1 [cs.OH], 11 Sep 2014.
- M. M. Albu, M. Sănduleac and C. Stănescu, "Synergetic Use of Smart Meters for Power Quality Monitoring in Emerging Networks", in IEEE Transactions on Smart Grid, Vol. 8, no. 1, pp. 485-492, Jan. 2017.
- M. M. Albu, M. Sănduleac and C. Stănescu, "Synergetic Use of Smart Meters for Power Quality Monitoring in Emerging Networks", in IEEE Transactions on Smart Grid, Vol. 8, no. 1, pp. 485-492, Jan. 2017.
- R. Morello, C. De Capua, G. Lipari, M. Lugarà, G. Morabito, "A Smart Energy Meter for Power Grids", 2014 IEEE International Instrumentation and Measurement Technology Conference (I2MTC 2014), May 12-15 2014, Montevideo, Uruguay, pp. 878-883, 2014.
- L. I. Minchala-Avila, J. Armijos, D. Pesántez, Y. Zhang, "Design and Implementation of a Smart Meter with Demand Response Capabilities", Energy Procedia, Vol. 103, pp. 195-200, December 2016.
- Qazi Mamon Ashraf, Amir Alif Azman and Norbaizura "Energy monitoring prototype for the Internet of Things: Preliminary results" in IEEE, 978-1-5090-0366-2/2015
- Martin Stusek and Jiri Pokorny "A Non-invasive Electricity Measurement within the Smart Grid Landscape: Arduino-based Visualization Platform for IoT" 2017 9th International Congress on Ultra Modern Telecommunications and Control Systems and Workshops (ICUMT)
- IEEE Smart Cities, Accessed on 10th July 2017. [Online]. Available: <http://smartgrid.ieee.org/>
- Akshay Jadhav, P.Rajalakshmi, "IoT enabled smart and secure power monitor" in 2017 IEEE Region 10 Symposium (TENSYPMP).