

# Energy Auditing Using IOT and Analysis Using Machine Learning

Prof. Sangeeta Kotecha<sup>1</sup> Vivek Nair<sup>2</sup> Darshan Sondagar<sup>3</sup> Krutik Patil<sup>4</sup> Punam Nakate<sup>5</sup>

<sup>1</sup>Guide <sup>2,3,4,5</sup>Student

<sup>1,2,3,4,5</sup>Department of Electrical Engineering

<sup>1,2,3,4,5</sup>Atharva College of Engineering, India

**Abstract** — This project is an effort to write electronic read meters. The Internet of Things (IoT) provides the advantages and benefits of wirelessly transmitting information about the consumer's energy consumption and provides a way to measure energy consumption. The main purpose of this project is to measure the energy consumption of household appliances and create a budget using IoT. The power grid must be implemented in a distributed topology that can absorb many different energy sources. IoT can be used in many applications of smart grids, including distribution of power plant equipment, smart meters for electricity generation and energy consumption, external electricity and various power generation sources. In addition, the system can predict energy costs using machine learning using previous data.

**Keywords:** Internet of Things (IoT), Energy Auditing, Machine Learning

## I. INTRODUCTION

Energy management is a growing concern for all businesses, large or small. Energy efficiency is considered the cornerstone of achieving sustainable workplaces, controlling rising energy costs and reducing the environmental footprint. Good energy management requires better energy choices by collecting data using smart meters and monitoring energy consumption. Smart energy meters are used to monitor the energy consumption of organizations, companies or households. Up to a certain limit, everyone can manage their own tariff. It monitors the customer's electricity usage and transmits the information to the customer at the scheduled time. Traditional energy analysis is not sufficient for modern energy analysis as it does not have the necessary information to forecast energy demand. The aim is to get more accurate information from customers connected to low and medium power lines and to find new ways to make our daily lives more energy efficient. We offer innovative solutions for energy monitoring and full control of energy meters by making traditional energy meters smart. Sensor content initially deployed for billing purposes allows for condition estimation and other grid metrics that were previously unavailable. Along with the aforementioned features, this enables real-time energy monitoring, analysis and cost estimation using machine learning.

## II. LITERATURE REVIEW

Anitha et al., [1] Measurement Analysis Report Using IoT Regarding IoT, IoT as an emerging field, IoT-based devices have revolutionized electronics and IT. The main purpose of the project is to raise awareness about energy use and energy efficiency. How to use household appliances to save energy. There is a shortfall in the current electricity bill due to manual operation. The system will use the Internet of Things to provide meter readings and information about problems when

electricity consumption exceeds the limit. Arduino esp8266 microcontroller is programmed to create targets with the help of GSM module. It is claimed to fix all the flaws in existing electronic meters. All details are sent to the user's mobile phone by the IoT and GSM module and displayed on the LCD. This saves time and helps eliminate human intervention in the use of IoT. Devadhanishini et al., [2] Intelligent Energy Monitoring Using IoT recognizes energy consumption as an important and complex issue. Automatic power meters are used in large power plants. Arduino WIFI and SMS integration make the system an intelligent energy monitoring system. Smart meters provide information to optimize and reduce power consumption. The system also includes a sound sensor that automatically turns off the power when there is no one at home or at home.

Mohammed Hosseiu et al. [3] published an article titled Design and Implementation of Smart Meters Using IoT, describing the evolution of IoT and technology. The electric power system of the future must be based on a distributed topology that can absorb different energy sources. IoT can be used in many applications of smart grids, including many areas such as energy consumption, smart meters, energy demand management and power generation. In this article, Smart Energy Measurement (SEM) explained that the main purpose of SEM is to collect energy consumption data of household appliances and monitor environmental parameters and provide service needs of home users.

Himanshu K Patel et al., [4] introduced an Arduino-based smart electricity meter that eliminates human intervention in reading the meter and generating value, thereby reducing the error rate occurring in India. The system includes the freedom to send messages to users to update their energy consumption as well as the final production bill and recycling of the newspaper. When necessary or due to downtime, power cut is done using relays. The system uses GSM for bidirectional communication.

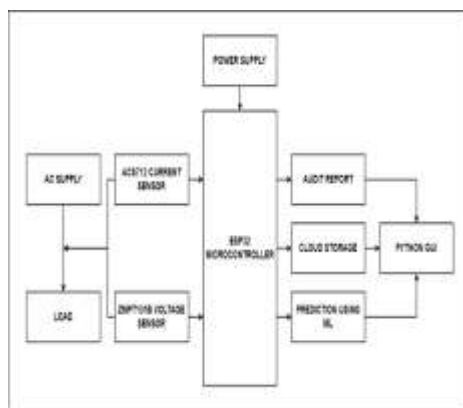
Bibek Kant Barman et al. [5] argued that the energy-efficient use of smart meters using the internet of things plays an important role in the development of smart plans in electrical systems. For this reason, accurate monitoring and control of energy consumption is of great importance for smart projects. There are many problems with the electricity meter, one of the main problems is that there is no communication to solve this problem and the demand for smart electricity meter based on the Internet of What. The smart meter uses an ESP 8266 12E (a Wi-Fi module) to control and calculate energy consumption and send readings to the cloud where customers can monitor. Therefore, the maintenance of consumer electronics is easier and more manageable. The system also helps detect power loss. Therefore, this smart meter helps home automation using IoT.

Garrab et al., [6] proposed an AMR method for energy saving in smart grids using smart meters and partial grid connections to meet the power demand. Smart meters are

one of the solutions for smart projects. In this article, AMR solutions are presented with detailed end-to-end information. It is based on the power measurement and power communication standard with the low power microcontroller MSP430FE423A. The microcontroller includes an electronic power meter ESP430CE1.

Landi et al., [7] now offers "ARM-based power management using smart meters and the web", a cost-effective ARM-based power management system. The integrated website helps to collect statistics on energy consumption, energy efficiency and connected devices to transport goods. This tool is used to monitor data. The power reader can record the meter's power reading wirelessly via Bluetooth. Two methods, Automatic Meter Reading (AMR) and Automatic Polling Mechanism (APM), were added and used in the project implementation to collect meter readings without human intervention. Some business applications are suitable for power meters with Bluetooth.

### III. SYSTEM ARCHITECTURE



### IV. METHODOLOGY

- 1) This project uses ESP32 as microcontroller.
- 2) It is used because it has a built-in Wi-Fi module required for IoT.
- 3) Current and voltage sensors will be used to calculate power consumption.
- 4) All sensors save their results to ThingSpeak server.
- 5) Data from ThingSpeak server can be converted to CSV files for analysis.
- 6) An energy audit report will be sent to the user.
- 7) Power Factor can also be calculated.

### V. CONCLUSION

A fully smart working meter with real time measurement of AC measurement will form a smart meter with special communication. The meter can communicate with customers and utilities, respectively, via a Wi-Fi channel. Every meter connected to the network can be monitored by the server. Information on energy consumption and current energy costs can be found instantly. Therefore, the entire mobile management of the shipping center can be done using this model. With the help of the Smart Energy Meter, the utility can access all of the customer's equipment without having to visit the meter on site, creating recurring costs. The meter allows users to track their consumption in real time. The

system allows analysis and estimation of costs using machine learning.

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