

Iot Based Power Theft Detection System

Prof. Shashikant V. Golande¹, Sakshi Sanjay Chalke², Pratiksha Dattatray Ghule³,
Krutika Govind Bansod⁴

^{1,2,3,4}Department of Electrical Engineering, Navsahyadri Group of Institutions, Savitribai Phule Pune University, Pune,
Maharashtra, India

ABSTRACT

Electricity theft is one of the major challenges faced by power distribution companies, leading to significant financial losses and reduced system reliability. The proposed project, “IoT Based Power Theft Detection System”, aims to detect and prevent unauthorized consumption of electricity using Internet of Things (IoT) technology. This system continuously monitors electrical parameters such as voltage and current using sensors connected to a microcontroller. The measured data is transmitted in real-time to a cloud platform through IoT modules. By comparing the energy supplied and the energy consumed, the system identifies any mismatch that may indicate power theft. In case of theft detection, an alert notification is sent to the electricity board through a mobile application or web interface. Additionally, the system can automatically disconnect the power supply using a relay mechanism to prevent further losses. The implementation of this system enhances transparency, reduces manual inspection efforts, ensures efficient energy management, and helps power distribution companies minimize revenue loss. This IoT-based approach provides a smart, reliable, and cost-effective solution for modern energy monitoring and theft detection.

Keyword - Internet of Things (IoT), Power Theft Detection, Smart Energy Meter, Real-Time Monitoring, Cloud Computing, Embedded System.

1. INTRODUCTION

Electricity is one of the most essential resources for modern society, playing a crucial role in industrial, commercial, and domestic applications. However, power theft has become a major concern for electricity distribution companies, leading to significant revenue losses and affecting the reliability of power systems. Illegal tapping of power lines, meter tampering, and bypassing energy meters are common methods used for electricity theft. Traditional detection techniques mainly rely on manual inspection, which is time-consuming, inefficient, and prone to human error.

With the rapid advancement of the Internet of Things (IoT), smart monitoring systems have emerged as effective solutions for real-time data acquisition and remote surveillance. IoT enables interconnected devices to collect, transmit, and analyze data over the internet, improving automation and system intelligence. By integrating IoT technology with smart energy meters, it becomes possible to continuously monitor electricity consumption and detect irregularities instantly.

The proposed system, “IoT Based Power Theft Detection System,” aims to develop an automated and reliable mechanism to identify unauthorized power usage. The system measures electrical parameters such as voltage and current using appropriate sensors connected to a microcontroller unit. The collected data is transmitted to a cloud platform for real-time monitoring and analysis. Any mismatch between the supplied and consumed energy is detected as a potential theft, and an alert notification is sent to the concerned authority. Additionally, a relay mechanism can be implemented to disconnect the power supply automatically when theft is identified.

This approach enhances transparency, reduces human intervention, ensures efficient energy management, and supports the development of smart grid infrastructure. The proposed system offers a cost-effective, scalable, and accurate solution to minimize electricity theft and improve the overall efficiency of power distribution networks.

2. LITERATURE REVIEW

Several researchers have proposed different techniques to detect electricity theft using smart technologies. Traditional methods mainly involve manual inspection of meters and physical verification, which are inefficient and time-consuming. These approaches often fail to provide real-time monitoring and immediate detection of unauthorized usage.

Recent studies have focused on smart metering systems integrated with wireless communication technologies such as GSM, Zigbee, and Wi-Fi. Smart meters help in remote data collection and monitoring of energy consumption. However, many existing systems lack real-time cloud-based monitoring and automated power disconnection features.

With the advancement of Internet of Things (IoT) technology, researchers have developed systems that transmit energy consumption data to cloud platforms for continuous analysis. IoT-based systems offer advantages such as remote monitoring, data storage, instant alert generation, and improved accuracy. Some systems use machine learning techniques to analyze consumption patterns, while others rely on direct comparison methods to detect mismatches in supply and load values.

Despite these developments, there is still a need for a cost-effective, scalable, and reliable system that can detect power theft in real time and take immediate preventive action. The proposed system addresses these limitations by integrating IoT technology with real-time monitoring and automatic relay control.

3. METHODOLOGY

The proposed IoT Based Power Theft Detection System is designed to monitor electrical parameters and detect unauthorized power usage through real-time comparison and analysis.

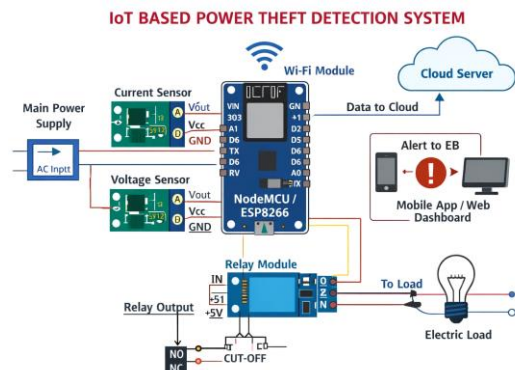


Fig.3.1.IOT Based Power Theft Detection

The proposed IoT-based Power Theft Detection System is designed to monitor electrical parameters in real time and detect unauthorized power consumption using an integrated sensing, processing, and communication framework. The system employs voltage and current sensors to continuously measure supply parameters, where the sensed analog signals are conditioned and fed into the NodeMCU (ESP8266) microcontroller for digital conversion and processing. The instantaneous power consumption is computed using $P = V \times I_P = V \times I$, and the calculated values are compared with predefined threshold limits or expected load profiles to identify abnormal variations indicative of power theft, such as sudden load imbalance, bypass conditions, or irregular consumption patterns. Leveraging the built-in Wi-Fi capability of the ESP8266, the measured data is transmitted to a cloud server using IoT communication protocols for real-time monitoring, storage, and visualization through a web dashboard or mobile application. Upon detection of suspicious activity, the system generates an alert notification to the concerned electricity authority and simultaneously activates a relay module to disconnect the load, thereby preventing further unauthorized usage. This integrated approach ensures continuous remote supervision, rapid anomaly detection, automated protective action, and enhanced efficiency in power distribution management, making the system suitable for smart grid and intelligent energy monitoring applications.

A) System Design:-

The system consists of the following main components:

Current Sensor, Voltage Sensor, Microcontroller (Arduino/NodeMCU), Wi-Fi Module (ESP8266, if not inbuilt), Relay Module, Cloud Server / IoT Platform

B) Working Principle:-

The voltage and current sensors continuously measure electrical parameters from the main supply and consumer load. The microcontroller processes the sensor data and calculates power consumption. The measured data is transmitted to a cloud server via Wi-Fi for real-time monitoring. The system compares the energy supplied with the energy consumed. If a significant mismatch is detected, it indicates possible power theft. An alert notification is sent to the electricity authority. The relay module automatically disconnects the power supply to prevent further unauthorized usage.

C) Data Monitoring and Control:- All energy consumption data is stored on the cloud platform for record maintenance and analysis. Authorities can access the data remotely through a web dashboard or mobile application. This ensures transparency and quick response to theft detection.

Describe research design, models, algorithms, and tools used.

D) Algorithm:-

The following algorithm is used for power theft detection:

Step 1: Start the system

Step 2: Initialize sensors and Wi-Fi module

Step 3: Read voltage and current values from supply side

Step 4: Read voltage and current values from load side

Step 5: Calculate power for both sides

Step 6: Compare supply power and load power

Step 7:

If difference \leq threshold \rightarrow Normal condition

If difference $>$ threshold \rightarrow Theft detected

Step 8: Send alert notification to cloud/dashboard

Step 9: Activate relay to disconnect supply (if theft detected)

Step 10: Repeat process continuously

This algorithm ensures continuous monitoring and real-time detection.

CONCLUSION

The proposed IoT Based Power Theft Detection System effectively detects unauthorized electricity usage using real-time monitoring. The system compares supply and load power values to identify mismatches. IoT technology enables continuous data transmission to the cloud platform. Instant alerts are generated when theft is detected. The relay mechanism helps in automatic power disconnection. The system reduces manual inspection and human errors. It is cost-effective, reliable, and easy to implement. Overall, the project enhances energy security and supports smart grid development.

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