IOT Based Energy Meter Reading

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ABSTRACT

An IoT-based energy meter system automatically monitors and transmits energy consumption data over the internet, replacing manual meter readings to improve efficiency, reduce errors, and combat power theft. These systems use microcontrollers, such as an Arduino or ESP8266, to collect data from an energy meter and transmit it to a cloud platform or web server for real-time access by consumers and utilities To automate the manual process of reading energy meters, making data accessible remotely and in real-time.

Keywords: Keywords for IoT-based energy meter readings include core terms like IoT, smart meter, energy monitoring, automatic meter reading (AMR), and cloud connectivity

INTRODUCTION

The Internet of Things (IoT) is revolutionizing traditional energy meters by transforming them into smart systems. An IoT-based energy meter reader enables automatic monitoring and data transmission without the need for manual intervention. It uses sensors, microcontrollers, and communication modules to record energy consumption and send the data in real time to web or mobile applications. This approach not only reduces human error and manpower requirements but also improves energy management and monitoring efficiency An IoT-based energy meter is a smart device that uses Internet of Things (IoT) technology to automatically collect and transmit electricity consumption data over the internet, enabling real time remote monitoring, automated billing, energy theft detection, and remote load control for both consumers and utility companies**.**

LITERATURE SURVEY

Arun Singh, K. S. and Dr. Gaayathry K. (2021): This paper presents a smart electricity meter using a NodeMCU for cloud transmission and automatic billing, applicable to industrial and domestic purposes.

• **Arun V S et al. (2020**): A review paper on smart energy meters that analyzes the energy consumption and facilitates automatic bill generation, providing remote access to readings.

• **P. S. Sreejith et al. (2022):** This paper proposes a low-cost, real-time ARM-based energy management system with a web server for collecting consumption data**.**

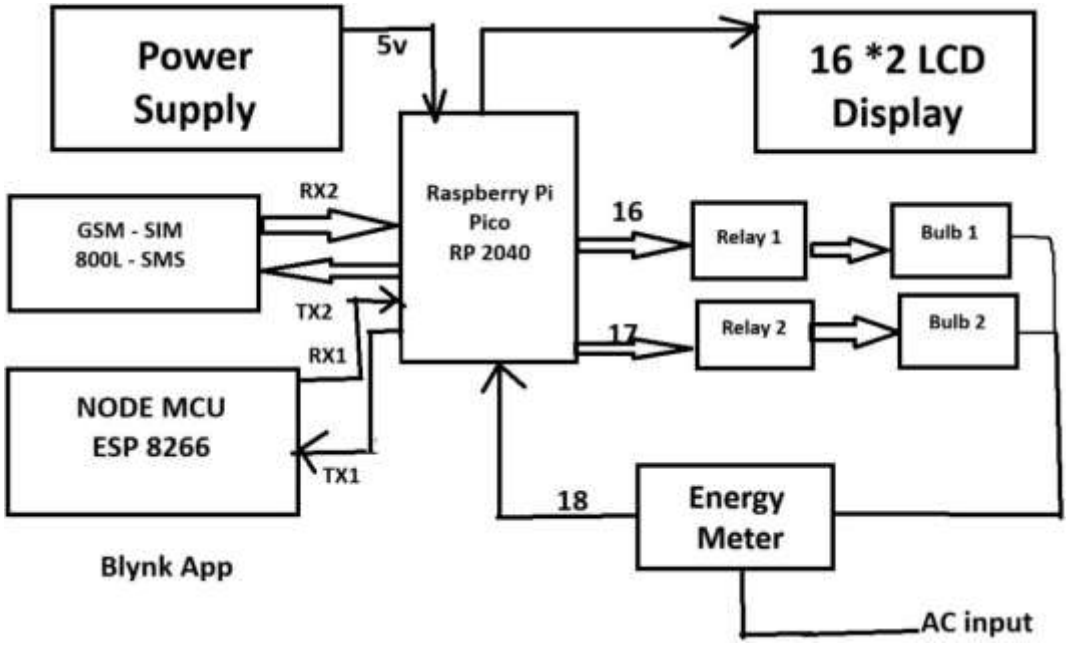
• **IJARCCE.com (2020):** Published in the International Journal of Advanced Research in Computer and Communication Engineering, this paper reviews smart energy meters, focusing on automatic bill generation and labor reduction.

• **SATHYABAMA (2022):** A technical report for a project on an IoT-based prepaid smart energy meter, outlining components like Arduino Uno and various communication protocols. An IoT-Based Smart

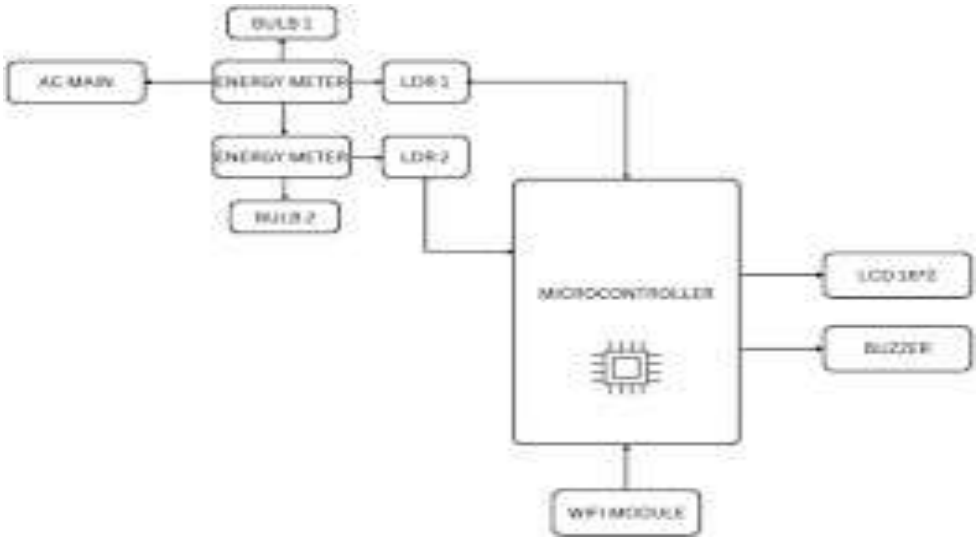
Energy Meter with Real-Time Power Tracking System: A Review" (2021): Published in IEEE Xplore, this paper reviews the design and development of IoT-based smart energy meters with real-time power monitoring, including details on hardware, software, and communication technologies.

BLOCK DIAGRAM

An ESP32-based smart energy meter block diagram includes an ESP32 microcontroller, AC voltage and current sensors (like ZMPT101B and ACS712 or PZEM-004T), a power supply, an optional display (LCD or OLED), and an IoT platform (like Blynk or ThingSpeak) for data transmission and monitoring The diagram illustrates how AC power is measured, processed by the ESP32 to calculate energy consumption, and then sent wirelessly for remote viewing and analysis.



Flow Chart



WORKING

An IoT-based energy meter with a Raspberry Pi typically involves an energy meter providing pulse output, which is fed to a Raspberry Pi for processing and data transmission via Wi-Fi to a cloud platform or server for display, billing, and alerts. A typical flow chart includes the energy meter capturing consumption, the Raspberry Pi processing this data, sending it to a central server or IoT platform, and generating user-facing data through apps or email, alongside features like remote control of connected loads.

The meter is equipped with sensors (e.g., current and voltage sensors) to measure key electrical parameters in real-time.

These sensors often work on principles like Faraday's law of electromagnetic induction, which creates a magnetic field around a current-carrying conductor, or the Hall-effect, which measures the magnetic field produced by the current.

The sensor data is fed into a microcontroller (like an Arduino or ESP32) which processes the information to calculate energy consumption (often in kWh).

ADVANTAGES

Automatic Reading: Eliminates the need for manual meter reading.

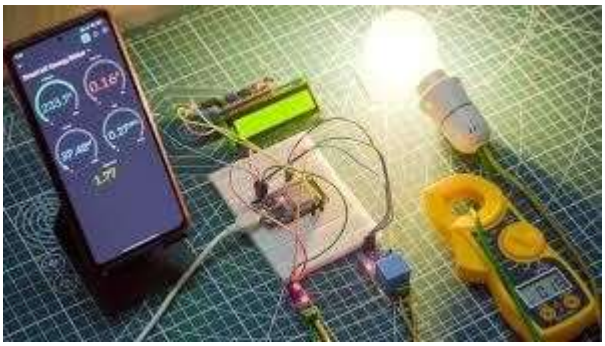
- Real-Time Monitoring: Users and providers can track energy usage instantly.
- Accurate Billing: Reduces errors in electricity bills.
- Time &Cost Saving: Minimizes manpower and operational costs.
- Remote Access: Readings available via mobile or web applications.
- Energy Management: Helps identify usage patterns for better conservation.
- Scalability: Can be expanded for smart grid and smart city applications

DISADVANTAGES

High Initial Cost: Requires investment in sensors, Raspberry Pi, and modules.

- Internet Dependency: Needs a stable internet connection for real time updates.
- Maintenance Issues: Hardware and software may need regular updates and servicing.
- Security Risks: Possibility of data hacking or unauthorized access.
- Power Supply Requirement: Continuous power is necessary for proper functioning

ACTUAL SETUP



CONCLUSION

An IoT-based energy meter using a Raspberry Pi offers real-time remote monitoring of energy consumption, enabling automated billing, power management, and theft prevention. Key benefits include increased accuracy, reduced human error, cost savings through energy conservation, and enhanced customer awareness. The system achieves this by collecting meter data, sending it to a cloud platform via a Raspberry Pi, and presenting it through user-friendly mobile or web applications for data analysis and control.

REFERENCES

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2. "IoT Based Smart Energy Metering System for Monitoring the Domestic Load Using PLC and SCADA" (2021). Focus: A system using PLC and SCADA to send data wirelessly to the internet for remote monitoring and power theft detection.

3. **SATHYABAMA: "iot based prepaid smart energy meter" (April 30, 2022). Focus:** A prepaid system that alerts consumers of low balance via mobile and automatically disconnects power when the balance reaches zero. ResearchGate:

4. **"Smart Energy Meter and Monitoring System using Internet of Things" (August 09, 2023).** Focus: An IoT system using ESP32 and Blynk app for remote energy monitoring and theft detection. IJERA (International Journal on Emerging Research Areas):

5. **"Smart Meter using Blockchain" (July 16, 2024). Focus:** A proposal for an automated, secure energy metering device that records energy consumption on a blockchain ledger and enables crypto-based payments.