IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 2, November 2026
Impact Factor: 8.2

Smart Power Monitoring System for Home Appliances.

Santhanahalli Preethi[1], Shalini P. Lutimath[2], R. Sneha[3], Triptee[4], Vinay Kumar Havinal[5]
Students, Department of Electrical and Electronics Engineering[1-4]
Assistant Professor, Department of Electrical and Electronics Engineering[5]
Rao Bahadur Y. Mahabaleswarappa Engineering College, Ballari, India

Abstract : *The Smart power monitoring system for home appliances is designed to improve electrical energy management, safety, and reliability in residential buildings. The main objective of this project is to continuously monitor the electrical parameters such as voltage, current, power, and energy consumption of home appliances in real time. The system uses sensors, a microcontroller, and IoT technology to collect and analyse electrical data. It can automatically detect abnormal conditions such as overvoltage, undervoltage, overload, short circuits, and excessive power consumption. When a fault occurs, the system activates protective mechanisms to isolate the affected circuit and prevent damage to electrical appliances. The self-healing feature helps restore normal operation automatically when safe operating conditions are confirmed. The adaptive monitoring feature analyses energy usage patterns and helps optimize electricity consumption. Users can monitor the system through a mobile application and receive instant notifications about faults and energy usage. This project aims to reduce electricity wastage, improve household electrical safety, minimize manual intervention, and ensure reliable and efficient power management.*

Keywords: Smart Home, Energy Monitoring, Self-Healing System, IoT, Fault Detection, Electrical Protection, Microcontroller, Energy Efficiency

I. INTRODUCTION

Electrical energy is one of the most important resources used in our daily lives, especially in residential buildings. Various home appliances such as fans, lights, refrigerators, air conditioners, televisions, and washing machines consume electricity regularly. However, many people are unaware of the amount of power consumed by individual appliances, which can lead to unnecessary energy wastage and increased electricity bills.

The Smart Power Monitoring System for Home Appliances is designed to monitor and manage the electrical energy consumption of household appliances efficiently. The system uses sensors, a microcontroller such as ESP32, and IoT technology to measure important electrical parameters, including voltage, current, power, and energy consumption in real time. The collected data is processed by the microcontroller and displayed through a mobile application or web dashboard, allowing users to monitor the electricity consumption of connected appliances. The system can also identify excessive power consumption and detect abnormal electrical conditions such as overload, overvoltage, and undervoltage. Notifications can be sent to users whenever abnormal conditions are detected. This project helps users understand their electricity usage, identify high-energy-consuming appliances, and take necessary actions to reduce power consumption. It aims to improve energy efficiency, reduce electricity costs, promote electrical safety, and encourage smart energy management in residential buildings. Overall, the Smart Power Monitoring System provides an effective and user-friendly solution for monitoring household electricity consumption using modern embedded systems and IoT technology.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 2, November 2026
Impact Factor: 8.2

II. OBJECTIVES

The main objectives of the proposed work are:

- To monitor the voltage, current, power, and energy consumption of home appliances in real time.
- To measure the electricity consumption of individual appliances.
- To identify appliances that consume excessive electrical energy.
- To detect abnormal electrical conditions such as overvoltage, undervoltage, and overload.
- To provide real-time energy consumption data through an IoT-based monitoring system.
- To display power consumption details through a mobile application or web dashboard.
- To reduce electricity wastage and improve energy efficiency.
- To help users monitor and manage electricity usage effectively.
- To provide alerts and notifications during abnormal electrical conditions.
- To promote safe, reliable, and efficient energy management in homes.

III. SCOPE

The project focuses on real-time monitoring of household energy consumption, automatic detection of electrical faults, and protection of home appliances. It uses IoT technology for remote monitoring and alerts, along with a self-healing mechanism for safe power restoration. In the future, the system can be enhanced with artificial intelligence, solar energy integration, and smart load management to improve energy efficiency and electrical safety.

IV. SYSTEM DESCRIPTION

Hardware Requirements

- ESP32 Microcontroller.
- Voltage Sensor.
- Current Sensor.
- Relay Module.
- LCD Display.
- Buzzer.
- Power Supply Unit.
- Wi-Fi Communication Module.

Software Requirements

Arduino IDE, Embedded C/C++, Blynk IoT, Wi-Fi Connectivity, IoT Cloud, Fault Detection Algorithm, Energy Analysis.

Working Principle

The Smart Power Monitoring System for home appliances works by continuously monitoring the voltage, current, power, and energy consumption of household appliances using sensors. The ESP32 microcontroller processes the collected data and displays the readings on an LCD and mobile application through Wi-Fi. When abnormal conditions such as overvoltage, undervoltage, or overload are detected, the system automatically disconnects the affected circuit using a relay or suitable protection device and sends an alert to the user. Once the fault is cleared and safe operating conditions are verified, the system restores the power supply automatically where permitted. This helps improve electrical safety, reduce energy wastage, and ensure reliable operation of home appliances.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 2, November 2026
Impact Factor: 8.2

V. EXPECTED RESULT

The system is expected to monitor household energy consumption in real time, detect electrical faults, and automatically disconnect affected circuits for protection. It provides energy usage details and fault alerts through a mobile application. After verifying safe conditions, it restores the power supply automatically, improving electrical safety, reducing energy wastage, and ensuring efficient power management

VI. CONCLUSION

The Adaptive Self-Healing Smart Home Energy Monitoring and Protection System provides an efficient solution for monitoring energy consumption and protecting household appliances. It detects electrical faults, provides automatic protection, and enables remote monitoring through IoT technology. This system improves electrical safety, reduces energy wastage, minimizes manual intervention, and promotes reliable and efficient energy management in smart homes.

VII. ACKNOWLEDGMENT

The authors would like to thank the guide, Mr.Vinay Kumar Havinal , the project coordinators, and the Head of the Department of Electrical and Electronics Engineering, Rao Bahadur Y. Mahabaleswarappa Engineering College, Ballari, for their guidance and support.

REFERENCES

1. H. Ghayvat et al., “IoT-based Smart Energy Management Systems: A Review,” IEEE Access, 2020.
2. ESP32 and Arduino Official Documentation.