WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Power Monitoring System with Stripping and Scheduling Feature

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DOI : https://doi.org/10.55248/gengpi.6.0325.11161

ABSTRACT:

Effective energy management is essential in today's homes and workplaces. The goal of the Power Monitoring System with Stripping and Scheduling Features described in this paper is to increase energy efficiency and reduce unnecessary power consumption. The system enables real-time energy monitoring, automated power stripping for dormant or faulty devices, and device scheduling. To do this, we designed a circuit that continuously monitors energy consumption. In order to prevent waste, the technology may instantly stop the device's power when it notices unexpected power usage. The scheduling feature, which ensures efficient power use without requiring human input, also allows users to create device operation periods.

Keywords: power energy monitoring system, stripping and scheduling features.

Introduction:

Energy efficiency has become a crucial concern in the modern world due to the increasing dependence on electrical devices in homes and workplaces. Power waste, which usually results from devices operating excessively or malfunctioning, is one of the primary drivers of rising energy consumption and electricity costs. As energy costs increase and environmental sustainability becomes more significant, systems that can intelligently manage power usage are more important than ever. This project offers a power monitoring system with scheduling and stripping features to address these problems.

The system aims to provide a solut”on by providing real-time power usage monitoring, scheduling device operations based on user preferences, and automatically cutting off power to devices when they are not in use or malfunctioning. The primary objectives of this initiative are to reduce energy waste, improve device control, and ultimately reduce electricity costs for consumers. By combining these ingenious characteristics, the system offers a practical way to optimize energy use in both residential and commercial settings. By giving consumers more control over how their electrical devices function, this research not only saves energy but also advances the broader goal of sustainable energy practices.

LITERATURE REVIEW:

The saving and monitoring the usage of electricity is became a serious concern due to rising electricity bills(cost) as well as environmental concern.The below are some papers were reviewed for the past experience and innovation in this field,these papers have explored solutions,for this problems.

i)**A Home Energy Management System for Energy-Efficient Smart Homes (Hyunjeong Lee, Wan-Ki Park, Il-Woo Lee)**

There study proposed a Home Energy Management System (HEMS) that introduced concept smart plugs, occupancy sensors, and a home network to track and control energy usage. The system enables real-time monitoring, allowing users to manage their devices remotely and prevent unnecessary power consumption. Additionally,some features were also involved in this system.

ii) Smart Home Appliances Scheduling to Manage Energy Usage (O.A. Alimi, K. Ouahada)

This research work focused on appliance scheduling strategies to improve energy efficiency in residential areas such as building and society. The study categorized appliances based on their operational periods and developed an intelligent scheduling model to run devices during off-peak hours, lowering energy costs. By implementing demand-side management (DSM) techniques, the system ensured minimal energy wastage while maintaining user convenience. This research highlighted the importance of structured scheduling and automated power control in achieving sustainable energy consumption.

These studies provided a foundation for our work, which enhanced our idea for energy monitoring with automated power stripping and scheduling. By studying these existing solutions, our system offers a custom-designed power strip with real-time monitoring capabilities, effectively reducing standby power consumption ith that it also provide user-defined scheduling for better energy management.More papers was also provided ideas related to this.

Problem Definition:

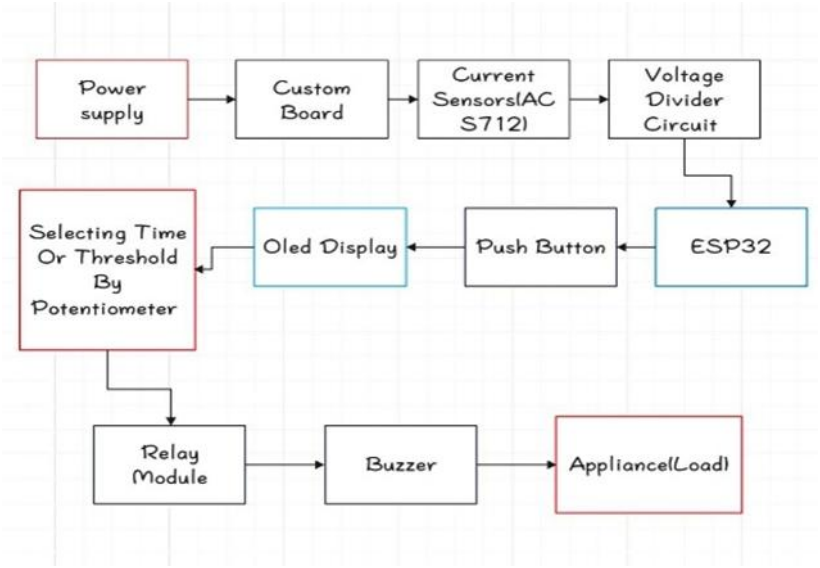
In today's world, people depend heavily on electrical appliances for daily activities. With the increasing use of appliances, energy consumption is also rising. One of the major issue is that many devices continue to consume some power even when not actively in use. For example, an oven left plugged in or an air conditioner on standby still consumes electricity. But, there is no automatic system to detect and cut off standby power to prevent unnecessary energy wastage.

Another challenge is that if a older appliance often consume more energy than their rated capacity, leading to inefficient power usage. Identifying such devices is crucial to sufficient electricity consumption. Additionally, users often forget to turn off appliances, causing to extra energy wastage.

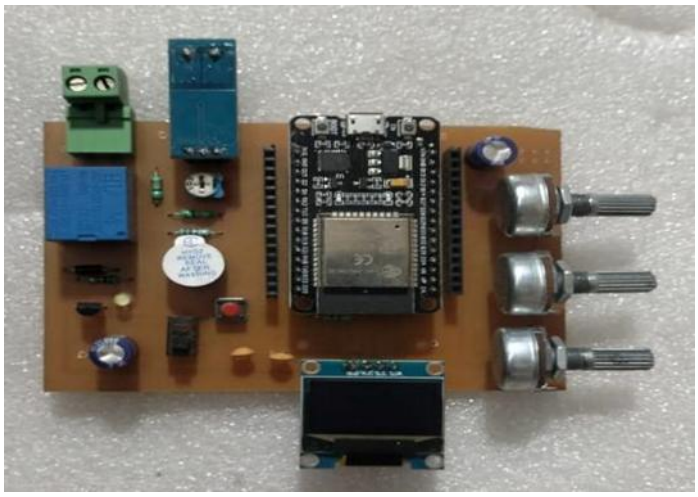
To solve these issues, an efficient energy monitoring and power stripping is required. This system should detect standby power usage, track energy consumption of individual devices, and allow scheduled time of appliances manually.

Methodology:

Flowchart/Block diagram:



Circuit On PCB Board:



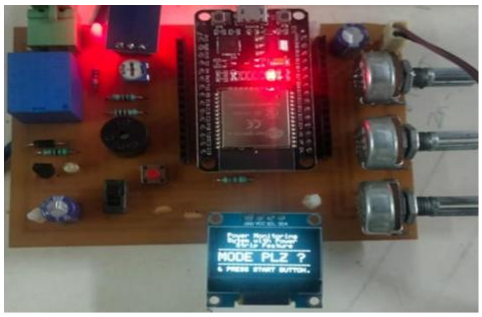
The above two figures showed the idea and design of this device.

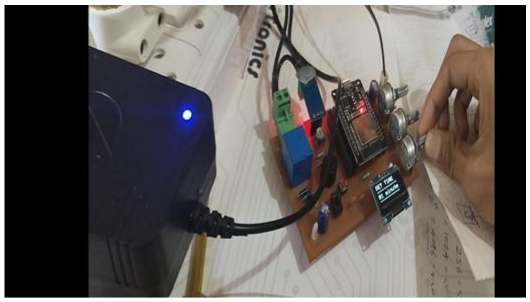
The Energy Monitoring System with Power Strip Feature is designed to optimize power consumption by automatically cutting off standby appliances, allowing time-based scheduling, and displaying real-time energy usage. The system operates by supplying 230V AC to a custom-designed board where appliances are plugged in. An ESP32 microcontroller processes data from the ACS712 current sensor, monitoring power usage. Users can select between Threshold Mode, which strips power if consumption drops below a set level for selected seconds, and Time Scheduling Mode, where

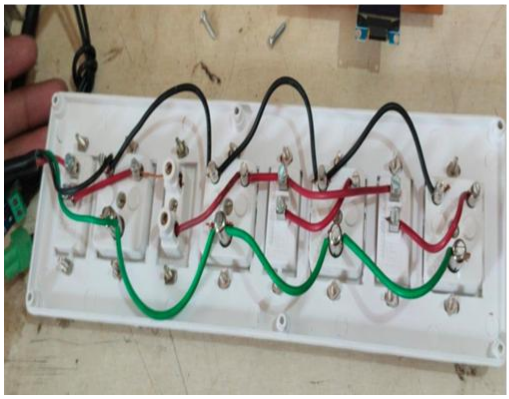
appliances turn off after a user-defined duration. The relay module controls power delivery, while an OLED display provides real-time monitoring and an Interface for user input. A voltage divider circuit ensures proper voltage regulation for ESP32, and a freewheeling diode protects against voltage spikes. The system also provide a watchdog timer to enhance reliability. This approach effectively reduces phantom loads, prevents unnecessary energy consumption, and enhances overall power management.

Implementation and Results

The Energy Monitoring System with Power Strip Feature was successfully implemented on a custom PCB, integrating an ESP32 microcontroller, ACS712 current sensor, relay module, and an OLED display. The system was tested with various household appliances, confirming its ability to strip power when devices entered standby mode and schedule power usage as per user-defined settings. The threshold mechanism accurately detected low power consumption, triggering power cutoff only if usage remained below the set limit for selected seconds. Real-time power readings were displayed, ensuring precise energy monitoring. The system performed reliably, with the watchdog timer preventing unexpected failures. Testing results showed a measurable reduction in standby power consumption, demonstrating the system's effectiveness in preventing phantom loads and optimizing energy use.







Conclusion& Future Scope

The project successfully addresses energy wastage due to standby power consumption by providing automatic power stripping, scheduled timer and real-time monitoring. The system effectively reduces electricity usage, making it a cost-effective and sustainable solution for household and office environments. Future improvements could include IoT integration for remote control, machine learning algorithms for predictive energy management, and compatibility with renewable energy sources for further efficiency. Expanding the system to support multiple devices with individual power monitoring could enhance its usability.

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