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Research Article

INTELLIGENT MCB RESET MECHANISM WITH BLUETOOTH INTEGRATION

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Abstract: This paper presents a smart solar cooling system integrated with the Internet of Things (IoT) for enhanced control and efficiency. The system consists of a solar-powered absorption cooling unit connected to an IoT platform, allowing for remote monitoring and management. Sensors within the platform collect real-time data on temperature, humidity, and solar radiation, optimizing the system's performance. Designed for high-temperature regions with limited electricity access, such as rural and remote areas, the system offers an energy-efficient and cost-effective cooling solution. The study's findings indicate that the smart solar cooling system effectively provides cooling, while IoT integration enables real-time performance monitoring and optimization, enhancing overall efficiency.

Keywords : Breaker Panel, Distribution Panel, Circuit Breaker, Electrical Power, Current Sensor

INTRODUCTION

Electricity continues to be vital despite the increasing manufacturing and use of electrical devices [1]. Traditional electrical distribution panels function as central nodes that transmit electricity to different appliances in household and business settings in Ghana, where hydroelectric power is the main energy source [2]. These buildings are powered by the national utility provider, and as the primary supply line ends at the distribution board, it acts as an interface between the end consumers and the main power supply [3][4]. In a building's electrical architecture, distribution panels are essential for controlling and safeguarding several electrical circuits that branch off of a single main line [5]. By separating problematic circuits, including those impacted by short circuits [6], they improve system reliability without affecting other network segments. They also offer a way to keep an eye on how much energy is being used at home [7]. To safeguard individual circuits, early systems used fuses, which needed to be changed when they blew because of problems like overloads, ground faults, or short circuits [8]. Resettable protection with increased load-handling capability was made possible by the invention of circuit breakers [9].

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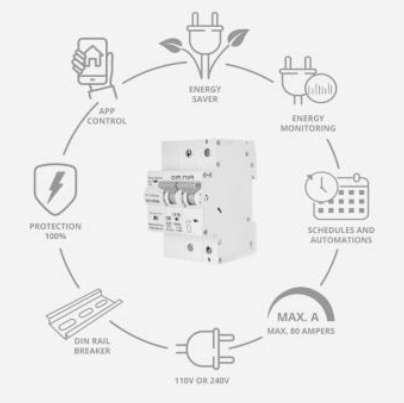

Fig. 1 Intelligent Miniature Circuit Breaker

OBJECTIVE

The goal of the Intelligent MCB Reset Mechanism with Bluetooth Integration is to design a wireless, automated system that enables users to remotely reset Miniature Circuit Breakers (MCBs) using Bluetooth technology. This system allows users to transmit a reset command via an Android application to an ESP32 microcontroller, which then triggers a servo motor to automatically switch the MCB back to the ON position. The project focuses on enhancing convenience and safety while minimizing the need for manual intervention in circuit breaker resets. By providing a more efficient and user-friendly approach, this system improves the management of electrical circuits in both residential and industrial settings.

BLOCK DAIGRAM

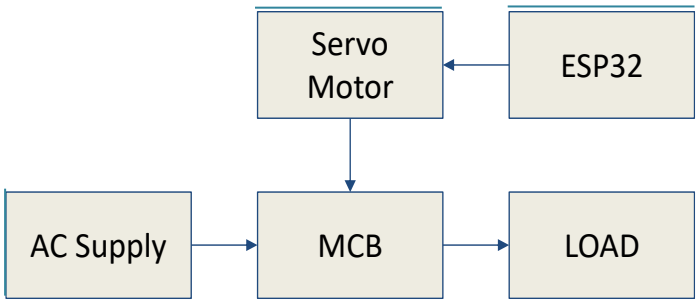

Fig. 2 :- Block Diagram

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ESP32 and Bluetooth Setup

The system begins by powering up the ESP32 microcontroller, which comes with Bluetooth functionality. The ESP32 establishes a wireless connection with an Android device, enabling seamless communication.

Android App Communication

The user installs and launches an Android application designed to interface with the ESP32 microcontroller. Through this app, users can control the Miniature Circuit Breaker (MCB) by sending specific commands via Bluetooth.

Signal Transmission

If the MCB trips and turns OFF, the user sends a reset command from the mobile app. This signal is transmitted wirelessly to the ESP32 microcontroller via Bluetooth.

Servo Motor Activation

Upon receiving the reset signal, the ESP32 processes the command and activates a servo motor attached to the MCB switch. The servo motor is physically connected to the MCB lever and rotates accordingly to restore the MCB to the ON position.

MCB Reset

The servo motor executes the required motion to reset the MCB, restoring power to the electrical circuit without manual intervention.

Real-Time Control

The system enables real-time control, allowing users to manage the MCB remotely through any Bluetooth-enabled device, such as a smartphone or tablet.

Efficient and User-Friendly Design

The entire process is wireless, remote-controlled, and highly efficient. Since users do not need to physically approach the MCB panel, the system is especially beneficial for hard-to-reach locations or industrial environments.

ADVANTAGES

1. **Remote Control:** Users can reset the **MCB remotely** via a **smartphone or tablet** using **Bluetooth**, eliminating the need for physical interaction with the circuit breaker.
2. **User-Friendly Interface:** The **Android application** offers an **intuitive and easy-to-use interface**, allowing users to control the **MCB with just a few taps**.
3. **Real-Time Operation:** The system enables **instant MCB reset** as soon as the reset command is sent from the app, ensuring **quick restoration of power**.
4. **Enhanced Safety:** By enabling **remote operation**, the system minimizes **direct contact with the MCB**, reducing the risk of **electrical shock or hazards**.
5. **Cost-Effective Solution:** The system leverages **affordable Bluetooth and microcontroller technology**, making it a **budget-friendly** approach to managing circuit breakers.

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6. **Seamless Integration:** The **ESP32 microcontroller** and **Bluetooth module** can be easily integrated into **existing electrical systems**, making it suitable for **residential and industrial applications**.
7. **Energy Efficiency:** The system operates on **low-power Bluetooth communication**, ensuring **minimal energy consumption** for continuous operation.
8. **Scalability and Flexibility:** The design allows for **easy expansion**, enabling users to **control multiple MCBs** across **various locations**, making it ideal for **larger electrical setups**.

CONCLUSION

This paper has presented the development of an Intelligent Miniature Circuit Breaker (IMCB) designed for residential use. The system integrates a microcontroller and current sensors to enhance the intelligence of a distribution panel. It continuously monitors the current flow within the circuit and automatically trips the breaker if the current exceeds a predefined threshold. Once the current level returns to a safe range, the system automatically restores the connection. Additionally, a GSM module is utilized to send real-time alerts to the user when a circuit trip occurs. Future enhancements of this system will include temperature sensors to monitor the heating levels of electrical wires, helping to prevent potential fire hazards caused by overheating. Furthermore, Artificial Intelligence (AI) will be integrated to provide predictive analysis, such as estimating the user's electricity bill based on their historical energy consumption patterns.

AUTHOR(S) CONTRIBUTION

The writers affirm that they have no connections to, or engagement with, any group or body that provides financial or non-financial assistance for the topics or resources covered in this manuscript.

CONFLICTS OF INTEREST

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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