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# Monitoring System for Distribution Box Power Trips

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**Abstract**

Electricity is essential for modern life, powering numerous daily activities. Without proper monitoring, power surges can damage devices, and outages can lead to data loss and reduced equipment lifespan. To mitigate these issues, a trip system in the distribution box disconnects electricity during surges. However, this can impact devices like CCTV cameras, refrigerators, and security systems, especially when homeowners are away. Therefore, this project aims to develop a monitoring system for power trips in distribution boxes, allowing users to supervise and control the miniature circuit breaker (MCB) remotely. Traditional home protection systems require manual reset after a power outage, which is inconvenient and can affect various appliances. This project seeks to automate this process by designing a system to monitor MCB status, using voltage sensors to detect flow, an IoT system with Blynk software for remote management, and ensuring the prototype meets these objectives. The project is limited to domestic use, relies on the home's MCB power supply, and requires Wi-Fi. IoT applications are prevalent in many sectors, including energy and utilities. This project uses the MG996R servo motor for MCB control, the ZMPT101B voltage sensor for monitoring, and the ESP32 Devkit1 microcontroller for connectivity with Blynk software. The system needs a stable 5V power supply with a 3A current to function properly, as the servo motor requires significant power. Previous research has used various microcontrollers like GSM, Arduino, and ESP8266.

## 1. Introduction

Electricity is essential for human existence, especially in today's technologically advanced society where we heavily depend on it for numerous daily tasks. Without adequate monitoring, there are notable risks associated with electricity, including potential dangers that can endanger lives. Unexpected power surges may damage devices by causing overheating and fire hazards, while sudden outages can lead to data loss in electronics such as computers. Additionally, frequent power interruptions can shorten the lifespan of electrical equipment.

MCBs are one of the protective devices that must be installed on all household wiring to safeguard users and equipment. It safeguards your circuitry, electrical appliances and protects you by suspending power supply in circuits during overload and short circuits. As opposed to the traditional fuses, MCBs can be used even after interruption of the circuit. They are generally used in low voltage electrical networks [1]. To address these issues, a trip system is installed in the distribution box to disconnect the electricity in the event of a power surge. Therefore, the development of a monitoring system for distribution box power trips will enable users to supervise and control the miniature circuit breaker (MCB), preventing potential harm due to power shortages.

## 1.1 Problem Statement

A conventional home security system relies on manual intervention, necessitating time and effort to reinstate power supply after a short circuit when the house is empty. This situation is unfavourable as it can impact electrical devices like the refrigerator, CCTV, security system, and alarm system. Hence, there is a need to implement an efficient monitoring system for checking the MCB status, as unexpected voltage spikes due to erratic weather conditions can remotely trip the MCB.

## 1.2 Objectives

The objective of this project is to enhance home electrical safety and convenience through a sophisticated monitoring system for miniature circuit breakers (MCBs). Firstly, the project aims to identify the voltage flow through the MCB using a voltage sensor, which is crucial for detecting anomalies and ensuring stable power supply. Secondly, it seeks to create an Internet of Things (IoT) system that enables users to monitor and manage the MCB remotely using Blynk software, providing real-time insights and control over the electrical system. Finally, the project involves verifying the condition of the prototype to ensure it meets the established objectives, ensuring reliability and effectiveness in real-world applications. This comprehensive approach not only addresses immediate safety concerns but also enhances the overall efficiency and user control of home electrical systems.

## 1.3 Scope

The scope of this project is specifically tailored to enhance residential electrical safety by focusing on key parameters and components. The voltage range for the project is confined to 240V, suitable for standard household electricity and ensuring compatibility with miniature circuit breakers (MCBs). The project employs the ZMPT101B voltage sensor to accurately detect voltage levels, which is essential for monitoring and identifying fluctuations. Additionally, the system utilizes the high torque servo motor MG996R to physically manipulate the MCB, providing the necessary force to pull the breaker when required. The project is conducted exclusively within residential single-phase electrical systems, targeting homes and ensuring the application is relevant to everyday users. The primary focus of the project is on managing sudden voltage surges, which can pose significant risks to electrical devices and overall household safety. By addressing these specific aspects, the project aims to provide a reliable and effective solution for monitoring and managing residential electrical systems.

## 1.4 Literature Review

IoT applications have been extensively adopted by various companies and organizations across multiple sectors, leveraging their ability to enhance efficiency, connectivity, and data management.[6] IoT-based applications are utilized in diverse fields such as agriculture, where they enable precision farming through real-time monitoring of soil conditions and crop health[7]; healthcare, where they facilitate remote patient monitoring and advanced diagnostics; manufacturing, where they optimize production processes and predictive maintenance; energy and utilities, where they enhance grid management and energy efficiency; and transportation, where they improve traffic management and vehicle tracking. This project specifically focuses on the energy and utilities sector, aiming to improve residential electrical safety and management.

In this project, the high torque servo motor MG996R is used as the control system to actuate the miniature circuit breaker (MCB), providing the necessary force to turn it on or off. For monitoring purposes, the voltage sensor ZMPT101B is employed to detect voltage flow through the MCB, ensuring accurate and real-time data collection. The Blynk software is utilized for designing the user interface, chosen for its compatibility with the microcontroller used in this project, the ESP32 Devkit1. The ESP32 by Espressif is pre-configured to work seamlessly with the Blynk IoT platform, enabling developers to easily connect their devices and take full advantage of Blynk's features, such as real-time data visualization and remote-control capabilities.[1]

The creation of this system requires a well-designed setup involving the microcontroller, servo motor, and power supply. Microcontrollers are sensitive to voltage fluctuations, which can damage them if not properly managed. Therefore, the power source must deliver a stable 5V output and sustain a current of 3A, as the high torque servo motor demands a significant current to function correctly. Previous research has explored the use of various microcontrollers, including GSM, Arduino, and ESP8266, highlighting the versatility and adaptability of these components in IoT applications.[2],[3],[4],[5]. By integrating these elements, the project aims to provide a robust and reliable solution for monitoring and managing residential electrical systems, ensuring safety and efficiency.

## 2. Methodology

### 2.1 System Block Diagram

In the system flow of this project, power moves from the main supply to the ELCB, then to the MCB, and finally to the load through the distribution box. To enhance the project functionality, an ESP32 Devkit will be introduced as a signal transmitter. The ESP32 Devkit requires power to operate, hence the necessity of a backup power supply, which can be a battery or a power bank. Additionally, a voltage sensor is essential for detecting voltage flow in the MCB to enable the ESP32 Devkit to monitor the voltage. In the absence of voltage flow, the ESP32 Devkit will send notifications to the Blynk Software via Wi-Fi. The servo motor is the final component, responsible for turning the MCB on when it is off. Figure 1 illustrates a visual block diagram depicting how the system operates.

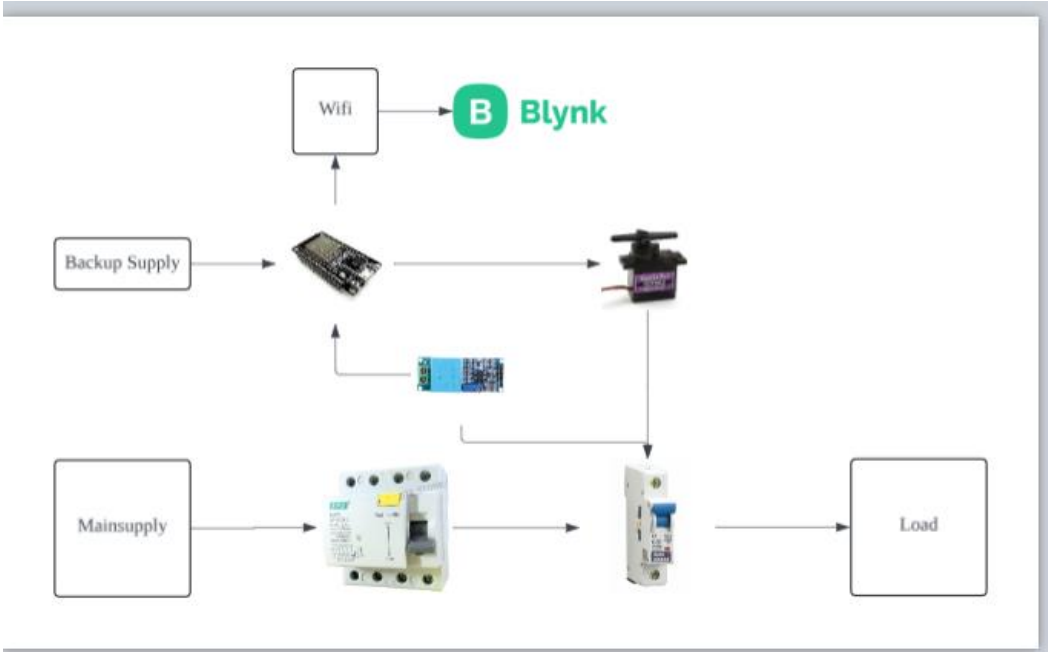


**Figure 1 System Block Diagram**

### 2.2 Circuit Design

The current project employed Proteus software to create a circuit design, demonstrating the circuit layout and the interconnections between various components. The circuit design shown in Figure 2 Arduino Uno Circuit Diagram will be implemented, and it was developed using Proteus software.

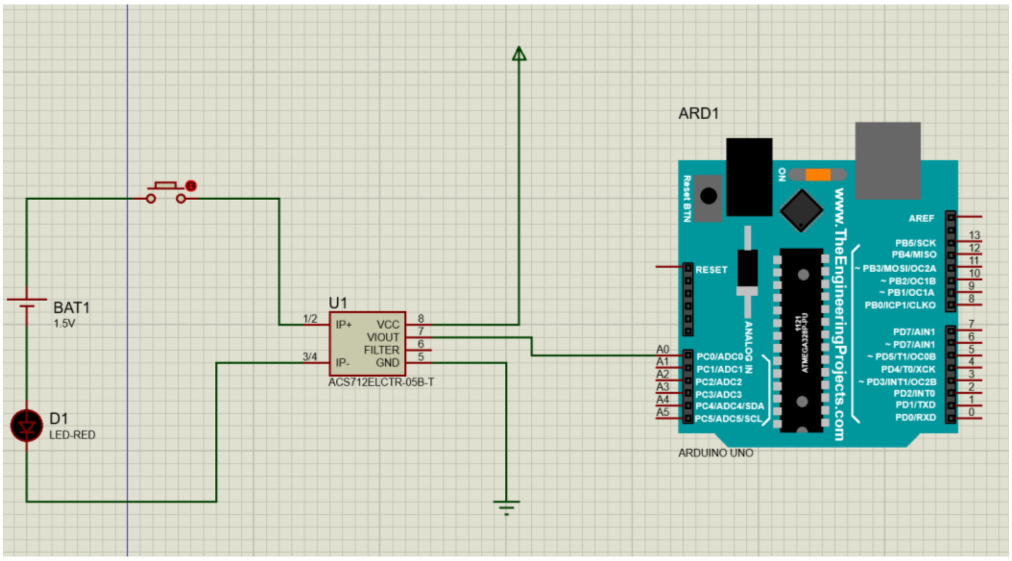


**Figure 2 Arduino Uno Circuit Diagram**

## 2.3 Blynk Setup

Blynk software is used to design the software and it can be used for the laptop, tablet or phone. Figure 3 shows the Datastream after the design is completed. Figure 4 shows the interface for the Blynk in the phone.

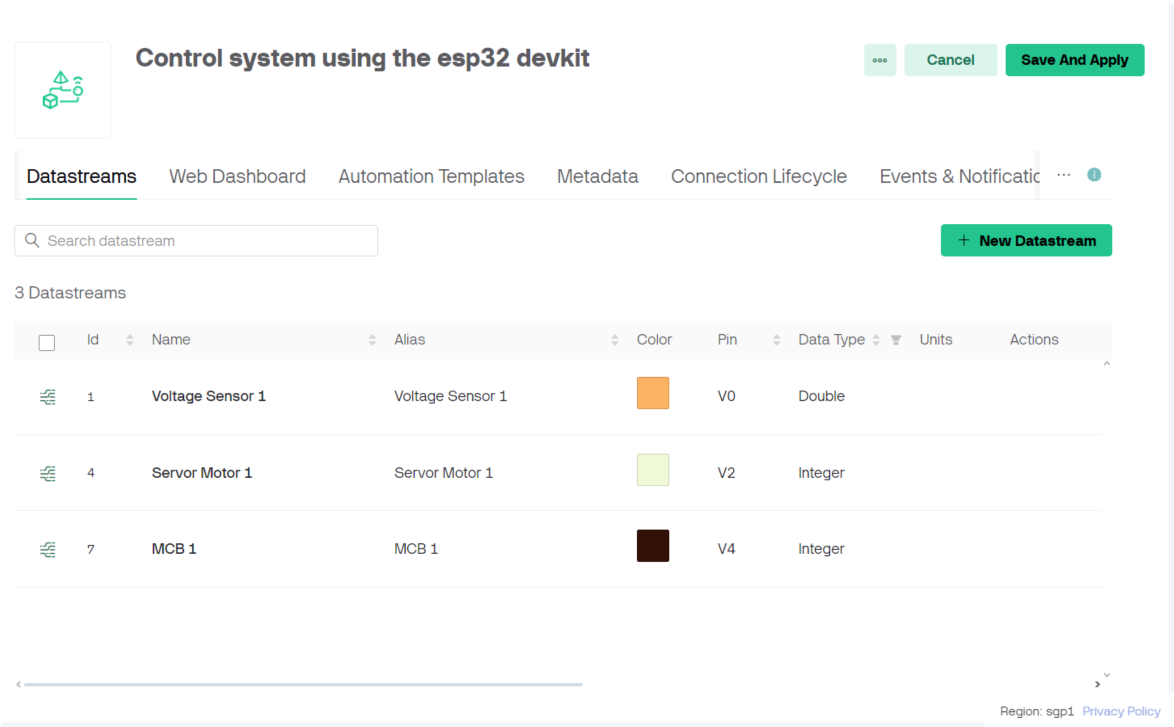


**Figure 3 Blynk Datastream**

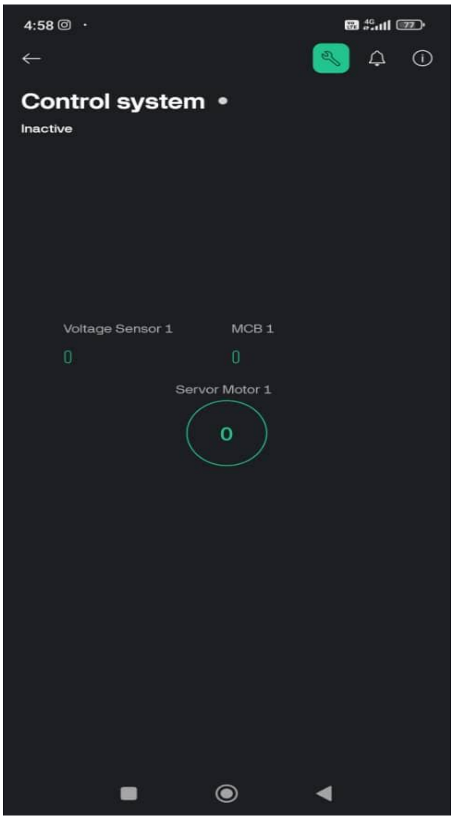


**Figure 4 Blynk interface in Phone**

## 3. Result and Discussion

When MCB is in OFF condition, there will be no increase in the voltage reading and it remain 0 while the load will not receive any supply causing it not to light up. When the MCB is in OFF condition the servo motor will be in the original condition which is 0 degree. Figure 5 show the MCB is in Off Condition which will cause the bulb to not light up since there is no voltage flow through the MCB. Figure 6 show the Blynk interface when the MCB in OFF condition and no voltage flow.

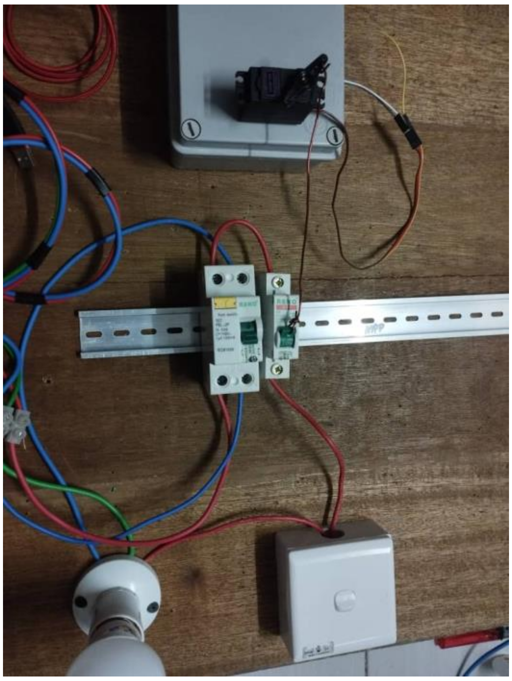

**Figure 5 MCB in Off Condition**

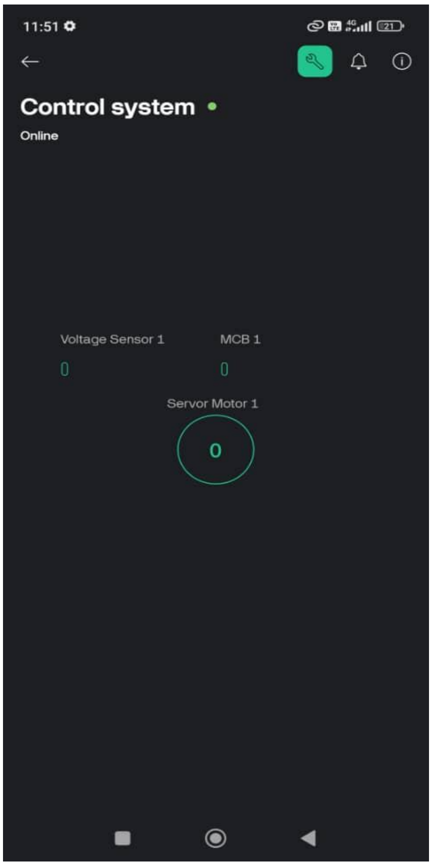


**Figure 6 Blynk Interface when MCB is OFF**

When MCB is in ON condition, the voltage will increase to 239V. The voltage is based on the main supply and when the MCB is ON the load will receive supply and causing the bulb to light up. When the MCB is ON, servo motor will be move anti-clockwise for 110 degrees to turn the MCB ON and act as the control system for the MCB. The servo motor can be control through the Blynk software. Figure 7 show the MCB is in ON Condition which will cause the bulb to light up since there is voltage flow through the MCB. Figure 8 show the Blynk interface when the MCB in ON condition and voltage flow.

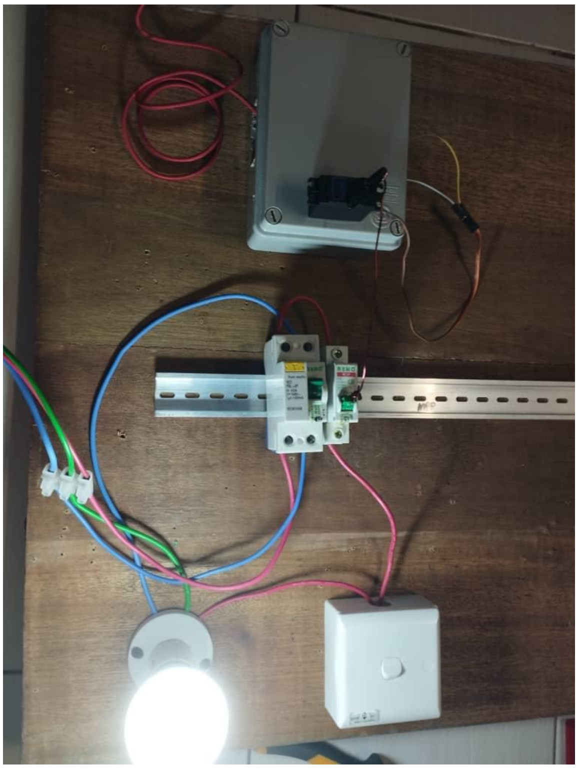

**Figure 7 MCB is in ON Condition**

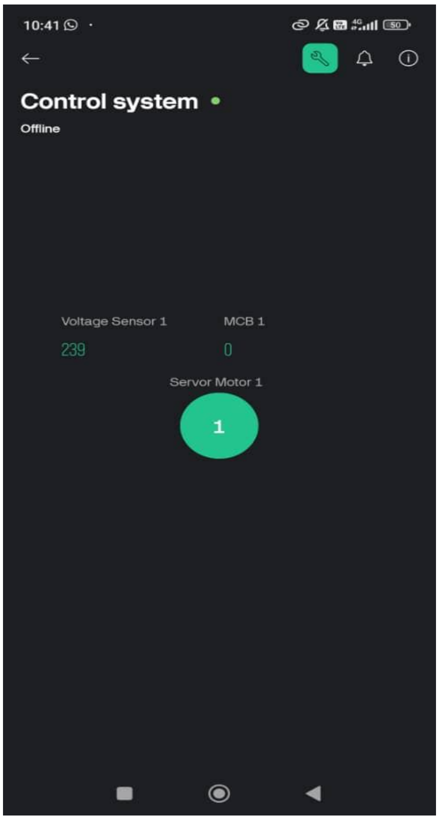


**Figure 8 Blynk interface when MCB is ON**

## 4. Conclusion

The project "Monitoring System for Distribution Box Power Trips" is nearing completion for potential commercial marketing, with a focus on residential applications. The goal is to create a real-time monitoring system for distribution boxes that can promptly alert users to power outages. The main objective is to address power disruptions by automatically restoring power when the MCB trips, often caused by surge currents like those from lightning strikes.

This initiative relies on the ESP-32 Devkit V1 for its Wi-Fi capabilities, which are essential for managing the MCB. The Blynk platform is used as the interface for MCB control. The device is particularly valuable for residential settings, especially during extended absences, as it can notify users of any incidents and enable them to reset the circuit breaker remotely. This capability helps prevent potential electrical problems in unattended homes.

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