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Android App-based Circuit Breaker

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ABSTRACT: The advancement in smart technologies has paved the way for remote control of electrical appliances using Android applications. This paper presents an Android app-based circuit breaker system that allows users to remotely monitor and control the status of electrical circuits for safety, convenience, and energy efficiency. The system uses a microcontroller, Bluetooth module, and relay system interfaced with an Android app. This innovation aims to provide a cost-effective and reliable solution for households and industries to manage power consumption and ensure circuit protection. Testing has shown successful results in controlling circuit breakers wirelessly, thus enhancing safety and control measures.

I. INTRODUCTION

Modern electrical systems require advanced methods for monitoring and control to prevent electrical hazards and enhance operational efficiency. Traditional circuit breakers, though effective, lack remote control capabilities, which is essential in today's smart homes and industrial automation.

The objective of this paper is to design and develop a circuit breaker controlled via an Android application. The system integrates microcontrollers, Bluetooth technology, and a relay mechanism to control the circuit breaker's operation wirelessly.

Objectives:

- Develop a user-friendly Android app for circuit breaker control.
- Enhance electrical safety through remote circuit disconnection.
- Enable real-time monitoring of circuit status.
- Reduce manual intervention in power management.

II. PROBLEM STATEMENT

Electrical accidents involving linemen are increasingly common during the repair of electrical lines. One of the primary reasons for these accidents is the lack of proper communication between the electrical substation and the maintenance staff (linemen). In the event of a fault, linemen may not have sufficient control over the electrical circuits, leading to accidental exposure to live wires, which can result in severe injury or even death.

In the current setup, when a fault or short circuit occurs, the power network experiences a high fault current that can damage equipment and pose significant risks to the safety of workers. The lack of a rapid, efficient way to cut off the power supply or isolate faulty sections of the network often exacerbates the danger to linemen.

III. LITERATURE SURVEY

3.1.1 Paper No:1 ANDROID APP BASED CIRCUIT BREAKERS CONTROLLING FOR LINEMAN SAFETY

Authors: CH.V.V. S. Srinivas¹, A.K.Chaitanya Varma

Year:2019

For the past several years, electrical accidents have been occurring to lineman staff while working on electrical poles. The reasons for those electrical accidents are communication mismatch between lineman and electrical substation staff and misconduct between lineman and transformer. To avoid these situations, the entire control of power supplies must be in the hands of the lineman only. So that no other person can be involved in controlling the power supplies without interference of lineman.

3.1.2 Paper No:2 Electric Line Man Safety With Password Based Circuit Breaker

Authors Prajwal R. Dawange¹, Tejas S. Bharud², Vishal R. Lakare³, Suraj A. Lahire⁴, Prof. S. S. Dawange⁵
Year:2022

This system is fully controlled by a microcontroller from the family. A matrix keypad is interfaced to the microcontroller to enter the password. The entered password is compared with the password stored in the ROM of the microcontroller. If the password entered is correct, then only the line can be turned on/off. The activation/deactivation of the circuit breaker is indicated by a lamp that turns on or off.

Related Work:

- **IoT-Based Circuit Breakers:** Studies on Wi-Fi and cloud-controlled breakers show higher latency and complex configurations.
- **Bluetooth-Controlled Devices:** Efficient for short-range communication, often integrated in home automation.

Gaps Identified:

- Lack of cost-effective, locally controlled solutions for home use.
- Limited accessibility for users without internet connectivity.
- Complexity in deployment of IoT for small-scale use.

IV. METHODOLOGY

The methodology for our project on electric lineman safety using password-based circuit breakers involves several key steps. First, we plan the project by setting goals and timelines. Then, we research existing safety methods and gather requirements for our system. Next, we design the system, both its hardware and software parts, and integrate them together. After that, we thoroughly test the system to make sure it works properly and meets safety standards. Once testing is complete, we deploy the system and provide training and documentation for its use. Finally, we monitor and maintain the system to ensure it continues to work safely and effectively. Through these steps, we aim to develop and implement a reliable solution to improve electric lineman safety

4.1 Architecture & Components

- **Microcontroller ESP32:** Central control unit for processing commands
- **GSM SIM900A GSM/GPRS Module:** Wireless communication interface with Android app.
- **Relay Module:** Controls the physical disconnection of the circuit.
- **Power Supply Unit:** Ensures constant power delivery to the control circuit.
- **Current sensor:** continuously monitors the power supply and current flow in the circuit.
- **Android Application:** Designed using MIT App Inventor for user control.

4.2 Block Diagram:

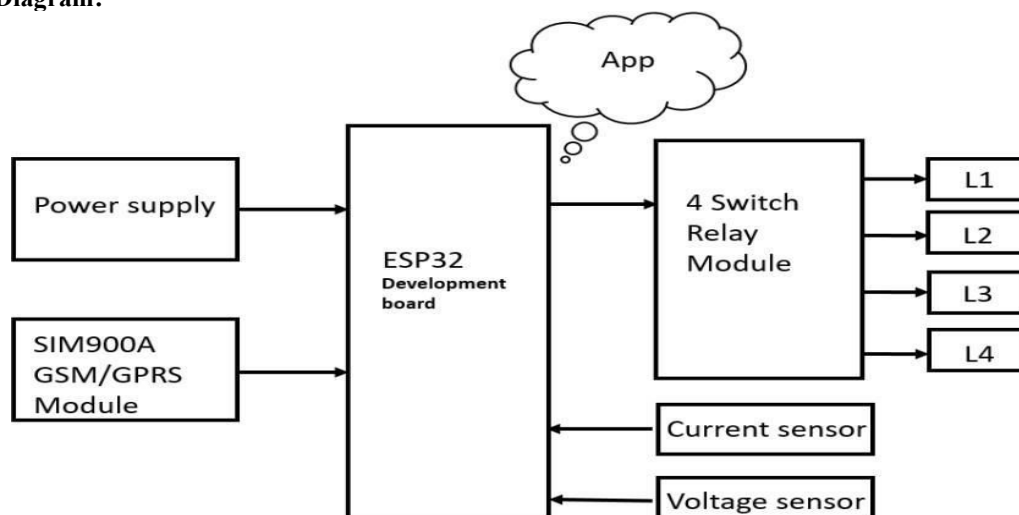


Fig 1. Android App-Based Circuit Breaker

4.3 Software Development

- **Android App Design** (MIT App Inventor): The app was created using MIT App Inventor with basic ON/OFF buttons and real-time status monitoring.
- **Microcontroller Coding** (Arduino ID): Arduino C++ libraries were used to develop the control logic.

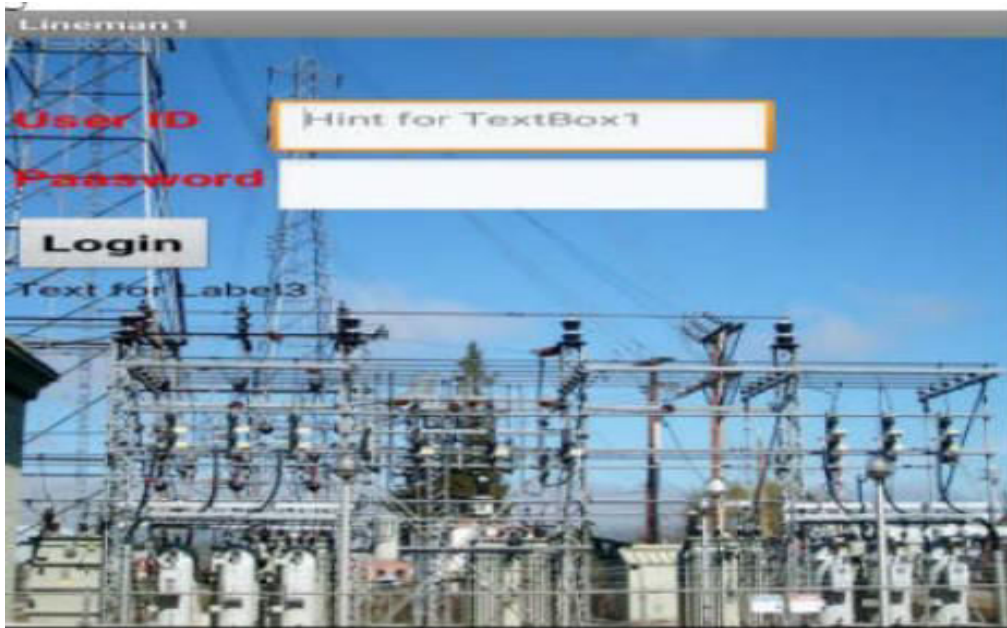


Fig 2. Software interface

4.4 Working Principle:

The **Android Circuit Breaker System** is designed to enhance the safety of wiremen and lineman while they manage electrical lines, particularly during maintenance tasks. The system integrates several key components, including the **ESP32 microcontroller**, **GSM module**, **LCD display**, **Relay module**, **current sensor**, and **Android mobile application**, to control and monitor electrical circuits remotely.

Here's a detailed breakdown of how the system works:

4.4.1 Components Involved

- **ESP32 Microcontroller**: The heart of the system, responsible for processing commands and controlling the overall operation.
- **GSM Module**: Used for communication, generating **One-Time Passwords (OTP)** to secure access and enable wireless connectivity. The GSM module is connected to the **TXD** pin of the ESP32 microcontroller.
- **LCD Display**: Displays real-time information about the system's status, such as the current voltage and power supply status.
- **Relay Module & Relay Driver IC (ULN)**: Used to control the switching of the electrical circuit. The relay is activated to switch the power ON or OFF.
- **Current Sensor**: Continuously monitors the current flow in the electrical circuit to ensure safety and detect any abnormalities or overloads.

4.4.2. Communication via Android App

- **User Authentication**: The system is controlled and operated via an **Android mobile application** developed using **MIT App Inventor**. The app provides a **secure user ID and password** for authentication. Once the correct credentials are entered, the lineman gains access to the system and can control the circuit breaker.
- **OTP Generation**: The **GSM module** generates a **One-Time Password (OTP)**, which is sent to the authorized user's phone for extra security. The OTP must be entered in the app to confirm the action.

- **Remote Control:** Once authenticated, the lineman can use the Android app to control the electrical line. This includes turning the line ON or OFF remotely, providing full control without the need for physical interaction with the circuit breaker.

4.4.3. Operation of Circuit Breaker

- The system replaces a traditional **manual switch** installed on a **transformer** (usually operating at **11kV**). The manual switch is replaced with an **automated relay system**, controlled via the Android app.
- The system is designed to operate with a **three-phase supply** (440V), represented by **bulbs** that act as load indicators. The **transformer** is connected to the system and supplies **11kV voltage**.
- **Relay Control:** The relay, controlled by the ESP32 microcontroller, acts as a switch to control the power flow. When the user sends a command from the Android app (after entering the correct password and OTP), the relay is activated to switch the power ON or OFF.
- **Current Monitoring:** The **current sensor** continuously monitors the power supply and current flow in the circuit. It ensures that the current levels are within safe limits, providing real-time data to the system.

4.4.4. Safety and Monitoring

- **Continuous Monitoring:** The system continuously monitors the **current flow** in both lines. If there's an overload or any abnormal current readings, the system will automatically alert the operator and may disconnect the power to prevent damage or accidents.
- **Visual Indicators:** The **LCD display** provides information on the status of the circuit, such as the current state (ON/OFF) and any issues with the power supply or current flow.

4.4.5. Practical Implementation

- This system is **practically installed on a transformer** (TC), which typically operates at **11kV** voltage. The **manual switch** on the transformer is replaced by the **Android-controlled system** to provide remote control via the mobile application.
- The system is connected to the **three-phase supply** (440V), and the relay controls the power flow to bulbs, which act as load simulators for testing the circuit.

V. ADVANTAGES

- Used in electrical substations to ensure line man safety.
- This system is used in buildings and houses in several ways.
- This system provides 100% safety for line man so it can use very often in several applications.

VI. APPLICATIONS

- Used in electrical substations to ensure line man safety.
- This system is used in buildings and houses in several ways
- Used in hotels and shopping malls to save power.
- Automatic street lights ON/OFF mechanism is very used to reduce the power consumption without the manual effort.

VII. RESULTS

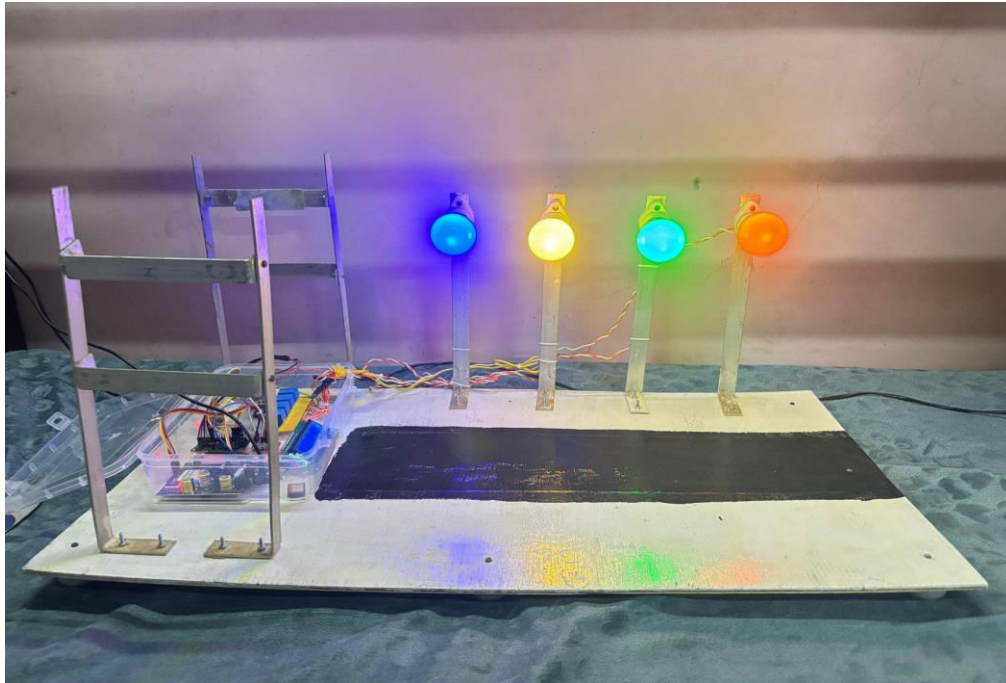


Fig 3. Android App-Based Circuit Breaker

VIII. CONCLUSION

The Android App-Based Circuit Breaker presented in this paper offers a cost-effective, user-friendly, and reliable method for controlling electrical circuits remotely. The integration of microcontroller technology with Bluetooth communication has proven effective for short-range control, making it ideal for residential use.

Key Contributions:

- Simplified power management through remote control.
- Enhanced safety by minimizing manual intervention.
- Cost-effective alternative to complex IoT solutions.

Future Work:

- Incorporating Wi-Fi for extended range control.
- Adding voice command features.
- Developing an alert system for fault detection

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