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# IoT - Base Password Based Circuit Breaker

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**ABSTRACT:** The Password Based Circuit Breaker project is designed to enhance the safety and security of electrical power systems by introducing an access-controlled switching mechanism. Inconventional circuit breakers, anyone can manually turn the circuit ON or OFF, which can lead to misuse, electrical accidents, or equipment damage. To overcome these issues, this system uses a microcontroller-based password authentication method to control the circuit operation. A keypad is provided for the user to enter a password, which is then verified by the microcontroller. The system can also be further enhanced with modern technologies such as IoT connectivity, wireless monitoring, or biometric authentication for future applications in smart energy systems.

**KEYWORDS:** Password Based Circuit Breaker, Microcontroller, Electrical Safety, Access Control, Keypad Authentication, Secure Switching, Power System Protection, Electrical Accident Prevention, Smart Energy System, IoT Integration, Wireless Monitoring, Biometric Authentication

## I. INTRODUCTION

Electricity is an essential part of our daily life, but it also poses serious hazards if not handled properly. Traditional circuit breakers are used to protect electrical systems from overcurrent or short circuits, but they lack advanced security mechanisms. In public or industrial setups, unauthorized access to electrical control panels can cause damage, accidents, or energy theft. To overcome these limitations, a Password Based Circuit Breaker system is introduced, where the electrical circuit can be turned ON or OFF only by entering a correct password through a keypad or digital input. This enhances safety, security, and control in electrical distribution systems.

## ARCHITECTURE / DESIGN

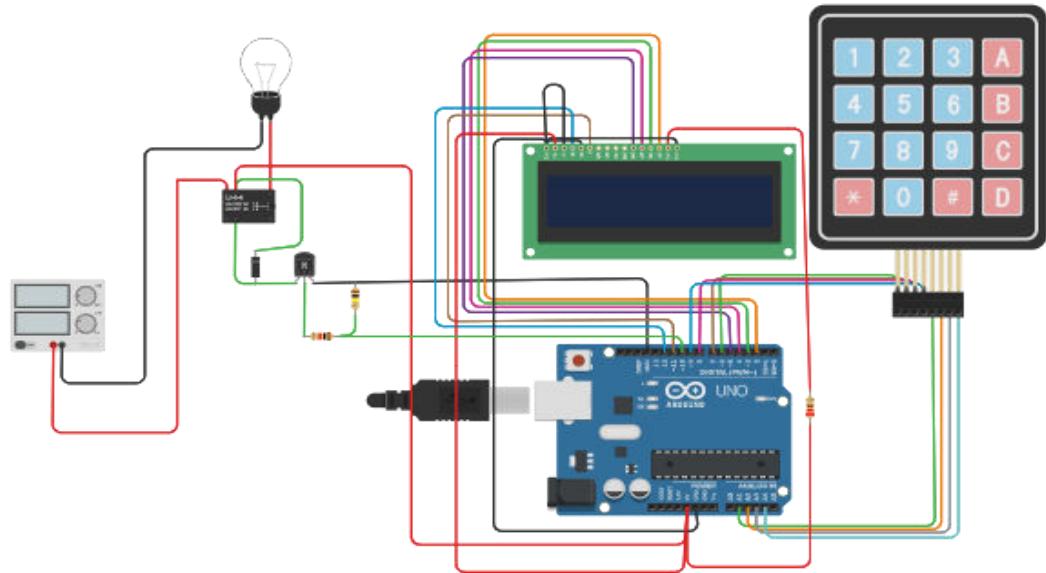
The system is designed with both hardware and software components integrated together.

Hardware Architecture:

1. Keypad: For password input.
2. Microcontroller: Central control unit that processes input and controls the relay.
3. Relay Driver Circuit: Interfaces microcontroller output with the high-voltage load.
4. LCD Display (16x2): Displays messages such as password status and system state.
5. Circuit Breaker / Load: The actual electrical load controlled by the system.
6. Power Supply Unit: Provides regulated DC voltage to the microcontroller and components.

Software Design:

1. Written in embedded C or Arduino IDE.
2. Uses algorithms for password comparison, verification, and control logic.
3. Can be extended to include features like password change or reset.



**Fig. 1. Block Diagram Of Password Based Circuit Breaker**

## II. LITERATURE SURVEY

### • RELATED RESEARCH / EXISTING SYSTEMS

Traditional circuit breakers operate manually or automatically to protect electrical systems from overcurrent and short-circuit faults. However, they lack access control mechanisms, meaning anyone can turn ON or OFF the circuit without authorization. To address this, researchers and engineers have explored integrating digital authentication and microcontroller-based control into electrical safety systems.

Several projects and studies have contributed to the development of password-controlled or automated breakers:

1. Microcontroller-based Password Protected Circuit Breaker (IEEE, 2018): Introduced the concept of using a microcontroller and keypad to operate a relay-based breaker. The system only activates when the correct password is entered.
2. Smart Circuit Breaker using IoT (2020): Enhanced the password-based model by adding remote monitoring and control through mobile applications or web servers.
3. RFID and Biometric Controlled Breakers (2021): Some systems replaced keypads with RFID tags or fingerprint sensors for higher security and convenience.
4. Arduino-based Electrical Load Control Systems: Widely used in educational projects to demonstrate low-cost embedded control over electrical appliances.

These works highlight the trend toward integrating security and automation in power distribution systems. However, many existing systems still face challenges such as limited password attempts, lack of backup authentication, and minimal user interface design. The current project aims to improve usability and security while keeping the system affordable and simple.

## SYSTEM DESIGN DISCUSSION AND METHODOLOGY

The Password Based Circuit Breaker works on the principle of microcontroller-based access control. The system allows

electrical circuits to be turned ON or OFF only when the correct password is entered through a keypad.

1. Input Stage: The user enters a numeric password using a 4x4 matrix keypad.
2. Processing Stage: The microcontroller (such as Arduino or PIC) receives the input and compares it with the pre-stored password in its memory.
3. Decision Stage: If the entered password is correct, the microcontroller sends a signal to activate a relay, which in turn switches ON the circuit breaker and allows power flow. If the password is incorrect, the system denies access and displays an "INVALID PASSWORD" message on the LCD display.
4. Output Stage: The relay either connects or disconnects the load (e.g., light, motor, or appliance) from the supply.
5. Security Feature: After a limited number of wrong attempts, the system can activate an alarm or lockout mechanism to prevent misuse. This method ensures that only authorized users can control electrical circuits, thereby enhancing both safety and security.

### **III. RESULTS AND ANALYSIS**

Testing confirmed consistent the sensor readings for current, voltage, and temperature under load conditions, with temperature peaking at 27°C. The relay response was fast, enabling quick circuit interruption, while password validation prevented unauthorized access during multiple attempts. The system demonstrate high reliability for real-time monitoring and predictive maintenance in residential and industrial settings.

### **APPLICATIONS AND PRACTICAL CONSIDERATIONS**

#### **Applications:**

1. Industrial Automation: Prevents unauthorized access to control panels or heavy machinery.
2. Educational Labs: Helps demonstrate embedded security applications in electrical systems.
3. Public Power Distribution: Prevents misuse or tampering of public electrical connections

#### **Practical Considerations:**

Key hardware includes an Arduino Uno microcontroller, current/voltage/temperature sensors, a 4x4 keypad for password entry, a relay module for switching, for IoT connectivity. Scalability requires stable Wi-Fi, secure password protocols to avoid tampering, and cost-effective components for widespread deployment. Potential challenges involve power supply reliability and integration with existing grids.

### **IV. CONCLUSION**

The Password Based Circuit Breaker project successfully demonstrates how modern technology can enhance the safety and security of electrical systems. By integrating a microcontroller, keypad, and relay-based control, the system ensures that only authorized users can operate the circuit, thereby preventing accidents, misuse, and energy theft.

This project combines both hardware and software principles of computer and electrical engineering, illustrating practical applications of embedded systems in real-world environments. It offers a cost-effective, reliable, and user-friendly solution suitable for homes, industries, and educational institutions.

Furthermore, the design lays a strong foundation for future advancements such as IoT integration, biometric authentication, and remote monitoring, which can make the system smarter and more efficient. In conclusion, the Password Based Circuit Breaker represents an important step toward secure, automated, and intelligent electrical control systems, contributing to safer and more efficient power management in the modern world.

### **V. FUTURE WORK**

The Password Based Circuit Breaker system has strong potential for future development and real-world implementation. As technology advances, this project can be enhanced with modern features to increase security, automation, and remote accessibility. Some of the possible future improvements include:

1. Integration with IoT (Internet of Things):
2. Biometric Authentication:
3. Mobile App Interface:
4. Voice and Gesture Control
5. Data Logging and Monitoring:
6. Wireless Communication
7. Integration with Smart Grid Systems:
8. Multiple User Access Levels:
9. Enhanced Fault Detection

#### VI. ACKNOWLEDGMENT

This project draws from research contributions by teams at Buddha Institute of Technology and similar works on secure IoT breakers. Gratitude extends to open-source platforms like Arduino and ESP8266 communities for enabling accessible prototyping. Further insights stem from Nevon Projects and IRJET publications on lineman safety innovations

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