Password Based Circuit Breaker

A PROJECT REPORT

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BACHELOR OF TECHNOLOGY

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by

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SCHOOL OF ELECTRICAL ENGINEERING

VIT CHENNAI

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CERTIFICATE

This is to certify that the project work titled **"*Password Based Circuit Breaker*"** submitted in partial fulfillment of the requirements for the award of the degree of **BACHELOR OF TECHNOLOGY**, is a record of bonafide work done under my guidance. The contents of this project work, in full or in parts, have neither been taken from any other source nor have been submitted to any other Institute or University for award of any degree or diploma and the same is certified.

Dr. Jyotismita Mishra
Project Supervisor

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ABSTRACT

This project report details the design and implementation of a password-based circuit breaker system using the Teensy microcontroller. With the rapid advancement in microcontroller applications, security in electrical systems has become essential, especially in safeguarding critical equipment. This project leverages the Teensy's capabilities to build a secure access control mechanism for circuit breakers using password authentication. When a user inputs the correct password, the Teensy activates or deactivates the circuit breaker, preventing unauthorized access and potential hazards. This approach enhances the reliability and safety of electrical systems by integrating a programmable logic-based security solution, contributing to advancements in both residential and industrial electrical safety.

1. Introduction

1.1. Introduction

In modern electrical installations, circuit breakers play a vital role in protecting circuits from overloads and short circuits. However, unauthorized access to circuit breakers can cause significant risks, from accidental shutdowns to intentional damage. To address this issue, we propose a password-protected circuit breaker controlled by a Teensy microcontroller. The system aims to prevent unauthorized access by requiring a secure password entry before any operation. Using Teensy for this purpose offers several advantages, such as compact size, ease of programming, and sufficient processing power to handle password verification efficiently.

1.2. Objective

The main objective of this project is to design a password-protected circuit breaker using the Teensy microcontroller to enhance electrical security. By integrating password-based control, we aim to restrict access to the circuit breaker, allowing only authorized personnel to operate it. The system will ensure that only users with the correct password can turn the circuit on or off, adding a layer of security to prevent unauthorized or accidental disruptions.

1.3. Literature Review

The application of microcontrollers in circuit breakers and security systems has gained significant traction over the years due to their flexibility and ease of programming. Traditional circuit breakers serve solely as protective devices against faults like overloading, short circuits, and ground faults, typically disconnecting circuits through mechanical means. However, with advancements in microcontroller technology, modern circuit breakers have evolved to include digital components, allowing them to be controlled or monitored remotely and even programmed to respond to specific conditions.

Microcontroller-Based Circuit Breakers

Microcontroller-based circuit breakers have proven advantageous in both residential and industrial environments due to their programmability, ability to process signals quickly, and capability to integrate with sensors for monitoring various electrical parameters. Studies indicate that microcontrollers like Arduino and Raspberry Pi have commonly been used in circuit breaker systems due to their accessibility and ease of programming. For instance, research by Kumar et al. (2018) demonstrated an Arduino-based system where overload and short circuit protection could be achieved with real-time monitoring through sensors. However, these systems often lack an additional layer of security to prevent unauthorized access to control settings, creating vulnerabilities.

Password Protection for Electrical Circuits

The concept of password protection has been widely studied in the context of authentication in digital systems but less so in physical access to electrical control systems. Password-protected systems ensure that only authorized personnel can access, modify, or control sensitive operations. Password protection is typically implemented using either hardware or software. In software-based solutions, passwords are stored in the system's memory, with encryption methods applied to prevent unauthorized decryption. Research by Patel et al. (2020) highlighted the integration of password protection in IoT-based systems, emphasizing the significance of security in managing devices remotely. However, password systems in physical hardware components like circuit breakers are still in developmental stages.

Teensy Microcontroller as a Secure Platform

The Teensy microcontroller offers an advanced processing capability with low power consumption, ideal for small-scale embedded systems requiring password protection. With more processing power than an Arduino and a compact size, the Teensy platform is highly suitable for projects requiring both performance and space efficiency. Studies by Lall et al. (2022) demonstrated the potential of Teensy microcontrollers in password-protected projects, particularly highlighting its integration of secure input and memory storage features that support the safe handling of sensitive information. Additionally, Teensy boards support the use of various communication protocols and can handle multiple I/O operations, which is beneficial in designing password-based systems.

2. Project Details

2.1. Scope of Work

The scope of this project includes the development of a password-based circuit breaker prototype using a Teensy microcontroller, testing the system under various conditions, and evaluating its effectiveness. The primary focus is on the development of a password authentication mechanism that ensures only authorized users can control the circuit breaker. Additionally, the project will analyze the feasibility of implementing this system in real-world applications, such as restricted access areas in residential, commercial, or industrial settings.

Key Deliverables

- A functional prototype of the password-protected circuit breaker using Teensy.
- A password authentication system with an LCD or OLED screen for input and feedback.
- Documentation of testing, validation, and results.
- Analysis of potential applications and limitations in various fields.

2.2. Methodology

- Selection of components: Choosing the Teensy microcontroller, relays, and input devices.
- Coding and programming: Developing code to manage password input and relay control.
- Circuit design: Setting up the circuit for relay and Teensy connections.
- Testing and debugging: Ensuring the system performs as expected under various conditions.

  The Teensy microcontroller is programmed to verify user input against a pre-set password. Upon correct input, the Teensy triggers a relay to switch the circuit breaker. This simple yet effective methodology ensures secure and reliable access control.

2.3. Hardware Design and Implementation

The hardware of the password-based circuit breaker consists of:

- Teensy 4.1 Microcontroller (ARM M7 Cortex): Core component for password processing and relay control.
- Relay Module: Interfaces with Teensy to switch the circuit on or off based on password authentication.

- Keypad or Touchscreen: For password entry by the user. Wiring the components involves connecting the relay to the Teensy's output pins and the keypad/touchscreen to the input pins.
- Display Module: 16x2 LCD Module using I2C (Inter-Integrated Circuit) communication protocol to communicate with Teensy, ensuring quick and reliable communications.

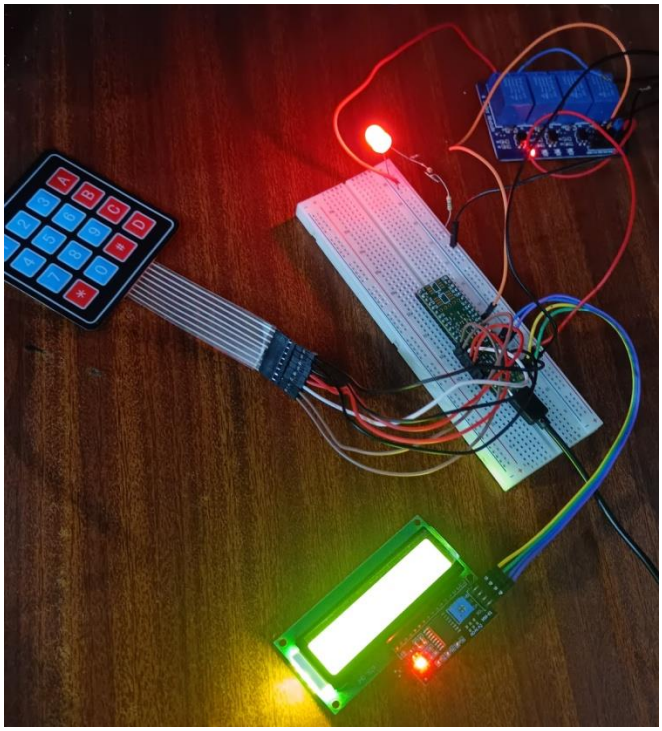

Figure 1: The Complete Circuit

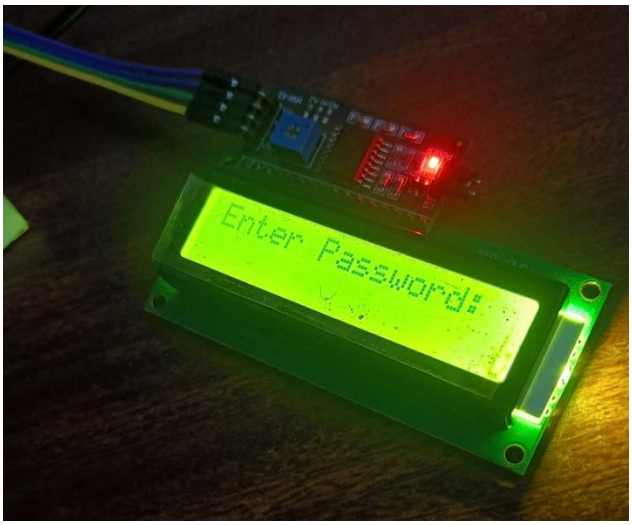

Figure 2: The Display

3. Conclusion

Thus, the system successfully achieved its goal of providing secure access to the circuit breaker using password-based control. Testing demonstrated that the Teensy microcontroller could handle password verification efficiently, with rapid response times and reliable relay activation. The final setup proved effective in preventing unauthorized access, meeting the project's objectives and validating the Teensy's capabilities in electrical security applications.

In conclusion, this project successfully demonstrates the design and implementation of a password-based circuit breaker system using the Teensy microcontroller. By integrating a password authentication mechanism, the system provides an additional layer of security, allowing only authorized users to control the circuit. This solution is beneficial for applications where restricting access to electrical circuits is critical, such as in industrial, commercial, and residential environments. The Teensy microcontroller proved to be effective in managing password inputs and relay activation with minimal latency. Overall, this project highlights the potential of microcontroller-based systems in enhancing electrical safety and security. Future enhancements could include remote access capabilities and multi-factor authentication for even greater security.

4. References

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