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Password Based Circuit Breaker Control to Ensure Electric Line Man's Safety

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ABSTRACT:

Electrical accidents involving line men during maintenance work are rising due to inadequate contact between electrical substation staff & maintenance personnel. This project proposes password-based circuit breaker control system aimed at enhancing the safety of line men during electrical line repairs. The system allows the line man to control the power supply (turning it on/off) through a password entered via a keypad. The system operates through an Arduino-based Microcontroller, where password is entered compared with the one stored in Arduino's (ROM). If password matches, the line can be turned on/off, ensuring that only authorized personnel can perform such operations. A lamp indicates the status of the circuit, and the password can be changed after every use to maintain security. This system provides both safety and security for line men by ensuring only authorized access to electrical line operations

Keywords: Authentication, Security, Safety, Control Access, Authorization, Relay, Microcontroller, Keypad, Electrical Protection, Line Man Safety, Password Input, Circuit Breaker, Power Supply Control, Unauthorized Access Prevention

1.INTRODUCTION

In recent times, electrical accidents involving linemen have been on the rise, primarily due to poor communication between electrical substations and conservation staff responsible for repairing electrical lines. This design addresses this issue by furnishing a result to enhance lineman safety. The proposed system gives the lineman full control over switching the electrical lines ON or OFF.

The system is designed so that conservation labour supply must enter a Pass code to control the power supply. In case of fault in electrical line, lineman can switch off the power supply by entering the Pass code, assuring a safe form process. Once the form is complete, the lineman can return to the substation and restore the power supply to line by entering same Pass code.

Entered pass code is vindicated against one stored in microcontroller (ROM). Only if the pass code matches can the system turn the line ON or OFF. The status of the circuit breakers (activate or disactivate) is indicated by lamp (ON/ OFF). This system designed to be operated solely by authorized labour supply, thereby precluding accidents and assuring safety.

2. LITERATUTRE SURVEY

Sakthi Raja V et al..,[1] Ensuring safety is paramo

unt during electrical line maintenance. Traditional methods, however, come with challenges, including the risk of accidental line energization caused by operator errors at the station, potentially leading to serious injuries. A viable approach to mitigate these risks involves leveraging microcontrollers. By implementing a GSM-based circuit, the operation of electrical lines can be managed more efficiently, significantly reducing the likelihood of such accidents.

Hema. p. et al..,[2] A circuit breaker is an essential device designed to automatically interrupt the power supply, safeguarding electrical circuits from problems such as overloads or short circuits. Its primary function is to identify faults and halt the flow of electricity to prevent damage. Unlike fuses, which require replacement after they blow, circuit breakers can be reset and reused, either manually or automatically. Integrating a secure password mechanism enhances its functionality by providing an additional layer of security, minimizing the risk of unauthorized access. This advanced setup not only ensures the safety of technicians during line maintenance but also aids in efficiently managing and optimizing the power load across the distribution network.

B. Sai Kumar et al.., [3] Accidental linemen deaths during electrical maintenance highlight the need for advanced safety measures. A proposed solution is a circuit breaker system with password-based authorization, ensuring only authorized personnel can control it, reducing risks from miscommunication or unauthorized actions.

The system uses an 8-bit 8051 microcontroller, EEPROM for password storage, a keypad for input, and a relay to control the breaker. It features a status lamp and an LED alert for incorrect password entries. This design enhances safety, access control, and operational reliability

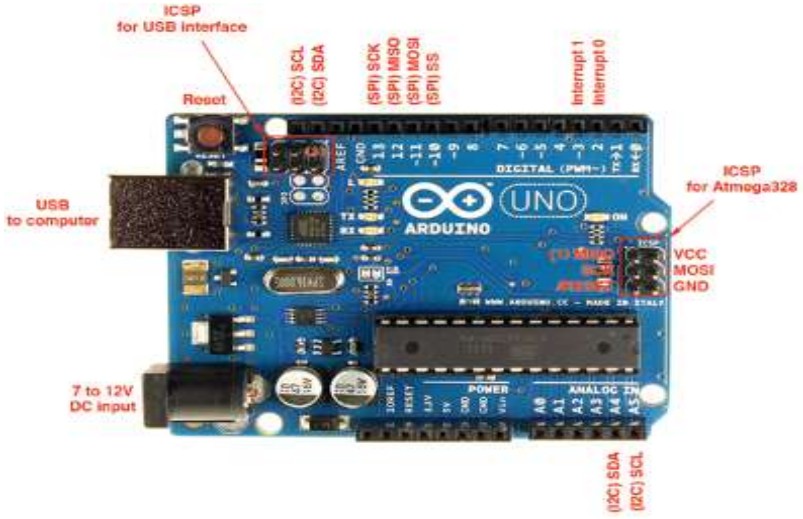
COMPONENT LIST

SR.NO	Component	Quantity	Purpose
1	Resistor (R1, R2, R3)	3	Voltage Drop
2	Arduino Uno	1	Used to control the system
3	Diode	1	Rectifier
4	LCD display	1	Password Display
5	Push button or a key pad	1	Input Password
6	Bulb	1	Load
7	Buzzer	1	Indication
8	Relay Module	1	Operate Relay
9	Connecting wire	1	Connecting wire
10	Battery with Battery connector	1	Supply
11	PCB Zero board	1	Connection

HARDWARE COMPONENTS

2.1 Arduino UNO Board: -

The Arduino Uno is a versatile microcontroller board based on the ATmega328 chip. Its name, "Uno," which translates to "one" in Italian, reflects its foundational role in the Arduino platform. Equipped with 14 digital I/O pins, 6 analog input pins, a 16 MHz ceramic resonator, a USB connection, a reset button, and an ICSP header, the Uno integrates key components for various projects. It can be powered through multiple sources, such as a USB cable, an AC-to-DC adapter, or even a battery, offering flexibility in its usage.



[4]

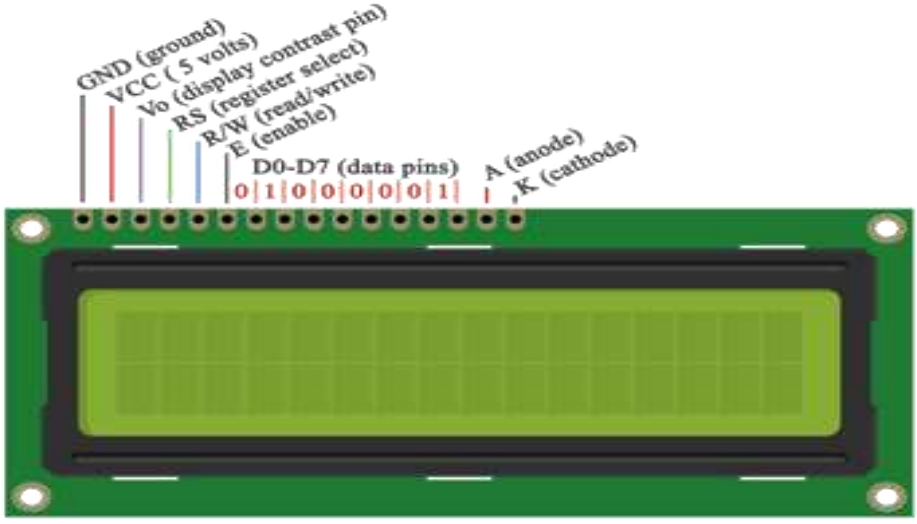
2.2 Relay Module: -

A relay is an electrically activated switch that operates using control signals. It features a set of input terminals for one or more control signals and a set of output contact terminals. Relays are commonly employed when it's essential to control a circuit using a low-power signal, or when a single control signal needs to manage multiple circuits simultaneously

[5]

2.3 LCD Display: -

A 16x2 activate is abecedarian module extensively employed in multitudinous bias and circuits. The term" 16x2 liquid crystal display " indicates that it can show 16 characters per line across two lines. Each character on display is represented within a 5x7 pixel matrix. This liquid crystal display operates using two registers the Command register and the Data register.



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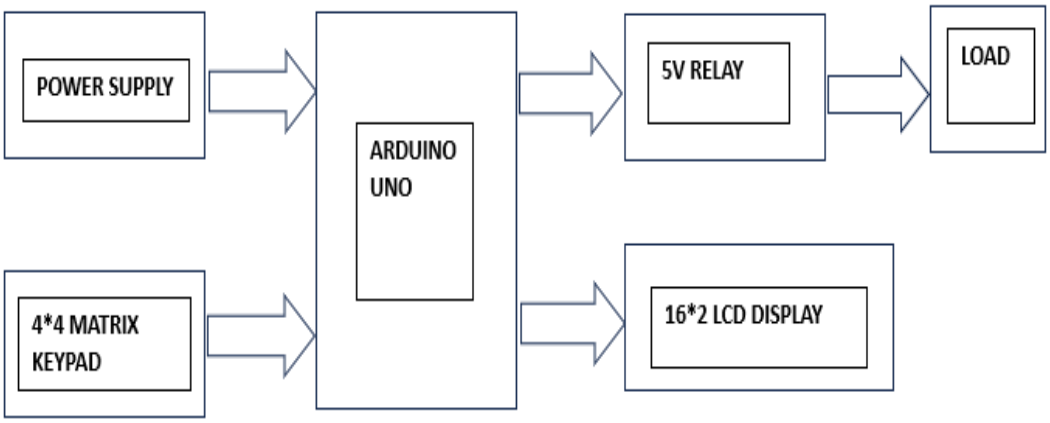
2.4 Keypad: -

A keypad is collection buttons organized in block or pad, generally featuring integers, symbols, letters. Keypads that primarily display figures are appertained to as numeric keypads. This system is designed to be budget-friendly and cost-effective. As mentioned before, icing the safety and protection of linemen is the top precedence. thus, the system has been developed to give maximum delicacy in achieving this thing. The design was successfully completed as per the conditions, with the primary ideal of precluding fatal accidents involving linemen.

[7]

BLOCK DIAGRAM:



METHODOLOGY: -

This project features a password-protected circuit breaker controlled by an Arduino Uno R3. It uses an exchange driver IC interfaced with a microcontroller. A keypad connected to a GSM modem enables user interaction, while an LCD screen displays system status updates. Key components, including a relay, are assembled on a breadboard, with operations managed through the input password. The circuit breaker can only be activated or deactivated when the correct password is entered.

The LCD displays the relay's ON/OFF status, and a notification is sent to a designated recipient to report the

line's condition. After each operation, the user must re-enter the correct password to restore the system. The following steps outline how to construct a password-secured circuit breaker using an Arduino, relay, keypad, and LCD display.

Components Required

- Arduino Uno R3
- Relay module
- 4x4 keypad
- 16x2 LCD display
- Jumper wires
- Power supply

Circuit Setup

1. Power Supply Setup:

Connect the power supply to the system.

2. Relay Module Connections:

Attach VCC to the Arduino's 5V pin

Connect GND to the Arduino's GND pin

Link IN1 to digital pin 9

3. Keypad Integration:

Connect the rows to pins 2–5 on the Arduino

Connect the columns to pins 6–9

4. LCD Display Wiring:

Connect VSS and RW pins to GND

Attach VDD and A pins to the 5V pin

Wire the control and data pins (E, RS, D4–D7) to pins 8–2

Programming Steps

1. Initialization: Configure the keypad and LCD display.

2. Input Processing: Write a program to capture inputs from the keypad and display corresponding messages on the LCD.

3. Password Handling: Implement a secure password verification system:

When powered on, the system prompts the user to enter a password.

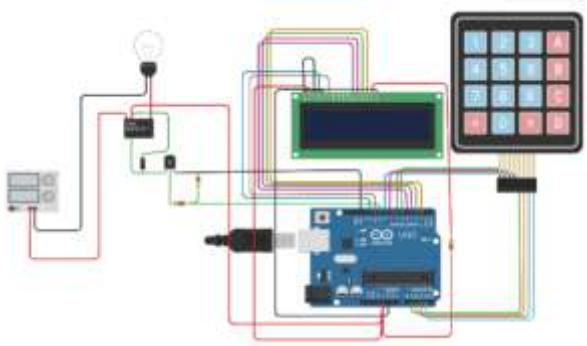
If the password is correct, the relay is activated, and a confirmation message appears on the LCD.

If the password is incorrect, an error message is displayed, and the system prompts for re-entry.

4. Testing: Test the system with both correct and incorrect passwords to ensure proper relay operation and error handling.

5. Final Integration: Enclose all components within a protective casing, providing an interface for password entry.

CIRCUIT DIAGRAM:



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WORKING:

Powering On the System

When the system is powered on, the Arduino initializes all components, including the keypad, liquid crystal display (LCD), and relay.

The relay starts in its default "Normally Open" (NO) state, ensuring no current flows to the connected load (e.g., a motor or light).

Entering the Password

The operator inputs the password using the keypad or push buttons. Each key press is detected by the Arduino and displayed on the liquid crystal display or serial monitor for debugging purposes.

Once the password is entered, the operator presses a designated key to submit it.

Password Confirmation

The Arduino compares the entered password with the pre-stored password in its memory.

If the passwords match: The Arduino sends a HIGH signal to the relay control pin, closing the relay and allowing current to flow through the connected load.

If the password is incorrect: The Arduino keeps the relay in its default state, ensuring the circuit remains disconnected.

Indicating the Status

If the correct password is entered: The liquid crystal display shows a success message, confirming that the circuit is active. The relay closes, enabling power to flow to the connected device, such as a motor or light.

If the password is incorrect: The liquid crystal display shows an error message, and the relay remains open, preventing power from reaching the load.

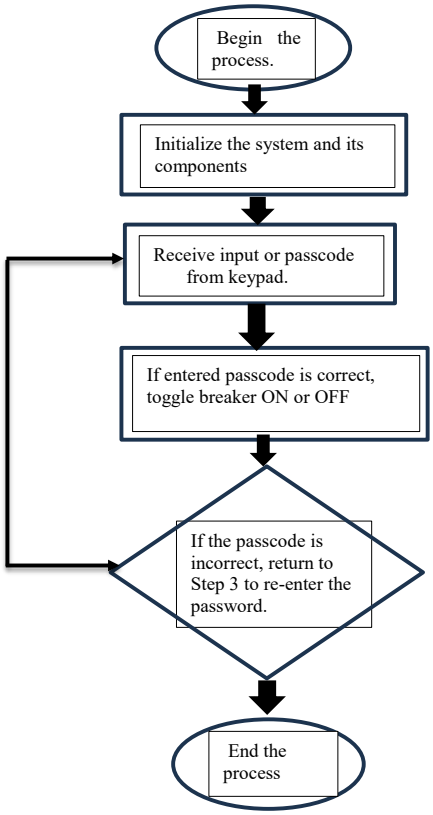
Resetting for Another Input

After each password attempt, whether correct or incorrect, the system clears the input buffer and waits for a new password.

Additionally, functionality can be added to deactivate the system by re-entering the password or entering a specific code.

ALGORITHM
Step .1: Begin the process.
Step .2: Initialize the system and its components.
Step .3: Receive input or pass code from the keypad.
Step .4: If entered pass code is correct, toggle breaker ON or OFF.
Step .5: If the pass code is incorrect, return to Step 3 to re-enter the pass code.
Step .6: End the process.

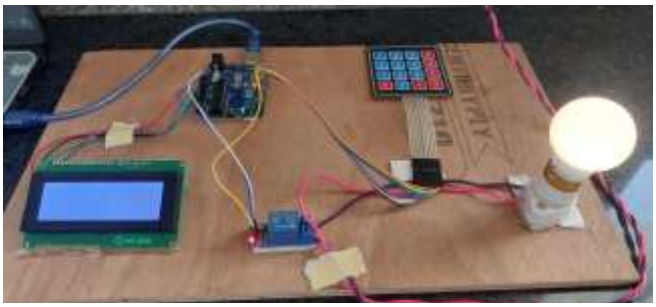
FLOWCHART



CONCLUSIONS

A passcode -based circuit breakers is very effective ensuring improved safety and security of electrical systems as it prevents unauthorized persons from taking control of circuit breaker thereby safeguarding the electrical system from accidents caused by misuse. Such a system, therefore, presents an effective, efficient, and reliable solution for improving the safety and security of electrical systems by combining technological control with safety practice. In general, a password-based circuit breaker is one efficient way to protect electrical structures.

RESULT:



The Passcode-based Circuit Breaker design introduces a secure and effective system for managing electrical power through Passcode authentication. Access to the circuit is granted only when the correct Passcode is entered, effectively precluding unauthorized use. To enhance security, the system locks itself after several failed attempts and requires a reset to recapture functionality. crucial tackle factors, including a microcontroller, keypad, relay, and display, work in harmony to ensure reliable operation, easing fault-free circuit switching. Tests demonstrate the system's trustability under both valid and invalid Passcode conditions, showcasing its strong error- handling capabilities and energy effectiveness. This innovative approach is well- suited for perfecting the safety and control of power distribution in manage appliances, artificial outfit, and other critical operations.

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