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Electrical Line Man Saftey with Password Based Circuit Breaker

Sanjay Kumar K[1], Madhukumar.D[2], Dhanush G S[3]
[1,2]*Assistant Professor, Department of E&E, SJMIT Chitradurga, Karnataka, India.*
[3] *Student, 6th semester, Department of E&E, SJMIT Chitradurga, Karnataka, India.*

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Abstract: This project introduces a Arduino UNO -based circuit protection system that enhances electrical safety and access control using password authentication. The system is built around the Arduino Uno, a widely used and beginner-friendly microcontroller platform. It replaces traditional manual circuit breakers with a digital mechanism that restricts access to electrical circuits based on user input. The core components include a 4x4 matrix keypad for password entry, a relay module for switching the load, and an LED to indicate the status of the circuit. The absence of a display module (such as LCD or OLED) simplifies the hardware design, making the system more compact, cost-effective, and easier to assemble. Feedback to the user is provided through LED indicators and/or a buzzer, which signal successful authentication or incorrect password attempts. The Arduino Uno is programmed to compare the entered password with a predefined value stored in its memory. Upon successful authentication, the relay is activated, allowing current to flow to the connected load. If the password is incorrect, the system remains locked and may trigger an alert or retry logic. This approach ensures that only authorized users can operate the circuit, reducing the risk of electrical accidents, tampering, or unauthorized usage.

Keywords: Arduino UNO, LCD

1. Introduction

Nowadays, electrical accidents to the line man are increasing, while repairing the electrical lines due to the lack of communication between the electrical substation and maintenance staff. This project gives a solution to this problem to ensure line man safety. Electrical safety and controlled access are essential in both residential and industrial environments. Traditional circuit breakers offer basic protection against overloads and short circuits but lack user-level access control. To address this limitation, this project introduces a Password-Based Circuit.

Breaker system using the Arduino Uno microcontroller, designed to restrict circuit activation to authorized users only. The system operates without any display module, relying instead on a 4x4 matrix keypad for password input and LEDs or buzzers for feedback. When the correct password is entered, the Arduino activates a relay module, which connects the load to the power supply. Incorrect password attempts trigger visual or audible alerts, enhancing security and preventing unauthorized access. By combining basic hardware components with embedded programming, this project demonstrates how microcontrollers can be used to enhance safety, security, and automation in real-world electrical systems.

2. Literature Survey

1. **B. Malleswari, K. Anitha, V. Jaikumar, A. Arun Chakravarthy "Password Based Circuit Breaker Using GSM Module" 2023.** In this paper an automatic electric switch known as a circuit breaker is used to safeguard an electrical circuit from harm brought on by overloading or short circuits**.** When we use our hands, we observe an increase in lethal electrical threats to cable workers during power line repairs because of a lack of communication and interaction between the repair employees and the power station workers. This project is made to tackle the issue with a design breaker so that only an authorised person may use it with a password in order to prevent such risks. Arduino has complete control over the system. The circuit breakers, which are switched on or off by a flashlight, are activated by entering the password into the keypad.

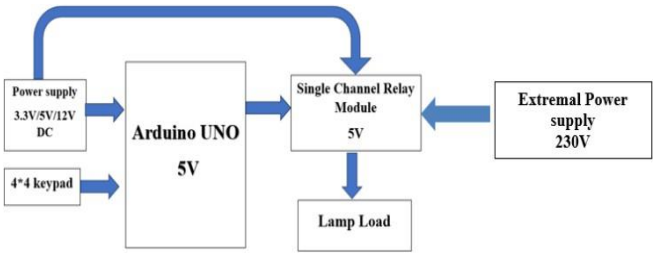
2. **Sakshi V. Wasekar, Divya K. Rahate, Sonali A. Parate, Achal V. Borkar, Prof. Bhagyashree Karmarkar "Password Based Circuit Breaker" 2023.** In this paper-Now a days, electrical accidents to the line man are increasing, while repairing the electrical lines dua to the lack of communication between the electrical substation and maintenance staff. This project gives a solution to this problem to ensure line man safety. In this proposed system the control (ON/OFF) of the electrical lines lies with line man. This project is arranged in such a way thatmaintenance staff or line man has to enter the password ON/OFF the electrical line. Now if there is any fault in electrical line then line man will switch off the power supply to the line by entering password and comfortably repair the electrical line, and after coming to the substation line man switch on the supply to the particular line by entering the password.

3. **Mallikarjun G Hudedmani, Nitin Ummannanavar, Mani Dheeraj Mudaliar, Chandana Sooji, Mala Bogar "Password Based Distribution Panel and Circuit Breaker Operation for the Safety of Lineman during Maintenance Work" 2021.** In this paper - Security is the prime concern in our day-to-day life while performing any activity. In the current scenario, accidental death of lineman is often read and evidenced. In this direction, a safety measure to safe guard the operator is found very necessary looking into the present working style. The electric lineman safety system is designed to control the control panel doors and circuit breaker by using a password for the safety. Critical electrical accidents to lineman are on the rise during electric line repair may be due to lack of communication and co-ordination between the maintenance staff and electric substation staff. The proposed system provides a solution that ensures safety of lineman. The control to turn ON or OFF the line is maintained by the lineman. The system has an arrangement such that a password is required to operate the doors of the control panel and circuit breaker (ON/OFF). A secured password is requested and received from the control room by the lineman for the point of repair

4. **C. Arunabala, G. Brahmateja, K. Raju, K. Gideon, B. Venkateswar Reddy "GSM Adapted Electric Lineman Safety System with Protection Based Circuit Breaker" 2023.** In this paper - This project focus on the safety of the lineman while working, so they do not feel the sudden electric shocks. As the lineman has to deal with live wires very often, the probability of critical accidents are already very high. Therefore, it was necessary to provide a safely system of protection to avoid the accidents that may occurs in case of miss coordination between the lineman and station or control staff. This project designed to give a high security system and that in switching offthe meanly line with entering a password with a help of keypad. And here we have a safety system to work on it. When the lineman staff get finished what they work on, they can activate theline by either of two ways, entering the same password that added before using keypad on station, or by sending SMS message including the password that selected before, and here we have a very important feature that is gain time.

5. **Dr. Rakesh G. Shriwastava, Mrs. Priti A. Bhange, Suraj G. Raut, Tushar B. Kawale, Darshan S. Raghorte, Rakesh A. Mahure, Pradip R. Harami "Smart Safety with Password Based GSM Module Controlling Circuit Breaker" 2024.** This paper focus on Smart safety with password-based GSM module controlling circuit breaker. In our daily life, Safety is the major concern for all activities. Accidental to be very necessary in current working. Using passwords for security, Electrical lineman security systems are used to control circuit breakers. Serious electrical accidents occur becoming increasingly, when repairing power lines. It is happened due to lack of communication and coordination between maintenance and substation personnel. In the proposed system, the on and off line turning operation with the lineman to ensure the safety of linemen. For that, a secure password is required to operate the breaker operation and maintenance point of view. First request is registered and password is sent to the line operator\'s mobile phone and GSM module by AVR microcontroller. Entered password and password received by the GSM receiver are compare. If password is match, the operation of circuit breaker will be smoothly operated.

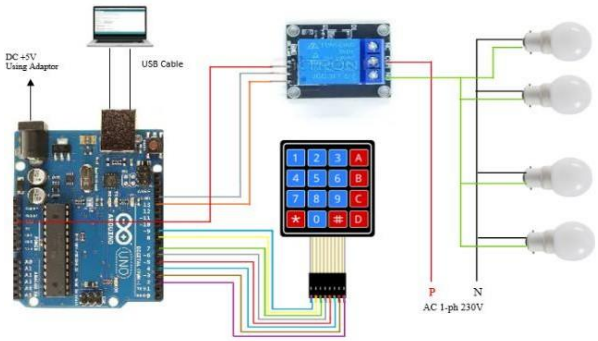
3. Methodology



The methodology for this project begins with identifying the safety hazards faced by electrical linemen while operating high-voltage circuits and recognizing the need for a secure system to prevent unauthorized access. The system is designed using an Arduino UNO as the main controller, a 4×4 keypad for password input, and a single-channel relay module to control the electrical circuit. First, the hardware components are selected and connected, where the keypad is interfaced with the Arduino UNO to allow users to enter a password [1] and the relay module is connected to the Arduino to switch the circuit on or off. The Arduino is programmed using the Arduino IDE to verify the password entered through the keypad and activate the relay only when the correct password is provided. After programming, the complete system is assembled on a prototype board, ensuring proper wiring and secure connections to prevent short circuits or accidental triggering [2]. The system is then tested under different scenarios, including

correct and incorrect password entries, to ensure the relay operates only for authorized access [3]. During testing, the response time of the relay and overall system reliability are carefully monitored to confirm that the system provides enhanced safety for linemen. Finally, any observed errors or performance issues are corrected through software adjustments or hardware improvements, and the system is optimized to ensure that unauthorized operation of the circuit is completely prevented while maintaining user convenience [4].

4. Pictorial View



1. Connect the Arduino UNO to a 5V power source (USB or external adopter). Ensure all components are properly grounded (GND connected)
2. Once powered ON, the Arduino initializes the keypad and relay module. The LED Bulbs will ON initially.
3. Use the 4x4 Keypad to enter the preset password (for example 1234). Each button press is read by the Arduino.
4. If the entered password is correct the Arduino.

- Sends a high signal to the relay module input pin.
- The relay deactivated (switches OFF the circuit).
- The LED Bulbs turns OFF-showing that the load or circuit is powered OFF

5. If the password is incorrect, the relay remains ON and LED Bulbs stays ON.
6. When the relay is ON, it connects power to the load
7. When relay is OFF, it disconnects the load [5].

5. Hardware descriptions

5.1 Arduino UNO

The Arduino Uno is a microcontroller board used for developing electronic projects. It is built around the ATmega328P microcontroller. The board includes 14 digital input and output pins, 6 analog input pins, a USB port, a power jack, and a reset button. It can be powered using a USB cable or an external power source. The Arduino Uno is programmed using the Arduino IDE software, which is easy to use for beginners. It is widely used in home automation, robotics, and sensor-based applications. Because of its low cost and simplicity, the Arduino Uno is suitable for students, hobbyists, and engineers.

5.2 Single -Channel Relay Module

A single-channel relay module provides a single, independent electromechanical switch that electrically isolates the low-voltage control side (e.g., from a microcontroller) from the high-voltage load side (AC or high-current DC), enabling safe and straightforward control of household appliances or industrial devices. Single-channel relay modules are use for Switching AC Loads Turning on/off lamps, fans, power strips, or pumps using a low-voltage signal. Controlling High-Current DC Loads Switching motors, solenoids, or other DC components that draw more current than a microcontroller's output pin can safely handle.

5.3 4×4 Keypad Matrix

A 4×4 keypad matrix functions by connecting four row lines and four column lines to a microcontroller; pressing any key creates a unique short circuit between one specific row and one specific column, it is a common input device with sixteen push buttons arranged in four rows and four columns whose primary advantage is using only eight microcontroller pins (four for rows, four for columns) to read the state of all sixteen keys by scanning the array.

5.4 LED Bulbs (0.5W)

A 0.5W LED bulb is a low-power, energy-efficient light source. It produces bright light using only 0.5 watts of power. The bulb generates very little heat and has a long lifespan. It is commonly used in night lamps, indicators, and electronic projects

5.5 Jumper Wires

Jumper wires are wires with a connector at both ends and are suitable for interconnecting components in a breadboard, prototype, or test circuit. They connect components without soldering. If you want to build your own circuits, jumper wires are the way to go. Read on to learn more. Below are a few things to look for in jumper wires. The first is how they work.

5.6 DC 12V Adopter

The adapter takes in 230V AC power from a wall outlet and converts it to 12V DC power, which is then used to power devices such as electronic devices.

5.7 USB Cable

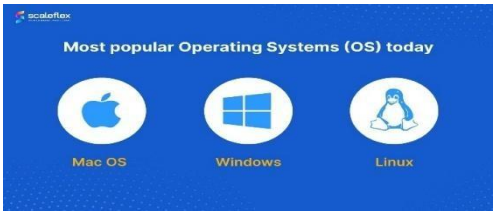
A USB cable is used to connect electronic devices for data transfer and power supply. It is commonly used to connect an Arduino board to a computer for programming and power. USB stands for Universal Serial Bus, and it supports fast and reliable communication between devices.

5.8 Desktop Computer or Laptop

Desktop computer or Laptop are used to develop the Arduino code and dashboard of blank server and dump or download the program to Arduino UNO.

6. Software Description

6.1 Arduino IDE





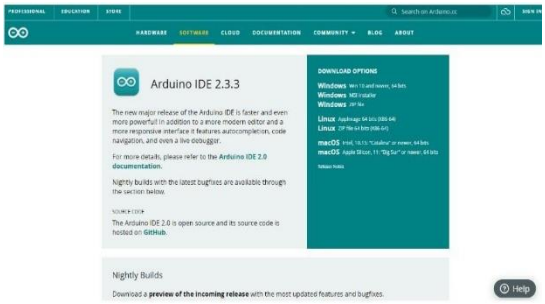
- Arduino IDE is an Integrated Development Environment (IDE) used for programming Arduino boards. It is a software application that provides an easy-to-use interface for writing, compiling, and uploading code to Arduino boards. The IDE is available for Mac, Windows, and Linux operating systems and can be downloaded for free from the Arduino website.



- The Arduino IDE provides a simplified programming language based on C++ that is easy to learn and use, even for beginners.

- C++ program is a software program written in the C++ programming language. C++ is a high-level programming language that is widely used for developing software applications such as operating systems, video games, and scientific simulations. It was developed as an extension of the C programming language and provides additional features such as object-oriented programming, templates, and exception handling.

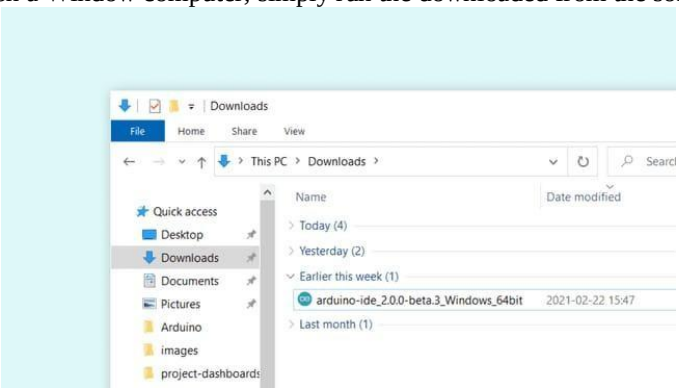
6.2 Instruction to Install Arduino UNO Software



• Go to the official Arduino website https://www.arduino.cc/en/software and download the latest version of the Arduino IDE for your operating system (Windows, Mac, or Linux)

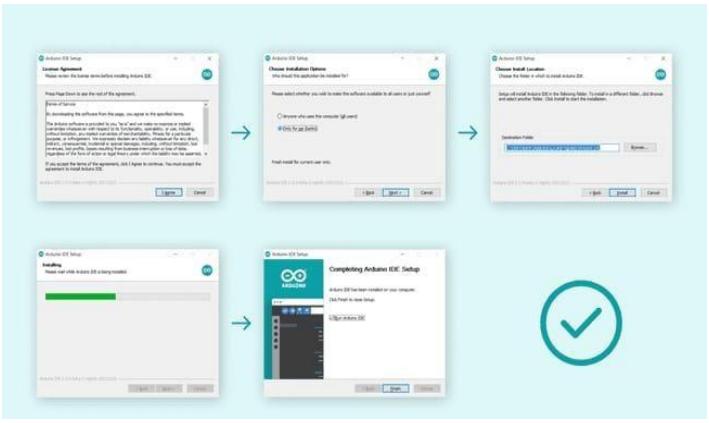
Windows

To install the Arduino IDE 2.0 on a Window computer, simply run the downloaded from the software page.



Follow the instruction in the installation guide. The installation may take several minutes.

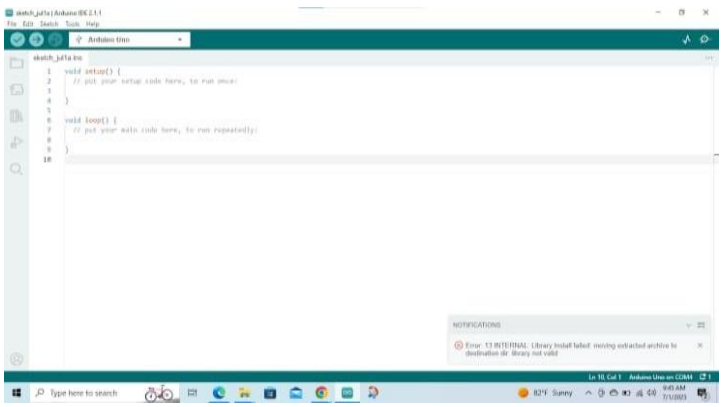
A



You can now use the Arduino IDE 2.0 on your windows computer

6.3 Opening Arduino IDE Software

1. Open the Arduino IDE



- Launch the IDE after installation.
- You'll see the code editor, toolbar, and message area

2. Select the Board Type

• Go to Tools → Board → Arduino Uno (or the board you are using).

3. Select the Port

• Go to Tools → Port → Select the COM port where your Arduino is connected (e.g., COM3 on Windows or /dev/ttyUSB0 on Linux).

4. **Write or Load a Program**
In the code editor, write your program (called a sketch) or open an example:
File → Examples → Basics → Blink.

5. Verify (Compile) the Code
Click the "✓" Verify button. The IDE will compile your code and show any errors in the message area.

6. Upload the Code
Click the ➞ Upload button. The code will be transferred to the Arduino board via USB.
After uploading, the board will automatically start running the program

7. Result and Analysis



Fig 6.1: Initial Condition

Connect the Arduino UNO to a 5V power source (USB or external adopter). Ensure all components are properly grounded (GND connected). Once powered ON, the Arduino initializes the keypad and relay module. The LED Bulbs will ON initially.



Fig 6.2: Entering the Password

Use the 4x4 Keypad to enter the preset password (for example 1234). Each button press is read by the Arduino. If the entered password is correct the Arduino, sends a high signal to the relay module input pin, The relay deactivated (switches OFF the circuit). The LED Bulbs turns OFF-showing that the load or circuit is powered OFF. If the password is incorrect, the relay remains ON and LED Bulbs stays ON.



Fig 6.3: Output

When the relay is ON, it connects power to the load. When the correct password is entered the relay is turn OFF, it disconnects the load. The circuit will break.

7. Advantages

- **Access Control**: Only users with the correct password can operate the circuit, enhancing safety.
- **Simple Implementation**: Arduino Uno is beginner-friendly with abundant libraries and community support.
- **Customizable**: Passwords, number of users, and lockout features can be easily modified in code.
- **Low Cost**: Affordable components like 4x4 keypad, LCD, and relay modules.
- **Expandable**: Can be integrated with GSM, IoT, or biometric modules for advanced control.

8. Disadvantages

- **Power Dependent**: Arduino and peripherals need continuous power; failure may disable the system.
- Physical Access Needed: Without wireless modules, password entry requires physical presence.
- Not Tamper-Proof: Basic setups can be bypassed if someone accesses the hardware directly.

9. Applications

- Home Electrical Panels: Prevents children or unauthorized users from switching circuits.
- Industrial Machines: Ensures only trained personnel can operate high-voltage equipment.
- Educational Projects: Ideal for learning embedded systems, security, and automation.
- Server Rooms: Adds a layer of access control to critical power lines.

10. Conclusion

The Password-Based Circuit Breaker using Arduino Uno successfully demonstrates how embedded systems can be applied to enhance electrical safety and user-level access control. By replacing traditional manual switching mechanisms with a password-protected relay system, the project introduces a secure and intelligent way to manage electrical circuits. The design intentionally omits a display module, relying instead on a 4x4 keypad for input and LEDs for feedback. This minimalistic approach reduces cost, simplifies wiring, and makes the system more compact - without compromising functionality. The Arduino Uno handles password verification, relay control, and alert signalling, showcasing its versatility in real-world automation tasks. This project is highly applicable in smart homes, industrial safety systems, and educational environments. It serves as a practical example of how microcontrollers can be used to implement access control, automate electrical systems, and promote safer operation of power circuits. The modular nature of the design also opens doors for future enhancements, making it a strong foundation for more advanced embedded applications.

11. Future Scope

The 'Electrical Lineman Safety with Password-Based Circuit Breaker' project has significant potential for future advancements. Currently, it provides basic protection by ensuring only authorized personnel can operate the circuit breaker, reducing the risk of accidents. In the future, the system can incorporate multi-level authentication mechanisms, such as biometric verification (fingerprint or facial recognition), along with password security, to provide an even higher level of safety for electrical linemen working in high-risk environments. Integration with IoT and wireless communication technologies can enable remote monitoring and control of electrical circuits from anywhere, providing real-time status updates and alerts to supervisors.

References

1. Malleswari, B., Anitha, K., Jaikumar, V., & Arun Chakravarthy, A. (2023). Password Based Circuit Breaker Using GSM Module. Mathematical Statistician and Engineering Applications,
2. Wasekar, S. V., Rahate, D. K., Parate, S. A., Borkar, A. V., & Karmarkar, B. (2023). Password Based Circuit Breaker.
3. Hudedmani, M. G.Ummannanavar, Mudaliar, M. D., Sooji, C., & Bogar, M. (2021). Password Based Distribution Panel and Circuit Breaker Operation for the Safety of Lineman during Maintenance Work. Advanced Journal of Graduate Research.
4. Electric Lineman Safety System with Protection Based Circuit Breaker. International Journal of Communication and Computer Technologies.
5. Shriwastava, R. G., Bhange, P. A., Raut, S. G.,Kawale, T. B., Raghorte, D. S., Mahure, R. A., & Harami, P. R. (2024). Smart Safety with Password Based GSM Module Controlling Circuit Brea