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# Biometric Scanner Based Circuit Breaker on Transmission Line

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## ABSTRACT

Electric linemen currently have to ask staff members to turn off the lines that need maintenance or repairs. There is a significant possibility of misunderstandings and a possible danger to life. The goal of the suggested solution is to solve this issue by offering a safe way to turn the supply on and off in line. This system uses a fingerprint sensor for authentication because it shouldn't be accessible to everyone. We have a backup system with user authentication in place in case the fingerprint detection fails or encounters issues. The electric lineman uses a fingerprint sensor to submit a request for system access. Access is allowed and the line can be turned on or off based on need if the fingerprint matches the one on file. The output status of an allowed or denied access is displayed on the LCD. Relays are used to connect or disconnect loads and signal whether a load is on or off based on the system's condition. The microcontroller, which oversees all system operations, must be configured to produce results upon request from authorized users. The suggested method seeks to safeguard electric linemen's safety and lessen the possibility of human mistake.

**Keywords –** *Controller , Fingerprint sensor , relay, Electric lineman, etc.*

## 1. INTRODUCTION

Our homes, companies, and industries are all dependent on electricity, making it an essential part of contemporary life. To guarantee its dependability and safety, the infrastructure that provides this necessary resource must be regularly maintained and updated. Electric line workers are at the front of this maintenance effort; their duties include examining, fixing, and even shutting down power lines to solve problems and avert risks. Linemen would manually seek the required shutdowns from staff members in order to interrupt electricity lines for repair. This method has been in use for a long time. Nevertheless, there are a number of difficulties with this traditional approach, such as the possibility of misunderstandings and mishaps that might put both the public and employees in danger.

Innovative solutions that increase both the efficiency and safety of maintenance activities are desperately needed in response to these difficulties. By introducing a novel approach to electric line switching through the installation of a secure switching system, this research aims to address these issues. The suggested solution makes use of cutting-edge technology, including fingerprint recognition, to expedite the line switching procedure and authenticate authorized workers. The system seeks to reduce the possibility of unauthorized operation by incorporating a strong authentication method, therefore improving overall safety. Using a microcontroller as the central processing unit, which

coordinates the interactions between various system components, is one of the main characteristics of the suggested system.

Furthermore, an LCD display gives users immediate feedback on the progress of their requests for access, enabling them to confirm the results of their requests. In addition, a relay mechanism makes it easier to connect or disconnect the load smoothly, which guarantees efficient and error-free operation. In addition to mitigating safety problems, the proposed system seeks to enhance operational efficiency through the reduction of line switching time and effort. Modernizing electrical infrastructure maintenance methods is aided by the system, which equips electric lineman with the necessary instruments to carry out their jobs safely and efficiently. Furthermore, this study highlights the value of innovation in boosting operational effectiveness as well as placing a high priority on worker safety.

The effectiveness and dependability of the suggested system will be assessed via thorough investigation and testing, with the final objective being its possible incorporation into standard operating procedures within the sector. To sum up, this study is a major step in the direction of improving the effectiveness and safety of electric line maintenance procedures. This project aims to reduce the inherent hazards related to maintenance tasks while enhancing operational performance by implementing a secure switching system with sophisticated authentication and monitoring capabilities.

## 2. LITERATURE SURVEY

Athira P Nair et al. (2015) presented a paper titled "Electric Line Man Safety System With OTP Based Circuit Breaker" in the International Journal of Research in Engineering and Technology. The authors proposed a safety system for electric line-men that utilizes a One-Time Password (OTP) based circuit breaker. This system aims to enhance safety measures for line-men by incorporating advanced technology to control electrical lines, potentially reducing the risk of accidents during maintenance operations.

Brittian L. W. (1997) contributed to the National Electrical Safety Code, a comprehensive set of standards aimed at ensuring the safety of electrical installations and operations. The inclusion of these standards in the literature highlights the importance of adhering to established safety protocols and regulations in the field of electrical maintenance.

ByreddySwetha and Dr. Fazal Noor Basha (2013) presented a paper on "A Low Power Controlling Processor Implementing in SOC" in the IEEE Engineering in Medicine and Biology Magazine. While not directly related to electric line maintenance, this paper underscores the significance of low-power processing technologies, which could potentially be leveraged in the development of efficient and sustainable solutions for electric line safety systems.

The National Electrical Safety Code Committee (2002) contributed to the accreditation of standards related to live work minimum approach distances, highlighting the importance of maintaining safe distances during electrical maintenance activities. Compliance with these standards is crucial for minimizing the risk of accidents and ensuring the safety of personnel working on electrical lines.

## 3. METHODOLOGY

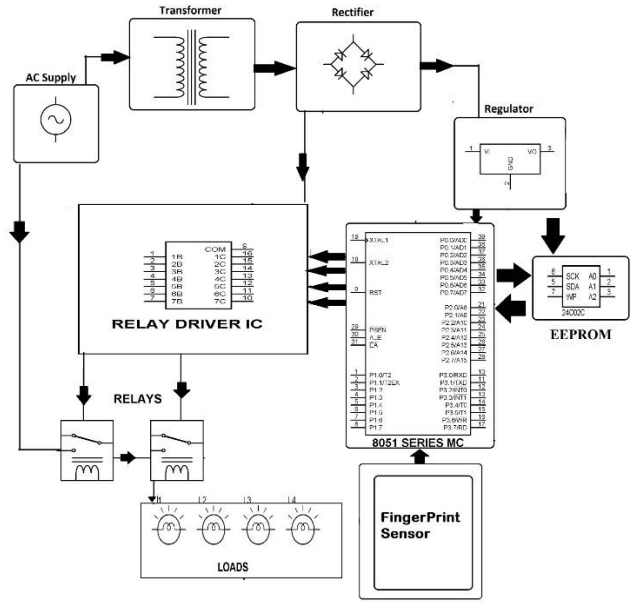


**Fig. No. 3.1 Block diagram of the system**

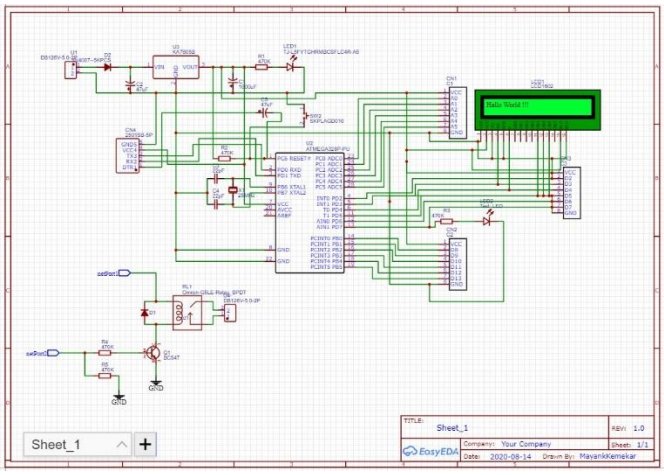

**Fig. No. 3.2 Circuit diagram of the system**

### 3.1 Component Description

1. **Arduino Nano**
   - Description: A compact, breadboard-friendly microcontroller board based on the ATmega328P.
   - Specifications: 14 digital input/output pins, 8 analog inputs, 16 MHz clock speed, USB interface for programming.
   - Purpose: Acts as the central control unit for the project, handling input from the fingerprint scanner and push button, processing data, and controlling the relay and LCD display.

2. **Biometric Fingerprint Scanner**
   - Description: A module capable of capturing and recognizing fingerprints for secure authentication.
   - Specifications: Typically includes an optical sensor, serial interface for communication with microcontrollers, and onboard storage for fingerprint templates.
   - Purpose: Ensures that only authorized personnel can activate or deactivate the transmission line, enhancing safety.

3. **Relay Module**
   - Description: An electromechanical switch used to control a high-power circuit with a low-power signal from the Arduino.
   - Specifications: Usually operates on 5V for the coil, can handle high voltage/current on the switched side, opto-isolated for safety.
   - Purpose: Allows the Arduino to switch the transmission line on and off without directly interfacing with high voltage, ensuring safety and reliability.

4. **16x2 LCD Display**
   - Description: A display module that shows two lines of text, each with up to 16 characters.
   - Specifications: HD44780 controller compatible, operates on 5V, can be interfaced with microcontrollers using parallel or I2C communication.
   - Purpose: Provides visual feedback to the user, displaying messages such as "Scan Finger,"

"Access Granted," "Access Denied," and status updates.

5. **Push Button**
   - Description: A simple tactile switch used to provide user input to the Arduino.
   - Specifications: Typically operates on 5V, with a momentary contact mechanism.
   - Purpose: Initiates the fingerprint scanning process when pressed, allowing the user to interact with the system.

6. **Breadboard and Jumper Wires**
   - Description: Prototyping tools used to build and test electronic circuits without soldering.
   - Specifications: Breadboards come in various sizes, and jumper wires can be male-to-male, male-to-female, or female-to-female.
   - Purpose: Facilitates easy connections between components during the prototyping phase.

7. **Power Supply**
   - Description: Provides electrical power to the Arduino and other components.
   - Specifications: Typically a 5V USB power source or a regulated power adapter.
   - Purpose: Ensures all components receive the necessary voltage and current to operate correctly.

### 3.2 Working of System

The primary goal of this project is to ensure that the transmission line can only be activated or deactivated by authorized personnel, thus preventing accidental shocks and ensuring safety during maintenance. This system uses an Arduino Nano microcontroller, a biometric fingerprint scanner, a relay module, a 16x2 LCD display, and a push button to achieve secure and controlled switching of the transmission line.

**System Initialization**

When the system is powered on, the Arduino Nano initializes all connected components. The LCD display shows a welcome message and indicates that the system is ready for operation. The fingerprint scanner is initialized to ensure it is ready to scan and match fingerprints against stored templates. The relay module is set to its default state, which is usually off, ensuring that the transmission line remains inactive until an authorized activation signal is received.

**User Interaction**

To activate the transmission line, a user must first press the push button. This action sends a signal to the Arduino, triggering the fingerprint scanning process. The LCD display updates to prompt the user to place their finger on the scanner. The fingerprint scanner captures the fingerprint image and processes it to extract unique features. These features are then compared against pre-stored templates in the scanner's memory. If the fingerprint matches one of the stored templates, the Arduino receives a confirmation signal from the fingerprint scanner. The LCD displays a message indicating successful authentication, such as "Access Granted." The Arduino then activates the relay module, which switches the transmission line to the on state, allowing electrical flow. The LCD might also display a status message, such as "Line Active," to inform the user of the current state.

**Safety Mechanisms**

In the event of an authentication failure, where the fingerprint does not match any stored template, the fingerprint scanner sends a negative response to the

Arduino. The LCD displays a message such as "Access Denied," and the relay remains in its default off state, preventing any unauthorized person from switching on the transmission line. This mechanism ensures that only individuals whose fingerprints are registered in the system can control the transmission line. For added safety, the system can be programmed to handle multiple failed authentication attempts. After a certain number of unsuccessful tries, the system can enter a lockdown mode, where no further attempts are allowed for a specified time period. This feature prevents brute-force attacks and ensures the system remains secure even if someone repeatedly tries to gain unauthorized access.

**Deactivation Process**

To turn off the transmission line, the authorized user again presses the push button. The system repeats the fingerprint scanning process to verify the user's identity. Upon successful authentication, the Arduino deactivates the relay, which in turn switches off the transmission line. The LCD updates to show a message such as "Line Inactive," confirming that the line has been safely deactivated. This controlled deactivation ensures that the line is only turned off by authorized personnel, maintaining operational safety.

**System Design and Integration**

The Arduino Nano serves as the central processing unit, interfacing with all other components. The fingerprint scanner communicates with the Arduino via serial communication, while the LCD display uses either parallel or I2C communication for displaying messages. The relay module is connected to one of the digital output pins of the Arduino, allowing the microcontroller to control the relay state based on the fingerprint authentication results. The push button is connected to a digital input pin, providing a simple and reliable way to initiate the scanning process. All components are powered by a regulated 5V power supply, ensuring stable operation. Proper connections and signal conditioning are employed to prevent noise and ensure reliable communication between components. For example, resistors and capacitors are used to debounce the push button, ensuring that the Arduino only registers a single press even if the button bounces. Diodes are used to protect the circuit from potential back EMF generated by the relay coil, safeguarding the Arduino and other components.

**System Testing and Calibration**

Extensive testing is conducted to ensure the system functions as intended. Each component is tested individually to verify proper operation before integrating them into the full system. The fingerprint scanner is tested with multiple templates to ensure accurate and reliable authentication. The relay module is tested to confirm that it correctly switches the transmission line based on the control signals from the Arduino. The LCD display and push button are also tested for correct interaction and feedback. During the testing phase, various scenarios are simulated to ensure the system's robustness. This includes multiple authentication attempts, both successful and unsuccessful, to verify the security features. The relay's response time is measured to ensure prompt switching of the transmission line, and the system's response to power interruptions is tested to confirm reliable operation after power is restored.

## 4. ADVANTAGES & DISADVANTAGES

### 4.1 Advantages

- Quick response time
- No need of remembering passwords
- Team based system to facilitate smooth working.
- Fingerprint sensors are accurate

- Cost effectiveness
- Avoids electrical accidents to line man

### 4.2 Disadvantages

- Biometric authentication systems store sensitive information about individuals, such as their fingerprints or facial features. If this information falls into the wrong hands, it can be used for identity theft or other malicious purposes.
- Biometric authentication systems may sometimes incorrectly identify individuals, leading to false positives. For example, a fingerprint scanner may not recognize a person's fingerprint if it's dirty or smudged. This can lead to frustration and inconvenience for users.
- Biometric authentication systems can be expensive to implement and maintain. The hardware and software required for biometric authentication can be costly, and the systems need to be regularly updated and maintained to ensure their effectiveness.

## 5. APPLICATIONS

- It is used in electrical substations to ensure line man safety.
- Finger print based circuit breaker is used in buildings and houses.
- Used for saving power in hotels and shopping malls.

## 6. FUTURE SCOPE

The system's design guarantees an innovative and reasonably priced method of creating a lineman's safety mechanism, but it does not preclude design adjustments or the addition of new features that would further boost safety. This project has room for technological advancement. For example, we can use the internet as a platform to provide the status of this mechanism's usage. The system can be utilized to determine what more is needed as well as tested under various demanding operating settings. Points that may be taken into account for this project's future scope are listed below.

- Availability of the front end of the system
- Maintaining lineman worker records

## 7. RESULT & CONCLUSION

### 7.1 Result

This technology offers a solution that can raise the project's level of safety. It is intended to use a fingerprint access method to operate a circuit breaker. the maintenance personnel, such as linemen, for ON/OFF control. The system is set up so that a password is needed to turn the circuit breaker ON or OFF, but it has some drawbacks, therefore we're going to try something different. The line works with the line guy alone. The lineman may easily fix the supply after turning it off, go back to the substation, and use the system to switch on the line. An ATmega 328 IC controls the entire system. The user cannot access it if he is not authenticated; if he is and his authorization is valid, the line can be turned ON or OFF. In our daily lives, security is our top priority. Everyone aspires to the highest level of security. A novel method for linemen life security is offered by this technology. A lineman can use the circuit without any issues. The circuit can be controlled as needed and operated without a load.

### 7.2 Conclusion

This biometric-based transmission line control system effectively enhances safety by ensuring that only authorized personnel can switch the line on or off. The integration of the Arduino Nano, fingerprint scanner, relay module, LCD display, and push button provides a reliable and secure method of controlling high-voltage

lines, significantly reducing the risk of accidental electrical shocks during maintenance operations. The system's design and implementation demonstrate a practical application of embedded systems and biometric authentication in enhancing operational safety.

## 8. REFERENCES

1. Athira P Nair, Josephin J, Anjana A S, Athira C P and Sebin J Olickal. (2015). Electric Line Man Safety System With OTP Based Circuit Breaker. IJRET: International Journal of Research in Engineering and Technology eISSN: 2319-1163 | pISSN: 2321-7308. Volume: 04 Special Issue: 03. Retrieve from: http://www.ijret.org

2. Brittian L. W., 1997. National Electrical Safety Code.

3. ByreddySwetha and Dr. Fazal Noor basha. (2013). "A Low Power Controlling Processor Implementing in SOC" International

4. IEEE Engineering in Medicine and Biology Magazine,1996, 116-120, 15(2):106-110.

5. National Electrical Safety Code Committee, 2002. Accredited Standards Committee C2 Rule 441 Table 441-1 AC Live Work Minimum Approach Distance, page 228

6. PravinkumarN.Mahadik, Mr. Pratik A.Yadav, Mr. Suraj B. Ghotpagar and Harsha P. Pawar.

7. M. Hassan Ali, et.al "Enhancement of a GSM Based Control System," in 2015, ISBN: 978-1-61804-271-2, pp. 189– 202.

8. MallikarjunHudedmaniet.al "Password-Based Distribution Panel and Circuit Breaker Operation for the Safety of Lineman during Maintenance Work", ISSN: 2456-7108 Volume 1, Issue 1, pp. 35-39, 2017 January.

9. Veena, "Electric line man safety system with OTP based circuit breaker", SR Engineering College, Volume: 2, May 2015

10. Muhaad Ali Mazidi and Janice GillisllispieMazid, "The Microcontroller and embedded system", Person Education, 2nd edition, Issue: 1999

11. Dr.Neelam Rup, Prakash, "International Journal of Engineering Trends and Technology", (IJETT), Volume 13, page: 261, Issue: 3 – Jul 2014.

12. Mark Halpin: "National Code Committee", Volume40, page: 228, Issue: 2002

13. Deepak Sharma & Major Sing Goraga: "International Journal Of Current Engineering And Scientific Research (IJCESR)" Volume2, issue-May 2015

14. Athira P Nair: "electric line man safety system with OTP based circuit breaker" BTC College of Engineerimg, Kerala, Volume: 04, issue: April, 2018