# Passcode based Circuit Interrupter

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*Abstract: : In recent surveys, the electrical accidents to the linemen are increasing year by year due to the improper communication between the electrical staff and the substation. These faults occur during maintenance and there is no proper coordination between the people to people. This paper deals about this issue and the solution brought out to reduce electrical accidents due to these communication failures. In our day to life, the applications of embedded systems are used in everywhere and it is cost effective and better accuracy and precise of results will get. Currently, the research is going on the basis of embedded systems which includes microcontroller plays a vital role. Recent technology like Arduino based system is used by implementing the password protection in circuit breaker. Password is entered by the specific person and there is a provision of password changing system. Arduino UNO is used to control the signal in the relay module and the matrix keyboard is introduced to enter the input and LCD display is used to display the output and the ON/OFF switches provided as the loads through the Relay switch. By using this system, accidents can be prevented and valuable human lives can be saved.*

*Keywords : Circuit breaker, Arduino UNO, 4x4 Matrix keypad, LCD Module.*

## I. INTRODUCTION

Nowadays, the present power grid deals with huge power network also as associated with more electrical equipment. During the electrical fault or maintenance conditions, the preservation staff or lineman are called to work over them. Working on huge power lines is a high risk for their lives. Also that, due to the miscommunication among linemen causes the switching of electric lines at inappropriate times. This even leads to loss of human lives. According to the survey taken in past 3 years in Tamil Nadu, 369 deaths of lineman have been recorded and many have got severely injured. Fig. 1. shows the Statistics for Number of deaths in Tamil Nadu.

According to the National Crime Records Bureau (NCRB), more than 8,000 people dying every year across the country due to electrical accidents caused by various electrical issues. In 2011 it is 8,945, 2012 it is 8,750, In 2013 it is 10,218 and in 2013 it was so huge number and after that government had taken various steps to control and prevent the electrical accidents. Even though, In 2014 it is 9,606, In 2015 it is 9986 and from 2016 to 2019 it is almost more than 15,000 peoples dying all over the country. Most of the accidents were fatal and it causes very harmful for society too. Statistical analysis of electrical accidents for both fatal and Non-fatal [1] & [2] of southern zone in India is tabulated below. Table-I. Comparison of analysis is between past three years.
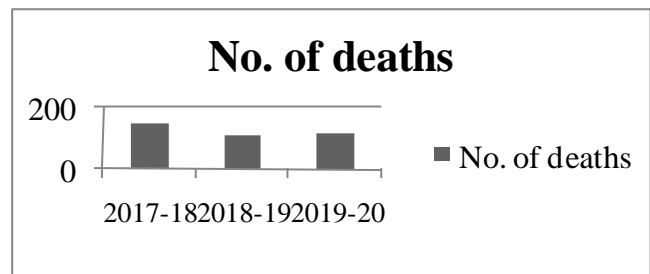


**Fig. 1. Statistics for No. of deaths in Tamil Nadu**

**Table-I. Statistical Analysis of Electrical Accidents**

| Year | State | Fatal | Non-Fatal | Total |
|------|-------|-------|-----------|-------|
| 2019-2020 | Kerala | 115 | 83 | 198 |
| | Bangalore | 10 | 6 | 16 |
| | Andhra Pradesh & Tamil Nadu | Appro. >1000 | Appro. >500 | Appro. >1500 |
| 2018-2019 | Kerala | 249 | 158 | 407 |
| | Bangalore | 128 | 44 | 172 |
| | Andhra Pradesh & Tamil Nadu | Appro. >950 | Appro. >400 | Appro. >1350 |
| 2017-2018 | Kerala | 242 | 152 | 394 |
| | Bangalore | 104 | 34 | 138 |
| | Andhra Pradesh & Tamil Nadu | Appro. >900 | Appro. >350 | Appro. >1250 |

## II. LITERATURE SURVEY

In this paper [3], the author ensures the safety for the maintenance staff in order to provide an arrangement such that a password is required to operate the circuit breaker and then it is comfortably used for the maintenance staff to operate in the repair side.

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And also it has the provision of having one time password in the registered mobile number so that no one can access.

The author in the paper [4], mobile agent software has been applied in implementing maintenance of circuit breaker and repairs. The software is comfortable for applying in circuit breaker maintenance and a good practice of its support for heterogeneous systems, security system, distributed events; low-bandwidth usage etc. With all these advantages the development work can easily be simplified. Also the application is more upgradable and flexible at work.

In this paper [5], automated load distribution system has been provided in which the load sharing is done automatically between industrial loads and rural loads and also password protecting device is implemented between linemen for the safety purpose during maintenance period.
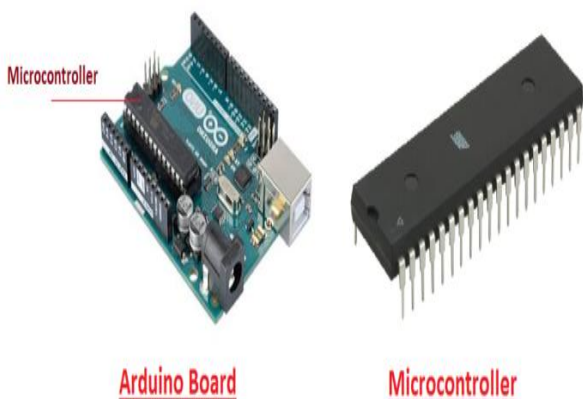
The author in paper [6], automatically operated electrical switch is designed for a circuit breaker to protect during maintenance and due to lack of communication between linemen and the electrical substation. Here, the system is controlled by 8-bit microcontroller and the password protection is used.

## III. COMPONENTS USED:

The main components are used here is Arduino UNO, power supply module, LCD module, 4x4 matrix keypad.

### a) Arduino UNO

With reference of [7], Microcontrollers are widely used in embedded systems and make devices work according to our needs and requirements. It consists of USB interface, 14 digital I/O pins, 6 analog pins and Atmega 328 micro controller. It supports serial communication using Tx and Rx pins. It can be programmed using C, C++ and Embedded C language. Some people get confused between Micro controller and Arduino. Fig2. shows the comparison between Microcontroller and Arduino. While former is a 40 pin chip that comes with a built-in-microprocessor and later is a board that comes with the microcontroller in the base and it has the boot-loader, which is easily accessible of input-output pins and also it can be easily upload and burn the programs into it.

In Fig3. Shows the Architecture of Arduino UNO. Arduino UNO is an open-source electronic platform with a microcontroller board developed by Arduino.cc and it is purely based on AVR micro controller Atmega328. The Board has the number of features like counters, PWM, interrupts, I/O pins, CPU, timers and 16MHz clock. It also has the RAM memory of 32KB. Fig4. Shows the pin description of Arduino UNO board.
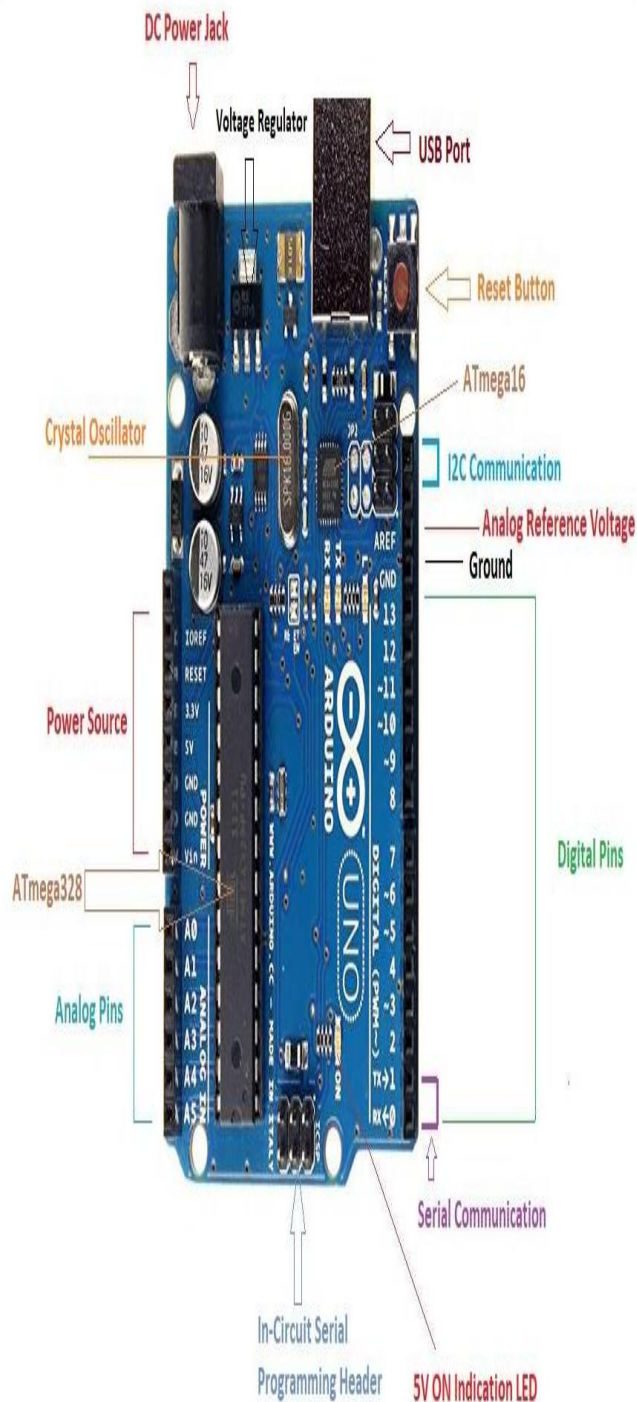


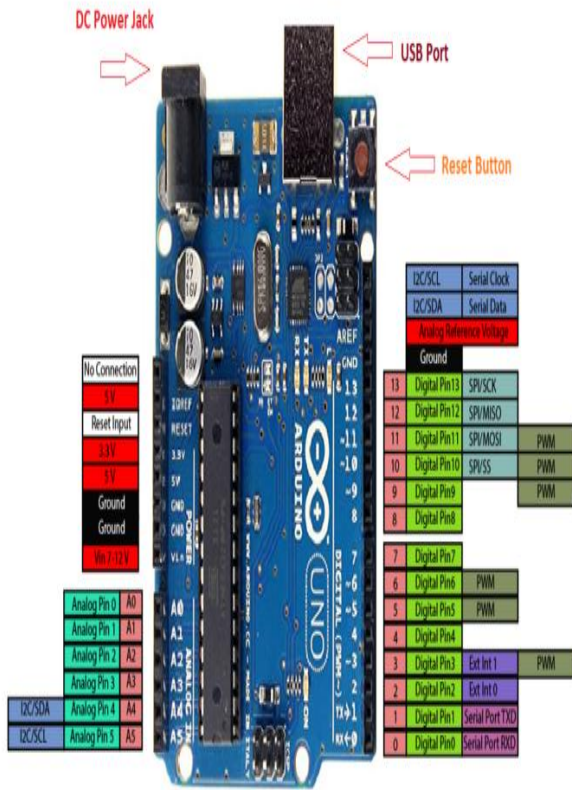**Fig. 3. Architecture of Arduino UNO**



**Fig. 2. Comparison of Microcontroller and Arduino UNO**

**Fig. 4. Pin diagram of Arduino UNO**

## b) Relay Module

The relay is a device which opens or closes the contacts and gives the commands to the circuit breaker to disconnect the faulty area through ON/OFF switch. Relay works on the principle of an Electromagnetic induction attraction type [8]. Fig.5. shows the Arduino Relay module. The Arduino relay module has 6 pins, in which 3 pins are SIGNAL, 5V and GROUND present in one side of the relay module. And the other 3 pins are located on other sides as Normally Close (NC), Common (COM), Normally Open (NO) which are output pins of the 5V relay. The output devices are connected at these pins.
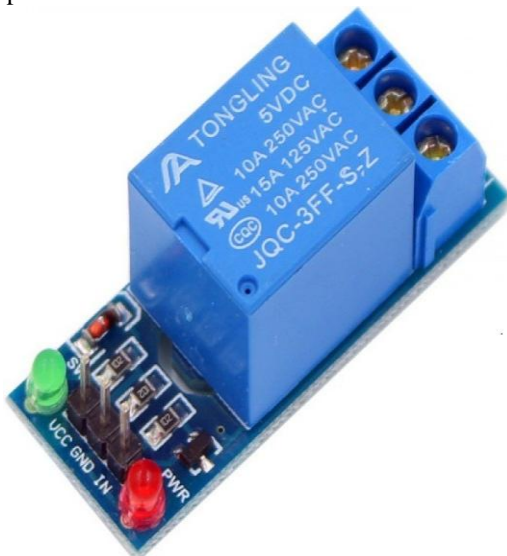


**Fig. 5. Arduino Relay Module**

## c) 4x4 Matrix Keypad

The 4x4 matrix keypad consists of 16 keys in matrix form which is non-encoded. Keypad will have eight terminals. Four are rows of matrix and four are columns of matrix. When a key is pressed, a row and a column will make a contact, otherwise, there will be no connection between rows and columns. Fig.6. shows the internal structure of 4x4 matrix keypad.
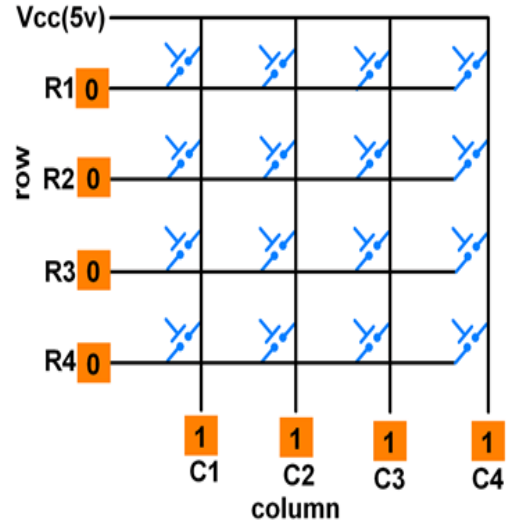


**Fig. 6. Internal Structure of 4x4 Matrix keypad**

## d) LCD Module:

The LCD display module is a 16x2 LCD, can display 16 characters per line in 2 such lines. The operating voltage of a LCD is 4.7V to 5.3V and current consumption is 1mA, when operated without backlight. It is an alphanumeric display module and can also display custom generated characters. It can work on both 4-bit mode and 8-bit mode. The interface IC HD44780 is used, its function is to get commands and Data from MCU and process them to as information onto LCD Screen. Fig.7. shows the 16x2 LCD display module which has 16 pins and its pin diagram.
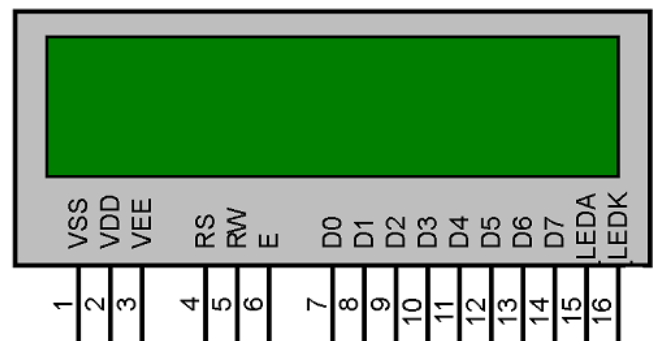


**Fig. 7. Pin diagram of 16x2 LCD Module**

## IV. SOFTWARE REQUIREMENT

Arduino IDE is an open source software is used for writing and compiling the code. Operating Systems Like MAC, Windows, Linux is available in Arduino IDE and also runs on Java Platform.

The main code is created on IDE platform and it generate Hex File and then it is transferred and uploaded in the controller. The program code is developed based on the Flow Chart designed for the problem Statement. Fig.8. shows the flowchart for the Passcode Based Circuit Interrupter.
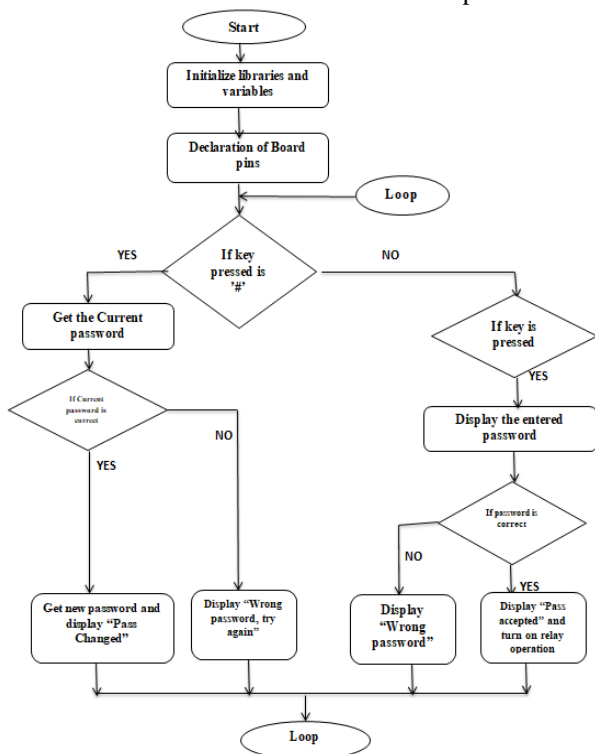


**Fig. 8. Flow chart of program code**

## IV. RESULTS AND DISCUSSION

Fig.9. shows the Block diagram of the system. The software is imported into the hardware to get the required output. The Password based Circuit Breaker is designed to turn ON/OFF the power line whenever required, only with the access of the password. The software is developed in such a way that, the operation of hardware could meet the requirements of the user. All the hardware components are connected to the microcontroller board that is, the Arduino Uno board. The total control of the operation of individual components is controlled by the microcontroller. Thus, it serves as the heart of the device.
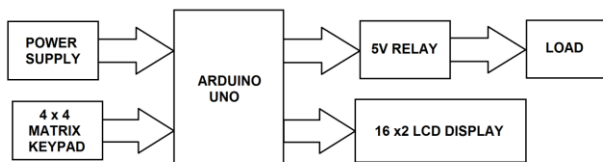


**Fig. 9. Block diagram of the system**

Fig.10. shows the Block diagram of power Supply. The Arduino Uno is powered by using a power source. The input is fed by using the 4x4 Matrix keypad. Data entered through the keypad is made readable by using the 16x2 LCD. Control signal for the relay module is given by the Arduino Uno. When entered password is the same as that of the initial password, then the control signal for the relay module switches from its current state. If not, then an error message

stating the incorrect password is displayed in the LCD. In case of change of password, the Arduino Uno checks for special character '#' in the input. A special function called Change() is executed to change the password. The current password is verified, before doing the change of password. Thus, the Password based Circuit Breaker works based on the instructions given by the Arduino Uno.
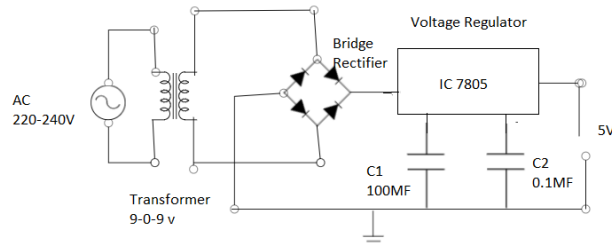


**Fig. 10. Block diagram of Power Supply**

The power supply for the Arduino Uno board is given by using the DC power jack (7-12V) or by using the USB port. The hardware components are connected to the main microcontroller board that is, Arduino Uno. 4x4 Matrix keypad pins are connected to the analog pins (A0-A5) and digital pins (2-3) of the Arduino Uno. Relay module is powered by the 5V supply pin and ground pin and the control signal pin is connected to the Digital pin 10 of the Arduino board. On the other side of the Relay module is connected to the power line, which is needed to be controlled by the Password based Circuit Breaker. LCD module is made to operate in 4-bit mode. $V_{ss}$ and Cathode pin (K) of the LCD is grounded and $V_{dd}$ and Anode pin (A) is given to the 5V supply pin. $V_o$ pin is connected to a potentiometer and can be adjusted in order, to vary the intensity of the LCD. Read/Write pin is grounded as only the read operation is to be performed. $R_s$ pin and Enable pin are connected to digital pins 9 and 8 of the Arduino board respectively. The Data pins (D4-D7) of the LCD module are connected to digital pins (7-4) of Arduino. The Reset button in the Arduino Uno board is used in case of any blockage of code running. Fig.11. shows the Internal circuit diagram of the password circuit breaker.
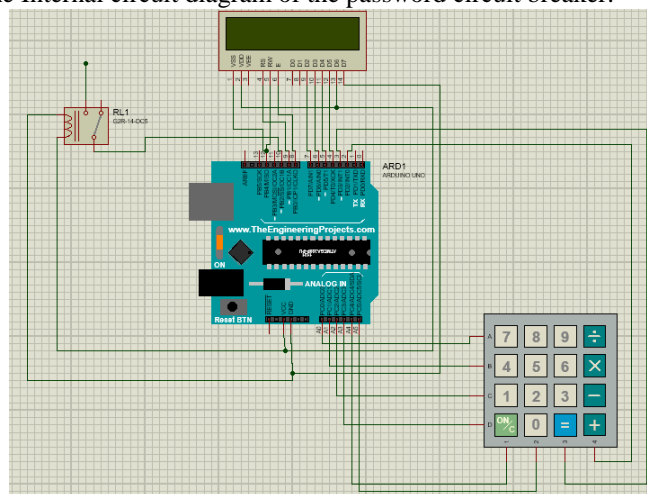


**Fig. 11. Circuit diagram of a password based Circuit breaker**

**a) Step- by- step methodology used:**

The Relay module and LCD module are powered by the 5V supply and ground pins of the Arduino Uno and turned ON. The LCD module displays the text "Enter the password". An initial password is saved in the memory of the microcontroller as programmed. The input is received by the device using the Matrix keypad. The entered password is compared with the initial password by using the Arduino Uno. If it is matched, then the Arduino complements the control signal of the relay module from its present state that is, if the control signal is HIGH, it is converted to LOW or vice versa. According to the control signal, the relay energizes or de-energizes the relay coil so that the power line is either tripped or connected as per the operating mode. Also, as soon as the password is matched, LCD displays the text message as "Pass accepted". When the password is mismatched, no relay operation is involved and a error message "Wrong password" is displayed by the LCD module. For changing the password, a separate function called as change() is used and a special character '#' is used to start the function. When the input from the keypad is sensed as '#', the change() function is called and the current password is asked by the Arduino Uno. LCD displays the text "Current password" to make the user enter the current password. This entered password is compared with the initial password as done before by the microcontroller. If it does not match with the initial password, then the LCD throws an error message as "Wrong password, Try again". If it matches, the LCD displays "New password" and prompts for the new password from the user. The new password entered through the keypad is now stored in the EEPROM memory of the microcontroller and thus, the password is changed. In further operations, the new password entered recently is considered as the initial password. Fig.12. shows the Hardware module of the passcode based circuit breaker. Table-II. Shows the tabular form of experimental results.
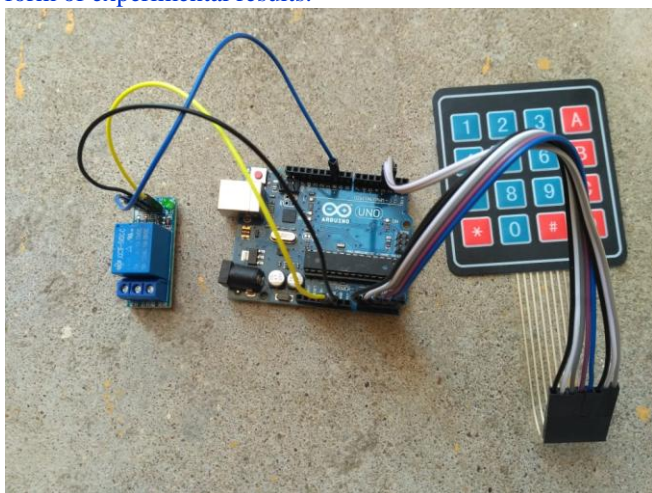


**Fig. 12. Hardware module of Passcode based Circuit breaker**

**Table-II. Tabulation of Experimental Results**

| Pre-defined Password | User entered Password | Message in LCD | Relay Operation |
|---|---|---|---|
| 1234 | 1233 | Wrong Password | No operation |
| 1234 | 1234 | Pass | Tripped |
| | | Accepted | |
| 1234 | # | Current Password | No operation |
| | 1234 | New Password | |
| | 5678 | Pass Changed | |
| 5678 | # | Current Password | No operation |
| | 1234 | Wrong Password Try again | |

## V. CONCLUSION

This paper deals to ensure the safety of the maintenance staff or line man. The line man has only the accessing power to turn ON/OFF the lines. Password is needed to operate and control ON/OFF the Circuit breaker. Lineman can use this password whenever the faulty line needs to repair and he can use the correct password to turn ON once the faulty line gets rectified by line man. Change of password also can be done to access comfortably by the line man. It gives a good idea of security. Thus proposed system can be used to maintain one password that cannot be stolen. This avoids the electrical accidents to the line man and improves the line man safety. It is also simple with the operating mechanism and can be produced easily as it made of commonly available components. In the future scope, it can also be interfaced with a GSM modem and IOT based system for remotely controlling the electronic circuit breaker through SMS. Not only for major power lines, but can also be used at houses during maintenance at the mains.

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