Security based Circuit Breaker for Maintenance and Management Using IoT

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Abstract

Electrical accidents to the electrical staff are increasing during the maintenance and repair of the line. This is mainly due to the miscommunication (or) lack of communication between the person working on the line and the upkeep staff. To overcome this problem we have proposed this system, which ensures the safety of the electrical staff. if the fault occurs in the line . The person who is working on the line will place his finger on the fingerprint sensor to switch off the line . This information will be passed to the substation through IoT .Again after solving the problem the same person palaces his finger on the sensor to close the line this information will also be shared with substation through IoT. This is how this proposed system ensures the safety of person who is working on the line this system works mainly using PIC microcontroller and IoT.

Keywords: Fingerprint sensor, Circuit Breaker, Microcontroller.

1. Introduction

Now-a-days, Electrical accidents to the Line-Men are increasing day by day due to the miscommunication between Line Man and Sub-Station Authorities.   This paper aims at Line-Man Safety. In this proposed system, the Closing and Opening of the Electrical Lines is done by Line-Man himself. In this proposed system, Line Man or Maintenance Staff has to authenticate the Opening / Closing of the system by Bio-Metric. IN this case, if there is any fault in any electrical line, that particular Line Man will ON/OFF the said line by Bio-Metric Authentication and comfortably rectify the problem in supply of the particular line. IN this paper we have also included IoT, so that the personnel at Sub-Station would know the status of the said problematic line / Transformer   including the details of the Line Man at the site. As published in THE HINDU Newspaper, a senior official TANGED CO., sharing data of fatal accidents involving Public and Departmental Official for 3 years, said 114 person were killed in 2019-2020 against 108 fatalities for 2018-2019. In 2017-2018, the total deaths were 147. With the implementation of our Project, the death rate of all above kind of fatal accidents will be reduced to a maximum extent.

2. Literature Survey

A. Security based circuit breaker

A circuit breaker is a device which will be operated automatically to protect any electrical system from the damages which may be caused by over load or short circuit. The function of a circuit breaker is to detect the fault in the system and interrupt the current flow to the circuit. The main advantage of the circuit breaker is, it can reset automatically or manually unlike a fuse which has to be replaced once it is operated. When the circuit

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breaker is operated manually there many chances of fatal accidents the lineman which may be caused due to miscommunication between the maintenance staff and substation. To avoid this we are using automatically reset type circuit breaker using fingerprint authentication. Here there is also a provision for changing the fingerprint, if any case the authorised personal is transferred to other area or line. The fingerprint sensor scanner system has a fingerprint module and a optical sensor. If any unauthorised person tries to login the system shows a message on the led display as " verification not ok".

b. Maintenance and management using IoT

Fatal accidents to the lineman are on the higher side during electrical lines repair because of the miscommunication or lack of communication between maintenance staff and substation. This above proposed system will surely help in reducing the accidents to the lineman. Here a microcontroller is used as the heart of the system. A program is assigned to the microcontroller, it is assigned in such a way that if aauthorised personal authenticates his fingerprint then the microcontroller sends the signal to the relay to either ON /Off. Once any personal authenticates his fingerprint it shows the status on the IoT platform developed. If any unauthorised person tries to authenticate the microcontroller sends the signal to the IoT stating , an unauthorised person is trying to login, and hence we can take a disciplinary action. IoT also states which authorised personal is operating at a particular area. Hence by this proposed system we can automatically operate the circuit breaker using fingerprint and also can manage the authorised personals status such as "Name of the person" " time of operating" " count of operations".
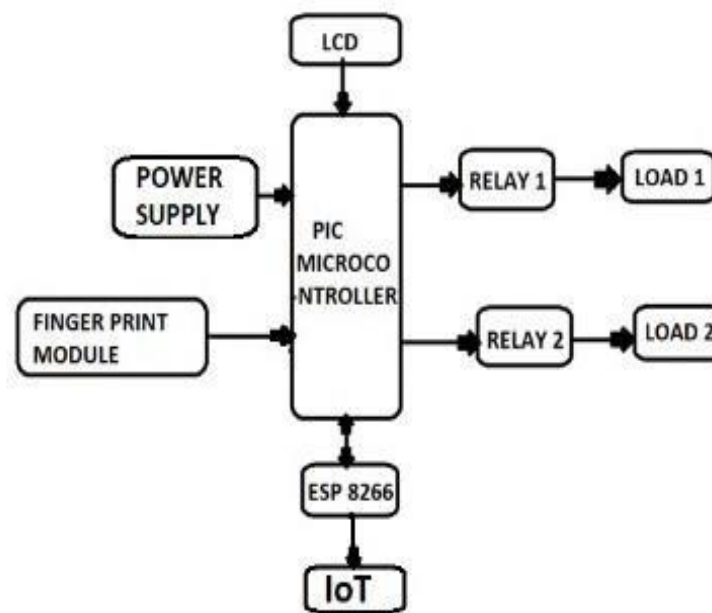
3. Block Diagram

FIG 1. Block Diagram

The block diagram consists of following blocks, they are power supply, fingerprint module, microcontroller, IoT, relay. If a thumb placed on fingerprint sensor it starts comparing fingerprint of current thumb placed on fingerprint sensor with duplicate fingerprint template of an authorized person. If fingerprint matches then signal goes tomicrocontroller. Then microcontroller activates relay either ON/OFF. Then it sends signals to IoT for system status. If fingerprint of the person is authorized. Then it will display the authorized person details. If fingerprint doesn't match then signal goes to microcontroller to IoT. Then it sends an alert message as unauthorized person try to access.

4. Flow Chart

Step1: Start the system

Step2: Initialize the system

Step3: collecting a duplicate template of fingerprint

Step4: Comparing the duplicate fingerprint with the pre-registered finger print

Step5: If the fingerprint matches go to next step

- If the fingerprint print doesn't match go to step 8.

Step 6: if the fingerprint if matching the microcontroller sends the signal to the relay

Step7: Relay operates as per the response from the microcontroller.

Step8: If fingerprint doesn't match the microcontroller sends the signal to IoT

Step9: IoT checks for the message if it is authorised or unauthorised.

- If yes got to next step
- If no go to step11.

Step10: Provide all the information as shown in the flow chart

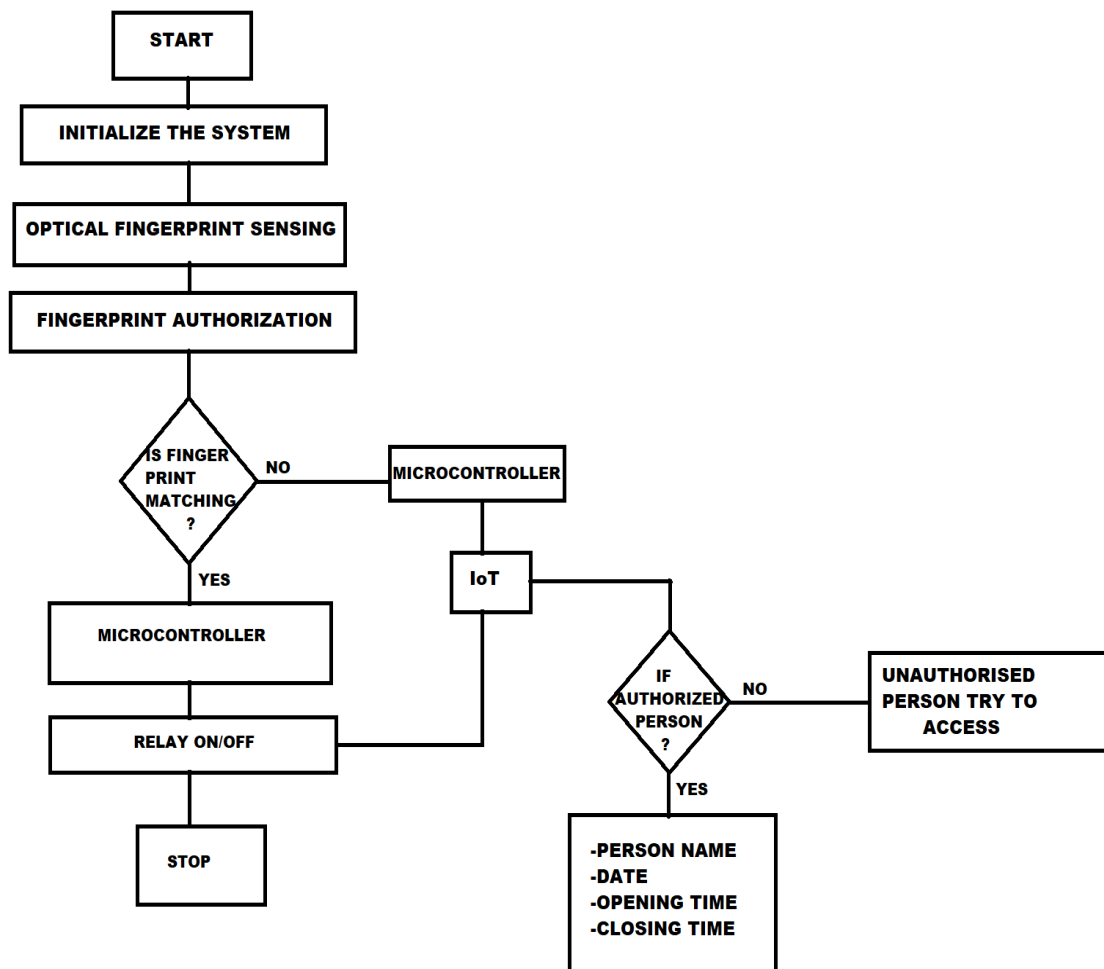Step11: Display a message unauthorised and alert the staff.

Step12: stop

FIG 2. Flow Chart

E.Elakkia, Parri Lokesh, Pojula Gokul Krishna, Shaik Mohammed Sajid,Shaik Mohammed Sajid, Nandini B
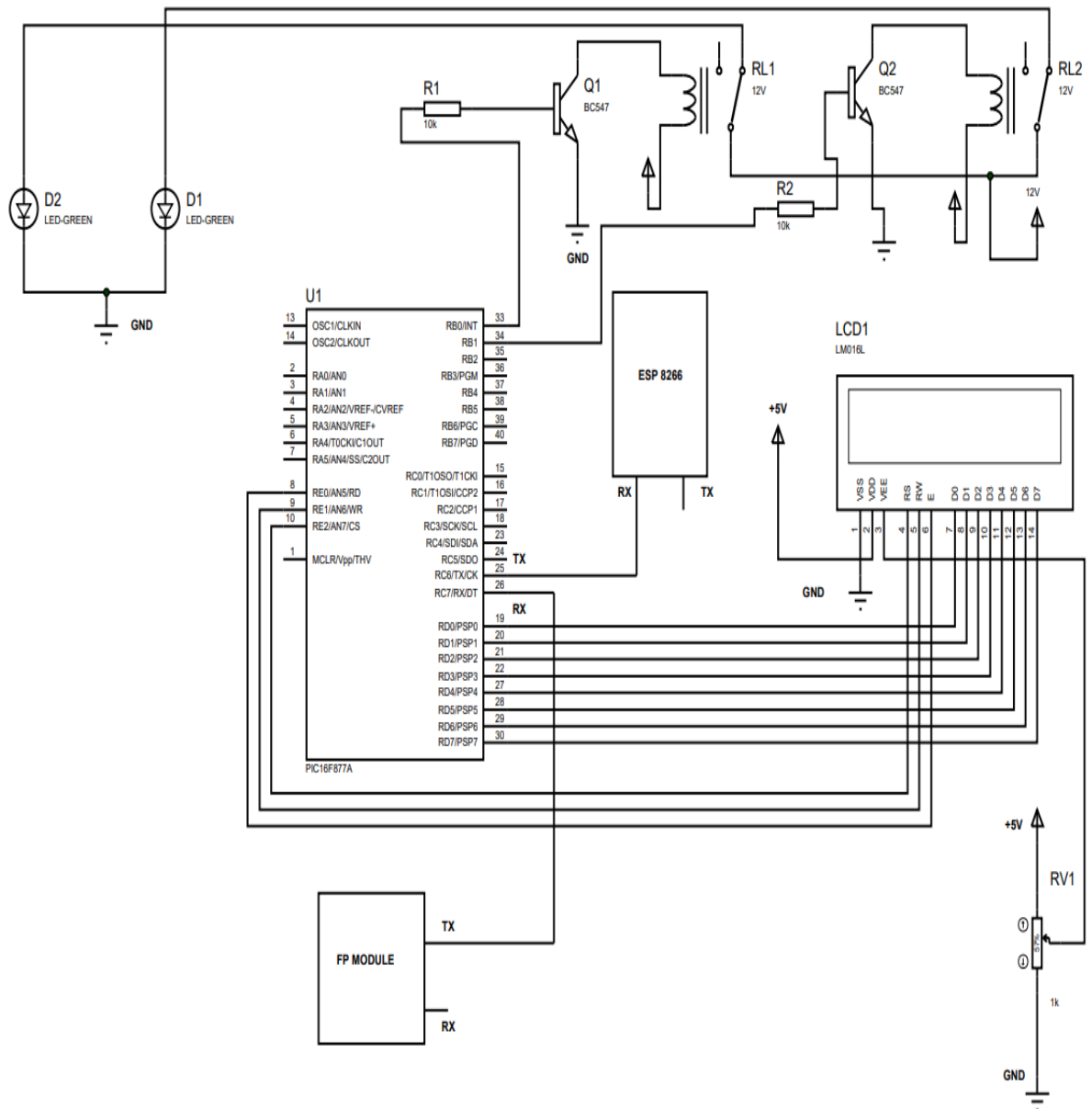
5. Circuit Diagram

FIG 3. Circuit Diagram

6. Circuit Diagram Discription

From the above circuit diagram, the power supply is distributed in two sections. One is to supply unit and another is to relay circuit.A 230v ac supply is converted into 5v dc by using a step-down transform and bridge rectifier and it is given to microcontroller unit and Iot unit. During maintenance the lineman may met with casulty. Inorder to overcome this problem we use relay circuit with fingerprint scanner. If a authorised person palaces his finger on fingerprint scanner and if it's matches with preset fingerprint then the relay circuit is open and if the same authorised person again places his finger on fingerprint scanner then the relat circuit is closed and we used IoT which stores the authorised person details. If unauthorised person try to access the relay circuit then a message (unauthorised person try to access) will send to sub station through IoT.

In the first block the finger we place will be scanned and the status will be sent to second block in which it will be

executed and signal will be sent to the next block is controller the controller runs the program then sends the program output signals to the next stage, i.e relay and IoT respectively. If the fingerprint that is placed

of an authorized person then the relay will open or close with espectively to the signal. If not the IoT displays that the finger placed is of an un-authorized person.

7. Advantages

1. increases Workman safety will working on LT field maintenance

2. Reduce operation time insteadof pulling isolator rod

3. Reliable on kit

4. low cost because of single biometric controller used for all relay and loads

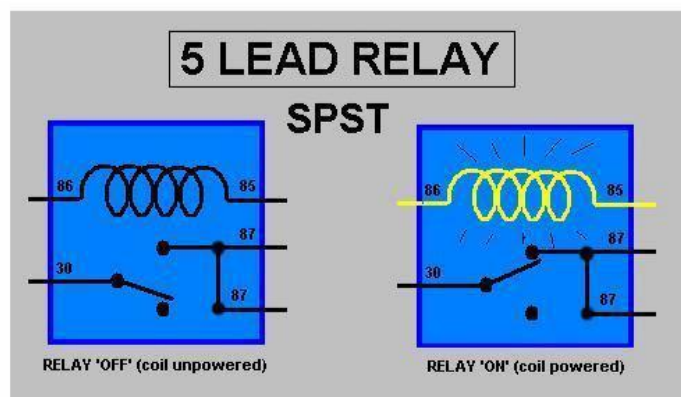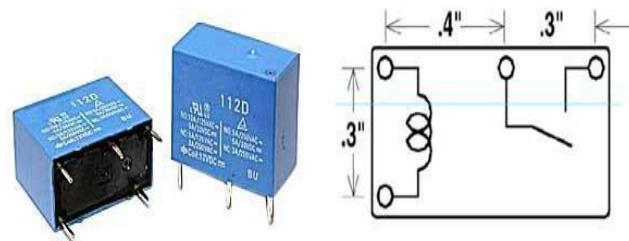5. more secure of using biometric

8 Applications

1. it can be used where more electrical accidents happen

2. Used in LT side of transformers

9. Hardware and Description

Relay

The relay is an electronic device which is operated electronically as a switch to open and close the circuit after receiving signals from peripheral/external devices . There we are using SPDT relay .SPDT is a single pole double throw relay . This relay consists of a one common terminal ,one coil and one normally close, normally opened terminal. When the relay coil is not energized, the normally closed and common terminal have continuity . And when the coil is energized, the normally open and common terminal have the continuity. Here we are using 12V DC and 10A relay. There are three ways of energizing the coil:

1) Normally closed (NC)

2) Normally open (NO)

3)Changeover(DT).

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Microcontroller

The microcontroller used here is PIC16F877, this is an 8-bit pic microcontroller which was introduced by microchip and it is commonly used in embedded systems and automation .The Hardware Kit consists of a PIC16F877A microcontroller. There are totally 10 LED outputs connected to the controller and 3 Potentiometer inputs connected to the controller. The Rx and TX Pin of the Microcontroller is connected to the ESP8266 Wi-Fi module for logging the Data into the cloud. We use ULN2803 to give 12V supply to the LED's to make it glow brighter. The PIC16F887 device are covered by this data sheet. The PIC16F887 device are available in 28-pin PDIP, SOIC, SSOP and QFN packages. The PIC16F884/887 are available in 40-pin PDIP and 44-pin QFN and TQFP packages

Below is the pin diagram of PIC16F887:

Special features of microcontroller:

* Power – Saving Sleep mode.

* Wide Operating Voltage Range(2.0V – 5.5v)

* Industrial and Extended Temperature Range.

* Power on Reset(POR)

* Power – up Timer (PWRT) and Oscillation Start-up Timer (OST).

* Brown –out Reset (BOR) along with Software Control option
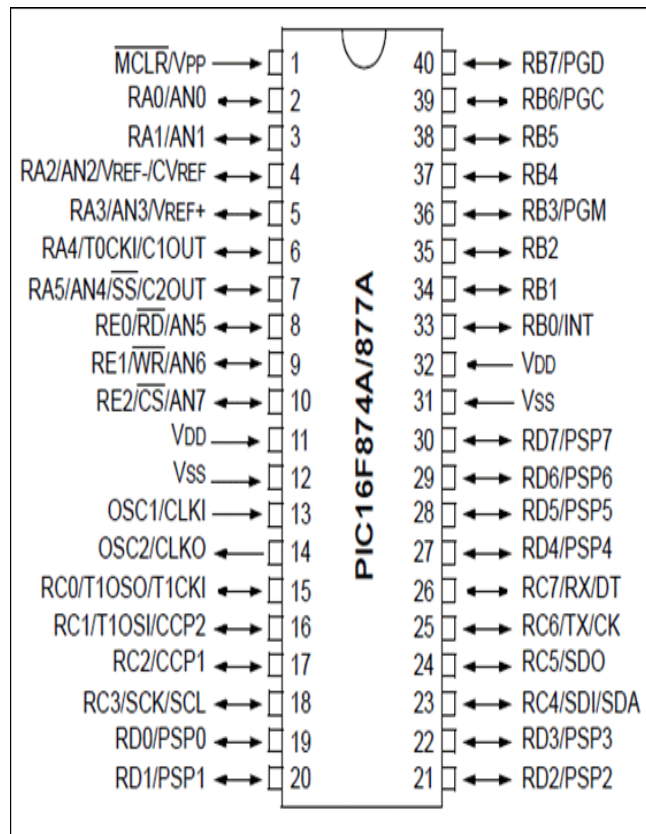
Fingerprint Sensor

These are the security systems used for biometric authentication.

Nowadays these are most commonly used security systems in the whole world

These are two main parts in fingerprint processing they're:

1) fingerprint enrolment

2) fingerprint matching

At the time of enrolling the user must enroll their fingerprint two times, so that the system can produce a perfect template of the fingerprint. At the time of fingerprint matching, the user has to press the finger against the optical sensor built in it, then the system takes the temporary template and compares it with the enrolled template. If it is matching the operation can be authorized. If it doesn't match it indicates unauthorized signal .

Voltage Regulator

The voltage regulator is a device which will help the user to protect any external devices from damage caused by either over voltage or low voltage. The voltage regulator is used to keep the voltages within the prescribed limit of the external device. In this project we are using IC78XX series of three terminal positive voltage regulators which has the output voltage as a fixed value. Hence these voltage regulators are Most commonly used

ULN 2803

ULN 2803 is a relay driver circuit IC. The ULN 2803 has a high voltage and high currentDarlington transistor array.If the current capability is to be obtained, then these Darlington transistors must be commuted in parallel. This device allows the users to interface with TTL signals . It is used for switching ON or OFF the relay for a very good level signal on the other side .

Resistor

The device which blocks the flow of electric current is called as a resistor. The resistors are two terminal passive component devices. In the electronic circuits , the resistors are used to reduce the flow of electric current and also can divide voltages. When a particular voltage of V is applied to the terminals of the resistor , the current flowing will be reduced because as of ohms law

$V=IR$. i.e., resistance is reciprocal to current, the higher the value of resistance the lower the value of current and reciprocal.

Capacitor

A capacitor is an electronic device which is used to store the electronic charge . The capacitor has one or more pairs of conductors which are parted by an insulator . The capacitor is also an electronic passive component device which as two terminals. The effect in the capacitor is called as capacitance.

Diode

The diode is a semiconductor unidirectional device . The diode has two terminals Anode and Cathode.It is called unidirectional because it allows current in only one direction. Di-electrode is called as diode . The diode has a low resistance in a direction and high resistance in another direction. The diodes are used for bridge rectifier in our project.

Important points of a diode to be remembered:

1) Maximum FCC (forward current capacity)

2) Maximum RVC (reverse voltage capacity)

3) Maximum FVC (forward voltage capacity)

Bridge Rectifier

The rectifier is an electronic device which will convert AC voltage into a DC voltage. This rectifier requires at least one or more diodes. As the diodes are unidirectional they conduct only in one direction. I bridge rectifier a total of four diodes are used, which are connected to the four arms of a bridge circuit. And they are connected in such a way that, during the positive half cycle of the supply two diodes conduct and during the negative half cycle of the supply remaining two diodes conduct. Hence producing a DC voltage during every half cycle of the supply.

Transformer

The transformer is an electrostatic device which will transfer electric power from one particular area to the another area through a concept called as inductive coupling of conductors of the transformer coil.

A change in primary coil current produces a fluctuating magnetic flux inside the transformer core which will produce fluctuating magnetic flux in the secondary side of the coil. Thus the fluctuating magnetic flux produces a fluctuating/varying voltage or EMF inside the secondary coil . Thus, this is the concept of mutual induction.

10. Results And Discussion
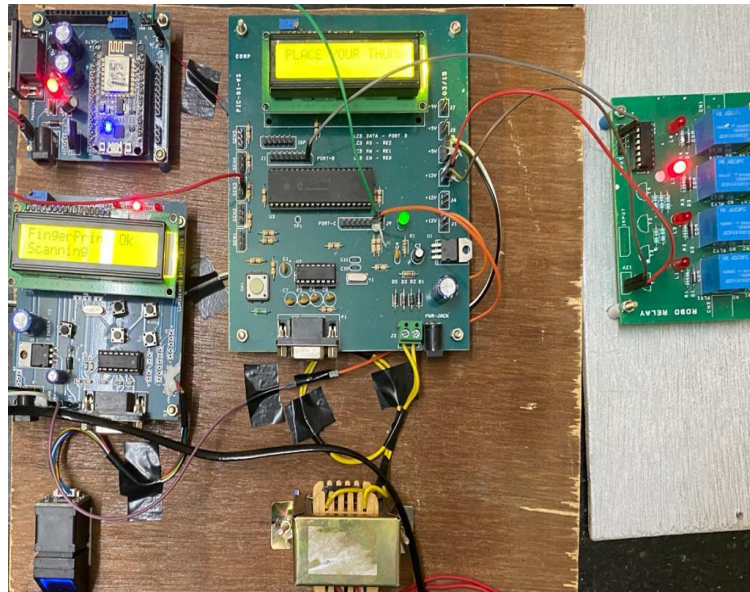
Circuit opened
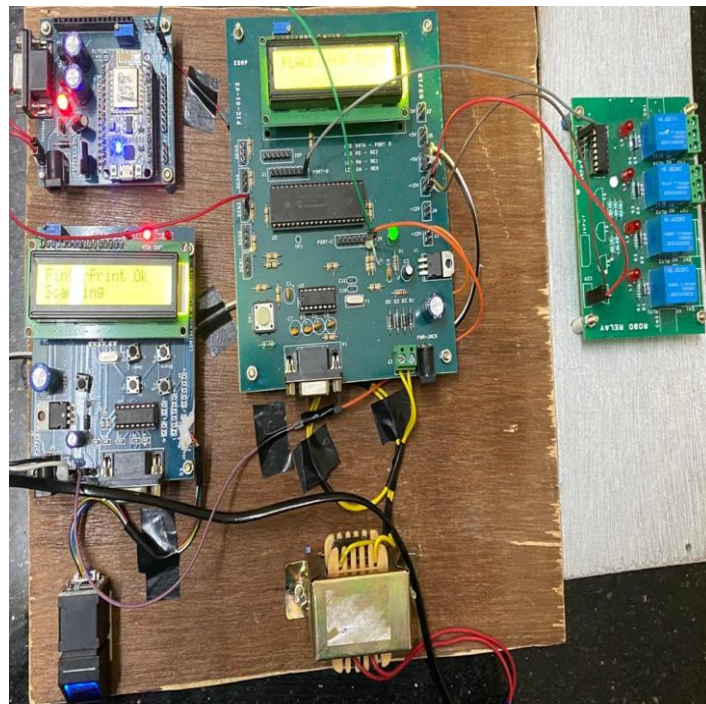
Circuit closed

When we place a finger in the fingerprint sensor it starts scanning the finger and it compares with stored fingerprints of the authorized person.If the fingerprint matches .it sends the signal to the controller (pic), then controller executes program and send the signal to the relay and IoT module respectively. If the finger placed fingerprint sensor is of a non-authorized person then the controller sends the signal to the IoT module and to the display, and it shows the finger that placed was of an un-authorized person.

11. Conclusion

The proposed safety system is successfully designed. This system provides a new way to increase the safety of lineman during any fault occurs or during maintenance work. This system also eliminatesthe faults occurs due to miscommunication between lineman and substation. In this system we use fingerprint scanner and IoT module so we can store the details of authorized person like person name, data, opening time, closing time and it also sends a message to sub station if some unauthorized person try to access.

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This system can be Implemented on the LT side of transformer in power system and it can provide a reliable operation and there is no scope of electrical accidents due to miscommunication..

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