Smart Circuit Breaker using IoT Technology

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Abstract - Nowadays, electrical accidents of the lineman are increased day by day due to electrical shocks, while repairing the electrical lines and this happens due to the lack of communication between the electrical substation and maintenance staff. Thus, to ensure the safety of line man a system is proposed using Node MCU ESP 8266 to control i.e.,ON/OFF the electrical lines. In this system the maintenance staff or lineman has to login into Blynk Application to ON/OFF the electrical line. If there is any fault in electrical line then lineman will switch off the powersupply to the line by using Blynk application and comfortably repair the electrical line, and after completing the maintenance, the lineman will switch on the supply to the particular line by using Blynk application. The relay ON/OFF operation will be indicated by the LEDs, also it displays the status on LCD. As soon as the maintenance work is finished the line man can log out the Blynk Application.

***Key Words*: Blynk Application, Circuit Breaker, Internet of Things, Line-man Security, Node MCU ESP 8266.**

1. INTRODUCTION:

Security is the main concern in our day-to-day life while performing any activity. Circuit breakers are mostly used for protecting & switching industrial electrical systems. Hence, reliability is most important for this. Failure of circuit breaker results in huge damage including revenue loss & fatality. circuit breakers are subjected to stress during their operation because it contains many mechanical as well as electrical components, which carry rated or fault power & participates in arc quenching methods.so the concern regarding reliability of circuit breaker operation raises issue. In order to discover reliability of circuit breaker, it is general practice to carry out preventive maintenance at fixed time intervals. In preventive maintenance program, circuit breakers are taken out of service at regular intervals. parameter like trip coil, close coil, spring charging motor current etc. are measured using special diagnostic equipment. Visual inspection & cleaning of its components like fixed and moving contact, tripping coil, closing coil, spring charging motor, operating mechanism etc. are consider to carry out for its overall healthiness. In accordance with time- based maintenance approach, the downtime of system increases although the circuit breaker looks healthy. Use of special diagnostic equipment will increases the maintenance cost of circuit breakers [3]. This proposed system is designed to ensure the safety by controlling the circuit breaker by using Blynk application. The proposed system facilitates automated circuit breaker. This is a shift in maintenance paradigm from time-based maintenance to as needed maintenance. This shift ensures the benefit to the safety of lineman by reducing overall maintenance cost and unnecessary downtime. In our system automatic circuit breaker operated electrical switch which is designed to protect lineman from damage caused by an overload or short circuit. With Fuse which operates once and then need to be replaced, but with an automated circuit breaker, it can be used to set or reset automatically to resume normal operation. The proposed system aims to solve this issue by making the use of Internet of Things (IOT). Proposed system is with high response time, which uses the interconnection network (internet) to control electrical loads. This system uses a Wi-Fi module paired with ESP 8266 microcontroller. LCD display is used in our system which shows the state of each load connected to the system, either ON or OFF. A user or operator at the other end can remotely connect with the system using a wireless device and an interface named “Blynk Application”. From the Blynk App interface, the user can control the state ON/OFF the connected loads remotely.

The proposed system build using has an advantage over other remotely operable circuit breakers as it uses a faster medium which is the wireless network to connect with the loads. This proposed system will eliminate the use of fuse which are comparatively slower as they mechanically break the circuit. This proposed system is indispensable when industrial safety comes to play, as use of such circuit braking systems removes any chance of common accidents, such as electrical shocks

2. LITERATURE REVIEW:

In past few years many theories were proposed about the circuit breaker system using IoT.

Mane Kirti [1] proposed a system that access only specified password to control the circuit breaker by authorized person only. It is fully controlled by the microcontroller which has an 8KB of ROM and matrix keypad was used to to enter the password and relay driver to switch ON/ OFF loads through relays.

Bhagwan Kharat[2] proposes a system that presents the architecture of an online monitoring and diagnosis System of an electrical equipment which has role to acquire, transfer and process information about monitored equipment. An interface is designed on top of which different local as well as system applications can be recorded. Controller will continuously transmit

parameters of circuit breaker to control room and also displayed on Monitor of computer as well as after C.B trip SMS get sent to the registered mobile number. Once message is received, the operator or any authorized person will give command to set or reset the breaker. It minimizes the fault clearing time and improves maintenance method which increases life time and reliability of the circuit breaker.

Abhijit Das [3] proposed a system that develops monitoring & control scheme of a typical circuit breaker using Arduino Mega 2560 embedded microcontroller along with Ethernet Shield for integration of IOT. The system facilitates diagnose of the electrical and mechanical health of circuit breaker in real time. It uses Open-source platform which eliminates the concern regarding reliability & security of the safety/safety related/strategic application as complete source code implementation is open & fully accessible to the user.

Lakshmi Devdas [4] proposed an idea that put forwards a more secured operating 8 condition for the line man and ensures unauthorized access and that a switching of the line does not occurs. This is implemented using a password verification method. With the help of matrix keypad user can enter password which is compared with a pre-set password. If it matches, the line man 11 can operate the line according the requirement. Parameters like voltage and current with ON/OFF status are accessed on a webpage, connected via an IOT.

Nair Athira [5] , have proposed a system that focuses on the safety of the lineman while working so they do not feel the sudden electric shock. With proper coordination among lineman and substation, lot of accidents can be avoided. The project aimed to provide the solution that ensures the safety of maintenance staff. The lineman detects the fault in the electric line, SMS get sent to the substation staff, who switch off the line and turn it on when the fault is resolved.

3. PROPOSED METHODOLOGY:

A. Proposed Block Diagram.

ESP8266 microcontroller is the main component of the proposed system which passes the information to switch the load ON/OFF by the input given by the user through IoT. Many loads can be controlled at a time by using a Wi-Fi module with the help of Blynk Application. It uses Mobile hotspot to get connected with the Microcontroller.

Blynk Application is user friendly. An Account must be created In the Blynk Application. In the Blynk Application widget must be created to control the Load. With the help of Arduino Software Node MCU is programmed to work accordingly. To instruct the Node MCU about Blynk Interface, Blynk library is included in the Arduino Software. The ESP8266 microcontroller receives input from the Blynk Application whether to ON/OFF the circuit. After Receiving the input, the microcontroller sends output to the Relay Module to ON/OFF the circuit. It also displays the status of the load by using the LCD display module. Relay module is connected with the external AC supply to power the load at normally open pin. A relay is working on electromagnetic principles. As soon as it gets instruction from the microcontroller it completes or breaks the circuit by attracting and repelling the armature and load get ON/OFF without any human efforts.

The circuit breaker system being operated using IoT is carried out by performing certain steps as given below:

(1) Node MCU is used as it has micro controller with free Wi-Fi module. It is very reliable for interfacing with Blynk Application without using external Wi-Fi module.

Node MCU can be programmed by Arduino IDE

(2) Relay Module is reliable for AC load. It can be used for Controlling AC loads using low voltage. It is powered with 3.3 V pin of Node MCU.

(3) LCD display is used for displaying the status of Load and the Connection of Blynk Application.

(4) We use IC 74HC595 for utilizing only 3 pins of Node MCU. It can be powered by Laptop or PC using USB

(5) We use 9V battery to power Node MCU. It can also be powered by Laptop or PC using USB.

(6) Load here can be any AC – devices.

(7) Blynk Application is used to control the state (ON/OFF) of the connected loads remotely.

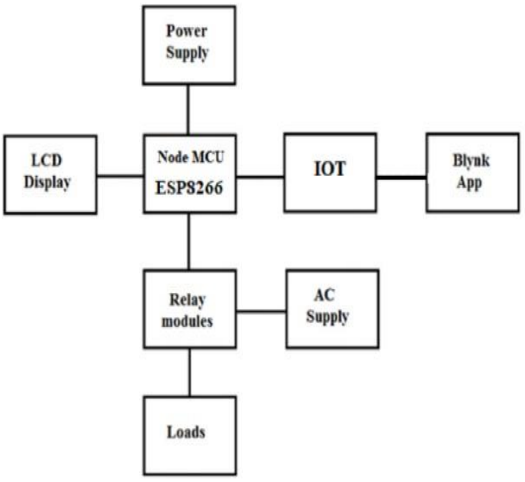

Fig 1. Block Diagram of system

B. Actual Proposed System:

The working of the proposed system is as listed below:

(1) The proposed system supports Wireless Local Area Network (WLAN) architecture. Node MCU is the Access Point (AP).

(2) The proposed system is automated circuit breaker.

(3) Node MCU is powered by 230VAC to 5VDC converter through Vin.

(4) Pin D1 (SCL) and pin D2 (SDA) is connected to SCL pin and SDA pin of I2C bus respectively.

(5) Pin D6 is connected to IN pin of Relay module.

(6)I2C bus and relay module both are powered by 5V convertor and ground pin is connected to GND pin of Node MCU.

(7)I2C bus is connected to LCD display matrix for reducing the pin load on Node MCU.

(8) LCD matrix is powered by 5V convertor via I2C bus.

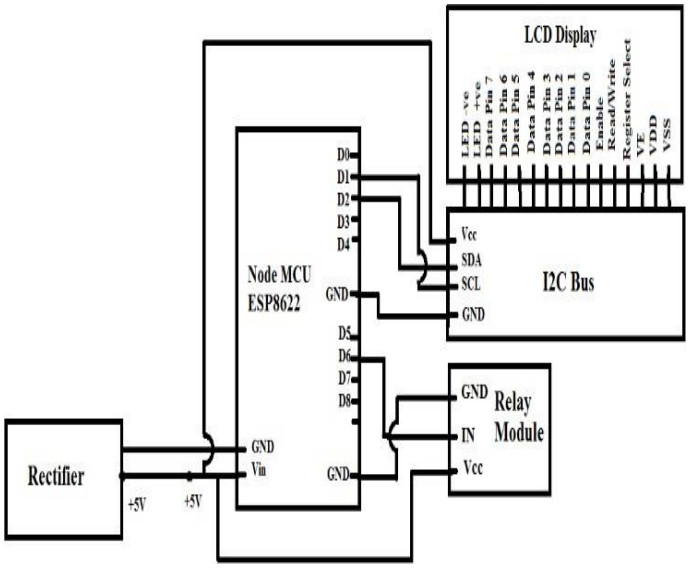

Fig 2. Circuit Diagram of proposed system

4.* RESULTS & DISCUSSION*:

This system is implemented using 2 bulbs as loads to check the status of the electric lines i.e., ON/OFF. Thus, it is observed that when we click on the ON button in the Blynk app the Bulb lights up and when we click on the OFF button the bulb will be turned off. Hence, we have successfully established a circuit breaker with the help of IoT using Node MCU connected on local network. The status of such electric lines is displayed on the 16*2 matrix LCD display.

Switch Status		ON	OFF
Button 1	Button 2		
ON	ON	Relay 1 Load 1 Relay 2 Load 2	- - - - -
OFF	ON	Relay 2 load 2	Relay 1 load 1
ON	OFF	Relay 1 load 1	Relay 2 load 2
OFF	OFF	- - - - -	Relay 1 Load 1 Relay 2 Load 2

Table. 1 Analytical results of the proposed system

Case Study:

- **Case 1:** When both the switches are ON, then the Node MCU sends 3.3V to both the channels. Hence, the resultant effect of this action is seen on the bulbs i.e., both blubs are glowing.

Fig.3. Both LEDs are ON

- **Case 2:** When we click on switch 1, the Node MCU sends 0 V to IN1 of the first channel of relay which leads to a power cut at Load 1. Hence the Load 1 is turned OFF.

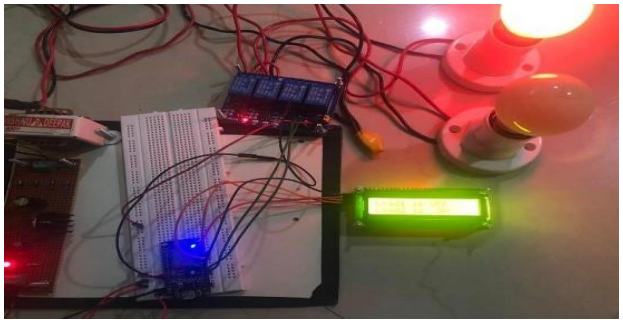

Fig.4. Only LED 2 is ON

- **Case 3:** When we click on switch 2, Node MCU sends 0 V to IN2 of the second channel of relay. Thus Load 2 is turned OFF.

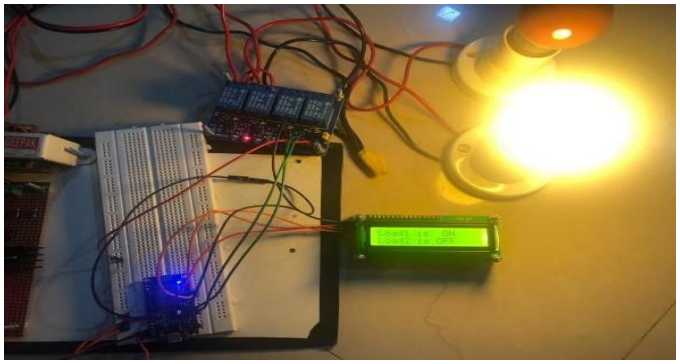

Fig.5. Only LED 1 is ON

- **Case 4:** When both switches are off, Node MCU sends 0V to both the channels. Hence resultant effect is seen on both Loads i.e. Both Load 1 & Load 2 are OFF.

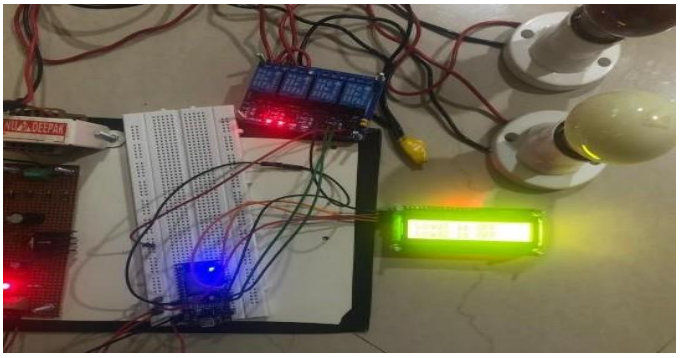

Fig.6. Both LEDs are OFF

5. CONCLUSION

Thus, with the implementation of IOT based circuit breaker the safety of the line man is ensured while working on high power lines by manually controlling the circuit system using Blynk application. The overall circuit breaker performance is maintained while reducing maintenance costs and unnecessary downtime. Also, the restriction of the unauthorized and non-interference of the outsiders with the supply circuit can be achieved. In this way we have proposed a smart circuit breaker by making it very reliablefor the user to handle it using IoT.

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FUTURE SCOPE

A modification to this project is possible developing a webpage that can be accessed by the substation personal anywhere. Proposed system can be enhanced by using an

EPROM for user to change the password for a more secured system. It can be interfaced with a GSM Modem for remote controlling of the circuit breaker via SMS.

REFERENCES

[1] Mane Kirti M., Attar Arifa U, Dandile Aishwarya A., Ghogale Pragati S.,Prof. Jagtap Sujit P.5, "Password Based Circuit Breaker", International Journal for Research in Applied science and Engineering Technology (IJRASET),Volume 6 Issue IV, April 2018, pp. 2229-2233.

[2] Bhagwan Kharat, Durvankur Sarwade, Dhananjay Bidgar, Prof. Bhushan Kadu,"Internet of Thing (I.O.T) Base Controlling & Monitoring of Circuit Breaker", International Research Journal of Engineering and Technology (IRJET), Volume: 04 Issue: 05 | May - 2017,pp. 668-673.

[3] Abhijit Das & Dr. K. Kalimuthu, S.S. Biswas, "IOT Based Circuit Breaker Monitoring& Control", International Journal of Applied Engineering Research, Volume 13, Number10 (2018), pp. 7806-7810.

[4] Lakshmi Devdas, Sreelakshmi V.G, Amal Kottor, Jinendhu Justin, "Automated Circuit Breaker with IOT Interfacing", IOSR Journal of Engineering, Issue-2018, pp.29-32.

[5] Athira Nair, Josephin J, Anjana A S, Athira C P, "Electric Line Man Safety System with OTP Based Circuit Breaker", IJRET, April 2015, pp 23-26.

[6] B. Sai kumar, G. Vijay Kumar, G. Sai Krishna, J.V.S. Nanda,M.V.S.S.R. Krishna Kanth,R. Sai Sunandh,"Password based circuit breaker using ardunio", Pramana Research Journal, Volume 10, Issue 4, 2020,pp. 108-113.

[7] Ganesh Krishna Naik, Srikanth N, Vinod Kumar K M, Rajashekar V, "Password Based Circuit Breaker", International Journal of Advance Electrical and Electronics Engineering (IJAEEE), Volume-5 Issue-6 2016, pp.566-574.

[8] Mithilesh Padhen , Prof P.V. Sontakke, " Password based circuit breaker using dtmf", International Research Journal of Engineering and Technology (IRJET), Volume: 06 Issue:09 | Sep 2019,pp. 347-350.

[9] Mr. TarunNaruka, Vivek Kumar Sharma, Vikram Singh, Sumit,Vishnu Sharma., "Password Based Circuit Breaker", IJIR ,Vol-3,Issue-4,2017,pp. 422-435.

[10] Yash Pal Gautam, "Password Based Circuit Breaker with GSM Module", International Journal of Advance Research, Ideas and Innovations in Technology. Volume3, Issue3, 2017, pp.1460-1464.