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Hardware implementation of safety smart password based GSM module controlling circuit breaker

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ABSTRACT

This research work highlights the hardware implementation of safety smart password-based GSM module controlling circuit breaker. Safety is the major concern in daily life for domestic activities. In current scenario, accidental death of a lineman are the major issues and to protect operators for the same. To control circuit breakers, passwords security is essential for lineman. Due to that electrical accident's ratio is increased day to day life at the time of repairing the lines. It is also done due to lack of communication and coordination between maintenance and substation. For safety of lineman, on and off line turning operation is proposed. Secure password is for breaker operation and maintenance. In the proposed system, password is sent to the line operator's mobile phone and GSM module by automatic voltage regulator (AVR) microcontroller. Entered password and password received by the GSM receiver is match so circuit breaker will be smoothly operated. If password is incorrect, message will appear on the LCD display for security purposed and message sent to control room regarding unauthorized access to the system.

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1. INTRODUCTION

In proposed system, electrical circuit's circuit breakers is projected from damage due to overloads or short circuits. To detect faults and block current flow is the major objective of circuit breaker [1]-[4]. The circuit breakers can be reset manually or automatically by replacing fuses. The ratio of electrical accidents of linemen are more in manual operation due to lack of communication and coordination between maintenance and substation [5]-[8]. The circuit breakers are designed using a secure password to avoid such incidents [9]-[15]. The design of 8-bit microcontroller from the ATmega328P family can be and fully controlled the operation of password circuit breakers. The password can change any time during operation and stored in microcontroller which is stored inside the microcontroller under electrically erasable programmable read-only memory (EEPROM) [16]-[20]. The password entering for circuit breaker operation, keypad is used.

The buzzer will sound an alarm if you enter the incorrect password [21]-[25]. In the proposed system, this model is designed for circuit breaker control, lineman safety, and maintenance point of view. If any fault occurs lineman enters the password to turn off the power supplied to the line and system repairs quickly. Figure 1 indicates the block diagram of smart safety with a password-based GSM module.

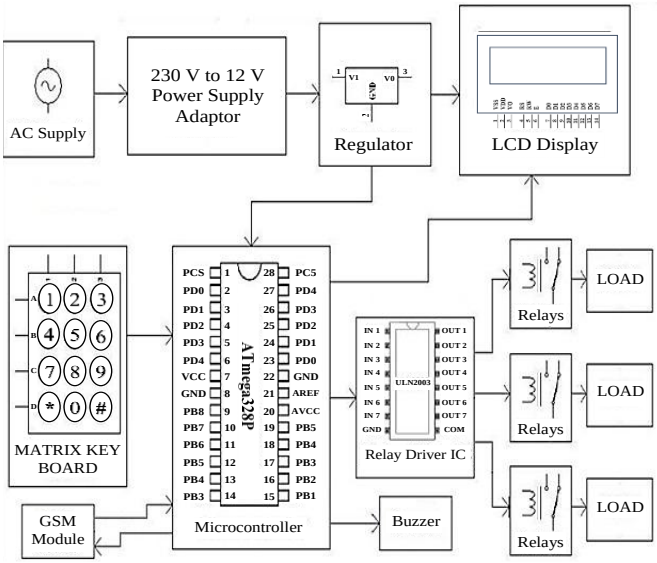

Figure 1. Block diagram of smart safety with password based GSM module

2. LITERATURE SURVEY

A comprehensive literature survey has been conducted to understand the existing research related to the proposed work. This survey includes various studies that focus on different aspects of circuit breaker control and monitoring systems. The following are some of the key research papers that have been reviewed, highlighting their methodologies, technologies used, and contributions to the field.

Kirti *et al.* [1] reviewed in paper title "Password based circuit breaker" that to control the circuit breaker, only specified password used and also provision of changing the password. For the program memory, 8-bit microcontroller 8051 family which has an 8 KB of ROM is used for controlling. For password entering matrix keypad is interfaced to the microcontroller and relay IC driver is used to switch the loads through relays. Step down transformer (230/12 V), is used to down the voltage to 12 V AC and is converted to DC using a bridge rectifier with capacitive filter for removed ripples. The voltage regulator (+5 V) is used for microcontroller and other components.

Kharat *et al.* [2] reviewed in paper title "Internet of thing (IoT) base controlling and monitoring of circuit breaker" that modern control centers system operators get alarm messages from many devices in real time. From alarms, it is still very hard to find out location and type of the potential equipment problem. One needs an automatic way of processing the events to identify whether sequences of equipment operation were as expected. Instead of many alarm messages, only one report should be sent to the operators with concise information about success or failure of a switching sequence. In the case of breaker, report will offer more detailed message whether the breaker failure logic worked out properly and finally disconnected faulted section. This kind of analysis enables tracking of every circuit breaker (CB) operation allowing reconstruction of an entire sequence of operations. In our project we studied designed to attain real time control and monitoring of circuit breaker. Measure and record loading of your output of CB and prevent overloading and increasing whole system life.

Nair *et al.* [3] reviewed in paper title "Electric line man safety system with OTP based circuit breaker" of International Journal of Research in Engineering and Technology that for lineman safety while working, sudden electric shock does not feel. The chances of critical accidents are already very high due to live wires and poor coordination between lineman and substation. This paper gives the solution for safety of maintenance staff and the lineman detect the fault in the electric line by SMS will be sent to the substation staff for switch off/on the line and fully operated on a microcontroller.

3. PROBLEM STATEMENT

Based on the literature survey, the key problem areas have been identified. One major concern is preventing unauthorized access and accidental activation of circuit breakers to mitigate electrical hazards and ensure safe working conditions for personnel. Additionally, enhancing safety for line workers during maintenance is crucial to ensure that circuit breakers remain deactivated until tasks are completed, reducing the risk of electrical shocks or injuries. Another critical issue is protecting sensitive equipment and systems from unauthorized tampering to secure critical infrastructure and prevent potential damage or disruptions.

4. OBJECTIVES OF PROJECT

The objectives of this project focus on enhancing security, enabling remote control, providing real-time monitoring, reducing costs, and ensuring seamless system integration. Enhanced security is achieved by preventing unauthorized access through password protection, safeguarding against tampering and accidental activation, particularly in hazardous environments, and improving electrical safety for personnel. Remote control allows operation of the circuit breaker from any location with GSM coverage, facilitating troubleshooting, maintenance, and load management without requiring physical presence, thereby offering flexibility and convenience. Real-time monitoring enables tracking of the circuit breaker's status, receiving alerts for unauthorized access attempts or abnormal conditions, and implementing preventive measures for prompt responses. Cost reduction is addressed by minimizing the need for manual intervention and site visits, reducing travel expenses, and optimizing resource allocation. Finally, system integration ensures compatibility with other systems, such as home automation and building management, fostering a more interconnected and efficient smart environment.

5. METHODOLOGY

5.1. Existing methods

In existing method, a lineman needs to visit power station and inform the in charge to ON/OFF. Then station in charge can be the inform to station operator and after the official procedure the line will be ON/OFF. But these methods were so old. There are the after latest technology give the password base method or finger prints scanner method so different types of method to operated but sometime loss connectivity lost signal or unskilled worker through likely not properly communicating so propose system give surety of controlling circuit breaker fully security based ON/OFF.

5.2. Proposed methodology

The proposed system methodology provides a solution to ensure worker and safety. The line ON/OFF control is performed only by the line operator. This system is designed to require a password to control the circuit breaker ON/OFF. The lineman can switch off the power and make repairs comfortably, and can also turn the line back on by entering the correct password after returning to the substation. Since you can change your password, you can set your desired password and work more safely. In the proposed system, control (ON/OFF) of the wire is assigned to the line operator. The project is designed in such a way that maintenance personnel or linemen must enter a password to turn the wire on or off. Now, if there is a problem with the wire, the lineman enters the password to cut off the power supplied to the line and repairs the line comfortably. When the lineman arrives at the substation, the lineman supplies power to the line. This project uses a 4×3 keyboard to enter the password. Compare the entered password with the preset password. If the entered password is correct, the corresponding wire will turn on or off. In this project, each wire has a separate password. Switching on and off a line (circuit breaker) is represented by a load.

5.2.1. Components description

The following are the descriptions of the key components used in the system. The power supply consists of a transformer that converts electricity between different voltage levels. The AC and DC voltages are achieved by converting and combining transformers, allowing electricity to be transformed from high to low voltage and vice versa. The system requires power to operate, with the microcontroller specifically needing 5 V DC, which is obtained by rectifying, filtering, and regulating the incoming AC current using the 7805 IC. The relay is an electrically operated switch that changes its contact positions when current flows through its coil, generating a magnetic field that attracts a lever. It has two switch positions and functions as a double-throw (changeover) switch. The buzzer is a small, enclosed component mounted on a printed circuit board. It operates on DC voltage, typically ranging from 3 V to 28 V, depending on the model. The Microcontroller ATmega328P is an 8-bit microcontroller with 32 KB of on-chip flash memory for programming. It processes one time password (OTP) generation and determines whether to switch the relay based on password verification. Finally, the GSM modem operates wirelessly on a GSM network and

functions similarly to dial-up modems. It enables data transmission via radio waves and requires a SIM card for operation, allowing communication with GSM phones and other GSM-enabled devices.

5.2.2. Operation of architecture

Figure 1 shows the architectural block diagram of the proposed "Smart safety with password-based GSM module controlling circuit breaker." We devised a system that requires the lineman to transmit the OTP in the format 1234. This format is used to represent an OTP. The deactivation feeder numbers 1, 2, and 3 are where they stand. A lineman needs to generate a four-digit password that's protected. The same thing happens when a lineman needs to send the same password in '1234' to activate the feeder. The four-digit number must match to activate the line that has been disabled.

When the utility worker transmits this data via text message to the power station where the GSM module is installed, the main authority will receive another message at the same time containing the latest LC's specifics, in order to avoid difficulties in case the utility worker forgets the password or loses the password, as well as to save the particulars. The lineman can't do this without the boss's blessing. Even though he's trying to charge the line without notifying the operator, he's going to get caught because the operator's number will be fed into the program, giving them his complete information about the line charge.

6. HARDWARE IMPLEMENTATION AND RESULTS

Figure 2 shows the operation begins and enters the mobile number. Figure 3 shows sending the OTP and matching the OTP. Figure 4 shows selected breaker is ON. Figure 5 shows selected breaker is OFF. Figure 6 shows sending the breakers status for registered mobile number. Figure 7 indicates the status for registered mobile number. The implementation of a smart safety with a password-based GSM module controlling circuit breaker utilizing ATmega328P microcontroller, relay, keypad, LCD display, and printed circuit board would be result in a fully operational circuit breaker that necessitates the input of a password before permitting the flow of electrical current. The circuit breaker would be under the control of a microcontroller, with the password being inputted via a keypad. The LCD display would provide instructions to the user for inputting the correct password. Upon entering the correct password, the relay would be triggered, enabling the flow of electrical current in the event of an incorrect password input.

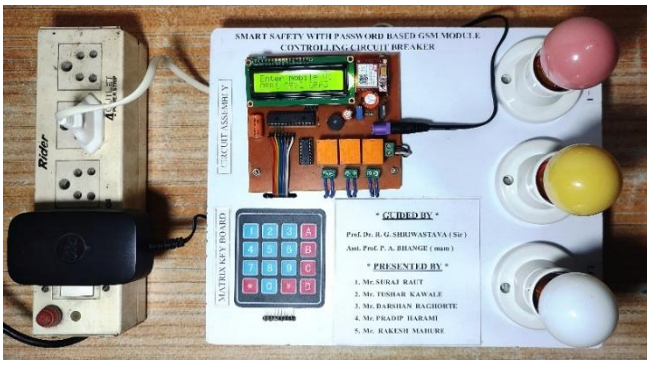

Figure 2. Operation begin and enter the mobile number

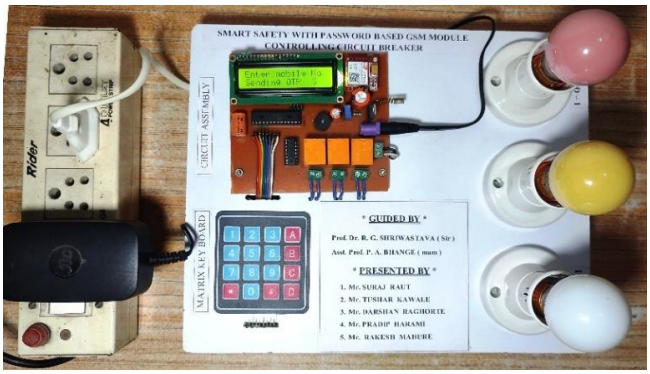

Figure 3. Sending the OTP and after match the OTP

Figure 4. Selected breaker is ON

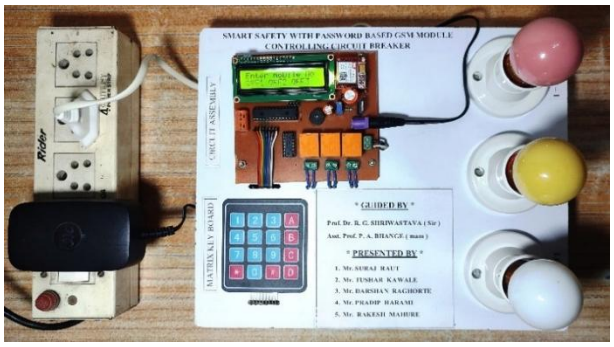

Figure 5. Selected breaker is OFF

Figure 6. Sending the breakers status for registered mobile number

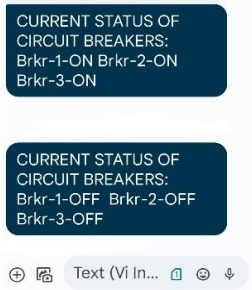

Figure 7. Receive the status for registered mobile number

7. CONCLUSION

This paper focus on hardware implementation of safety smart password-based GSM module controlling circuit breaker. Serious electrical accidents occur becoming increasingly, when repairing power lines. It is happening 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. Modified GSM can be connected to internet of things (IoT). So, relay of any of the area operate and directly connected to server. We can also use wireless ultrasonic, PIR sensors, and SCADA system for easy trouble shoot and identify the fault location directly and can easily rectify in future. We can also use EPROMS for interfacing the circuit breaker from other location through wireless communication.

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AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

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C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

DATA AVAILABILITY

Data availability is not applicable to this paper as no new data were created or analyzed in this study.

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