IOT Based SLT (Smart Line Transmission) Pole with Electrical Lineman Safety

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Abstract
Most of the times in TV, Newspapers we read and hear that someone died in electrical pole accidents and it may be a child, student, farmers, animals etc. Thus we need a solution to avoid accidents due to electric broken lines.

As we need a solution for avoiding accidents due to electric broken lines, the system includes smartness where if electrical lines are broken its location should be sent to the authorities automatically with the help of IoT technology without any human intervention as well as it should include a mechanism to avoid accidents and death caused by stepping on that broken electrical line. To modify the existing power distribution system for an automatic electrical line breakage detection and power supply breaking mechanism, a remote telemetry system is implemented in which RF transceivers are used to detect electrical line breakage. Also, the location where electrical line is broken will be sent to the authorities using GPS via IoT technology i.e., Wi-Fi along with the notification of SMS using GSM. To provide localized safety measurements of a lineman the system provides a password protected electrical line breakage system if automatic line breakage fails. Also to protect the entire system, a password protected door locks is implemented. The switching of the electrical line will be done by the Relay. All components in the proposed system are controlled by the Arduino Microcontroller.

Keywords: Arduino Microcontroller, GSM, GPS, Wi-Fi, RF transceivers, Relay.
Introduction

Electricity is one of the basic needs in every field. Electrical power system is non-linear and has complex system which is very difficult to detect and monitor regarding electrical line breakage in entire glob. Day by day the ratio of people who die due to Electrical accidents is increasing and in that major reason is by unknowingly stepping on a broken electric line which is caused by natural calamities, accidents, etc.

Idea of the proposed system in module1 is that every pole is designed in such a way that it is connected to each other through wireless communication (RF-Radio Frequency modules) Consider we are having 5 poles. If the 4th pole line is broken, 5th pole senses the signal from 4th, if there is no signal, it will alerts the public with a buzzer alarm so that anyone can get information that some danger aroused.

Once it acknowledges the breakage of the line occurred, it sends message to predefined numbers and also disconnects the power line automatically from substation poles 1 to 4 in order to ensure that no harm occurs to anyone. Also it sends location of that area where the line has broken to the authorities through GPS via Wi-Fi i.e. IoT technology and the location will be displayed on web browser.

Critical electrical accidents to line men are on the rise during electric line repair, due to lack of communication and co-ordination between the maintenance staff and electric substation staff.

The idea of the system in module 2 provides a solution that ensures safety of maintenance staff, i.e., line man and the control to turn ON/OFF of the line will be maintained by the line man only, because this system has an arrangement in such a way that a password is required to operate the circuit breaker (ON/OFF). Also to ensure the safety of the developed system, another system which is a password protected door lock system is included. It helps in protecting the accessing of the password protected circuit breaker system, such that only authenticated people can get access to the system.

Literature Review

Studies so far show that there is a need to automate the existing electrical power system by including IOT.
Dr. K. Sathiyasekar et al. [1] Proposed a scheme for minimizing the delay caused by traffic congestion and to provide the smooth flow of emergency vehicle by providing green signal to the path where emergency vehicle travels and also the system identifies accident location and sends that location immediately to the main server. The main server finds the nearest ambulance to the accident zone and sends the exact accident location to the emergency vehicle so that it reaches the nearest hospital soon.

B.A. Jan proposed [2] Proposed a new technique of detection of faults on EHV electrical lines up to and above 800 KV. The paper presents GPS (Global Positioning System) for detection of faults and protection of EHV lines both + 800 KV. Relays are located at each bus bar in a transmission network. These relays detect the fault and generate high transact signals and trace the time instant corresponding to different fault occurring at bus bar and it generates initial travelling wave.

Ing. Komi Agbesi et al. [3] Proposed a smart GSM based fault detection and location system was used to adequately and accurately indicate and locates the exact spot where fault had occurred which will ensure a shorter response time for technical crew to rectify these faults and thus help save transformers from damage and disasters. The system automatically detects faults, analyses and classifies these faults and then, calculates the fault distance from the control room using an impedance-based algorithm method. Finally, the fault information is transmitted to the control room.

Mr. Pravinkumar et al. [4] Focused on critical an electrical accident which happens to line men which are on the rise during electric line repair due to lack of communication and co-ordination between the maintenance staff and electric substation Staff. The proposed system provides a solution that ensures safety of maintenance staff, i.e., line man. On detecting a fault in electric line, the line man sends SMS and the main line is switched OFF which is again switched ON after solving the fault.

Anjana A S et al. [5] proposed a concept where the electric line man safety system makes use of a new concept of one time password (OTP). When the user put a request, the system generates passwords and a relay switches to turn ON or OFF the circuit breaker. OTP plays a major role in this system. The one-time passwords mean the generated passwords are different at each time and also the activation or deactivation of the circuit breaker is indicating by a lamp (ON/OFF).

Prof. Manik et al. [6] proposed a system which describes a modification to existing power distribution system with remote telemetry unit for wire break detection and a power supply
breaking mechanism. The circuit breaker with shunt trip mechanism breaks the supply and avoids damages from electrical accidents due to overhead transmission lines conductor breakage problems which will operate on open circuit principle rather than short circuit.

Methodology

System architecture

![System Architecture Diagram]

Figure 1.1: System Architecture

The system architecture shown in the figure 1.1

- **Activity Area:** It is the place where the components involved in the proposed system are implemented. It checks for electric line hazards and sends the SMS to authority substation and line man.
- **Wi-Fi**: It is an Internet of Thing (IoT) responsible in finding the Location of the occurred electrical line.

- **Authority of Substation**: Authority which is responsible in viewing and maintaining the confidentiality.

- **Line Man**: Controls ON/OFF of the particular location’s electrical line. Where, authority gets the SMS of the electrical line controlling.

- **The Internet**: GPS location’s activity area.

- **Google Map**: Map the location of the electrical hazard which can be viewed by the authority of substation.

Activity area sends the message about the electrical line breakage to the authority and the lineman where, authority can access the location via Wi-Fi module through the internet. Also, the message will be sent to the authority when the lineman tries to switch ON and OFF the electrical line.

3.1 *Block Diagram*

Module 1: Automatic Lines Break Detection System Using IOT Technology

![Figure 1.2 (Transmitter part)](image-url)
The block diagram of module 1 is shown in the figure 1.2 and 1.3.
In the figure 1.2 ie. At the transmitter part RF transmitter is connected to the Microcontroller for sending the data to the RF receiver and also a Relay is connected to the Microcontroller for switching ON and OFF the load line.

Whereas in the figure 1.3 ie. At the receiver part it contains a Microcontroller, GPS, Wi-Fi, GSM and Buzzer. The RF receiver receives the data sent from RF transmitter if that load line is not broken. When the load line gets broken, RF Transmitter won’t send the data to the RF receiver. Then the receiver will actuate GSM to send the notification and actuates GPS to fetch the coordinates and that coordinates will be sent to the Wi-Fi module. Wi-Fi module will be connected to the local network and using an IP address of that Wi-Fi module we can fetch the data of the coordinates through the web browser. For the purpose of safety we are using the Buzzer to indicate about the hazard.

Module 2: Password Automated Circuit Breaking Mechanism with Password Based Door Lock
The block diagram of module 2 is shown in the figure 1.4 and 1.5

The figure 1.4 i.e., Password based doorlock will contain a Microcontroller with a matrix keypad. It will allow only the authorized person to access through the system. Another system inside this module 2 i.e., figure 1.5 contains a block of arduino which is connected to the keypad to enter the password and an LCD display to visualize the password and other messages. LEDs like Red and Green are connected for the indication of activation and deactivation of the electrical lines and also a Buzzer is connected to give sound to the matrix keypad. When the entered password is correct and the circuit breaks the electrical line and GSM connected will send a message to the authorization about someone accessing the system.

**Conclusion and Future Scope**
The automatic detection of broken electrical lines of the electrical pole and also automatic power supply disconnection is very useful to avoid electrical shock hazards. Also, it is very easy to detect the location where the electrical lines are broken through a local network using Wi-Fi technology and also the wireless communication technology issued for the detection of broken electrical lines that can be used over years and years without any maintenance. If any malfunction occurs in the system and if automatic power supply disconnection is failed then we can use a password based electrical line disconnection system which is localized i.e., only authorized lineman who knows the password can disconnect the electrical line locally for certain number of poles without affecting the main station power supply. This helps to protect linemen from getting shock due to miscommunication between lineman and the substation authority that monitors the power control of the electrical lines. The system also includes a password protected door lock technique which helps to safeguard the password based electrical line disconnection system from unauthorized people as well as the environmental hazards.

As a future work, the system can be implemented such that we can send the location of the electrical broken line to an application instead of the web browser, for an easy accessing and recording regarding electrical line issues, to both authorities and lineman. Also, the authentication can be done using biometric method i.e., by using finger printer sensor.

References


