IJARCCE

ISSN (O) 2278-1021, ISSN (P) 2319-5

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified ⋇ Impact Factor 7.39 ⋇ Vol. 11, Issue 5, May 2022

DOI: 10.17148/IJARCCE.2022.115130

Digital Mapping of Faulty Transmission Lines

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Abstract: In everyday life, electricity is necessary, and proper use is critical, Electricity is a form of energy and is playing vital role in the world. Electricity has become an essential part of human life and is now considered to be a necessity. India is a vast country and relies upon the power. 95% of the people are blessed with the power supplied by the both centre and state government. So as to achieve balanced regional development of the country. The main objective of our project is to monitor the status of the electricity transmission line in real time, and whenever there is a fault in the line, we make use of an IoT device to locate the faulty line/area and display its location in a digital map we make use of an IoT device to locate the faulty line/area and display its location in a digital map.

Keywords: IoT, Faulty Transmission Lines, Thingspeak, Arduino.

I. INTRODUCTION

Power systems are the most complex systems and have great importance in modern life. They have direct impacts on the modernization, economic, political and social aspects. To operate such systems in a stable mode, several control and protection techniques are required. However, modern systems are equipped with several protection schemes with the aim of avoiding the unpredicted events and power outages, power systems are still encountering emergency and malicious operation situations. Due to the consequences, many countries around the world have research and expert teams who work to avoid blackouts on their systems. In everyday life, electricity is necessary, and proper use is critical. In towns or villages if there is any power cut due to storms or any other reasons, identifying the faulty line/channel is difficult and is time consuming. If there is any problem of fire, short circuit or any such, it needs immediate attention which is not possible if the area to be searched is wide spread or is in some rural place. The development in sensor and computer technology allows the realization of on-line monitoring systems for application to power transformers, in order to use this most expensive transmission equipment in the optimum technical and economical manner. state-of-the- art monitoring system for power based on field bus technology and process control software. To identify the areas with electric power supply, we use an IoT sensor which will be implemented at that place.

This sensor identifies if the power is present or not in that channel. If the power is not present, the device transmits signal to the database which is connected to the website. The website shows the electricity transmission areas linked to the IoT device in the form of a map. This map can be used to monitor the power transmission area. This can give the exact location of fault line or the whole area where the problem has occurred thus reducing the time needed for locating and identifying the fault.

II. LITERATURE REVIEW

[1] Proposed an IoT-based circuit methodology that integrates the ESP8266 controller with the voltage regulator circuit and transformer. By using the Wi-Fi module contained in it, the Wi-Fi enabled ESP8266 makes the proposed architecture internet-connected and generates a unique IP address, which the user may use to access the energy spent values of the load.

[2] The authors have developed an autonomous energy metre based on GSM technology that calculates the power bill automatically without any external assistance and sends information to customers about power usage.

[3] The multi-homing technique is utilised in this research study to join one or more devices into a heterogeneous multi-network utilising IP address and the optimum routing strategy. An effective Ant Colony Optimization is included in this proposed research endeavour. The best routing method in multi-homing networks is the on demand Multipath Distance Vector routing algorithm for boosting power efficiency.

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[4] This research presents a hybrid technique based on Positive Sequence voltage and current measurements from Phasor Measurement Units to detect and identify faults. The suggested fault detection and identification algorithm is implemented in two stages: the first stage uses Positive Sequence Voltage Magnitude (PSVM) to detect faults, and the second stage uses Positive Sequence Current Angle Differences to locate faults (PSCADs).

[5] With the growing diversity of frameworks on the market, developers confront a wide range of issues on a daily basis. Choosing the proper mix ensures that the essential requirements for developing web applications are met. Frameworks for front-end development discussed include: Angular, Vue, and React Django, Node.js, and Springboot are used in the backend. PostgreSQL and MongoDB are the databases used. A full stack provides a complete web development setup, such as LAMP/LEMP, MERN/MEAN/MEVN, and Spring stack.

[6] Using artificial neural networks and k-nearest neighbours algorithms, this research provides a solution for fault identification in transmission lines. A RLC pi circuit is used to create three phase voltage and current values. The nearest grid in the area feeds the majority of distribution lines. In a power system, there are three phases (A, B, C) and ground (G), and their combinations are susceptible to defects. The three-phase voltage and currents provide the information needed to distinguish between these fault types. A data set was used to train and test the network. The specified data set was tested after training, and the results were received. The accuracy of the Artificial Neural Network (ANN) was around 98.5 percent. When there is a lot more information, KNN takes more training time than ANN. The accuracy rate and the performance of ANN is significantly higher than KNN.

[7] This study depicts symmetric and asymmetric power transmission problems in power grids, as well as how a PMU (Phase Measurement Unit) may be used to pinpoint their position. PMUs are devices that employ a common time source for synchronization to estimate the magnitude and phase angle of an electrical phasor quantity (such as Current or Voltage) in an electrical grid.

[8] The back-end design of a web-based portal was demonstrated in this study. The role of a back-end web application developer is demonstrated, including building a database and adding tables and fields with a specific number of rows. He's in charge of server-side scripting. His main responsibilities include developing all server-side logic, defining and maintaining the core database, and guaranteeing excellent performance and responsiveness to front-end requests. He may also be in charge of integrating the application's front-end elements created by others. A real-life example was used to demonstrate the position and job of an administrator in this study.

[9] With the help of an e-commerce website as an example, this project teaches how to create a performance optimized web application utilizing the MERN stack. This online application was created with the MERN stack, Chrome developer tools, and simulation testing with Redux tools. Node.js employs the Chrome V8 engine and uses event-driven, asynchronous programming; Express enables writing back-end code and implementing it in a structured fashion simpler and easier; React.js is used to design the client-side interface; and finally, mongoose and MongoDB are used for data storage.

III. METHODOLOGY

Identification of fault lines and the location of it involves three steps. The first step is monitoring the transmission lines. The power generated from power source is supplied to required destinations with the help of transmission lines. A device capable of identifying if there is electric power present in the line is designed and is stationed near the lines and whenever there is a power cut or fault in the power transmission line, the status of the line should be monitored. Since the transmission lines carry large amount of voltage the device cannot be connected directly.

This problem is solved with the help of a specially designed inductor coil which is held in such a way that lets magnetic flux through it. It works on the principle of Ampere's Circuital Law; it creates an electric current which can be used to detect if there is current flowing through the lines or not. If there is current flow then only it creates magnetic flux and the device detects it without being in contact with the line itself. This device in combination with a logical circuit to generate suitable signal for input of the IOT device. The IoT device and logic circuits have a separate internal battery which is used for its working. The input power from transmission lines is inverted and supplied to the IOT device with the help of logic gates. This is done to reduce the power usage of the battery as it transmits signal only when the power is off. The IoT device sends three signals to the database. The first signal indicates the condition of the transmission line, the second signal is used to check the condition of the battery and the third message is the geographical coordinates of the device. The message is transmitted using Arduino, initially the physical address of the nodes are mapped to the geo-location during the installation phase,

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

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For the purpose of mapping the faulty line we use React-leaflet and Map tailer which is a opensource tool to make use of maps of various flavours. So, whenever the data is transmitted from the node it is directly receives its geo-location, then both the data (status and the geolocation) is stored in the database. Then a web application is built using following frontend technologies: CSS3, JavaScript, React.js with backend technologies like node.js, express.js and Mongo DB as the database (MERN Stack).We make use of Thingpeak API to obtain the data and save in the Thingspeak Cloud from which the data can be obtained from the cloud by the Web application and The signals obtained from the Arduino is send to the Thingspeak through GPRS module which is connected to Arduino The data which is obtained in Thingspeak is then fed to the database and then by knowing the longitude and the latitude of the fault Google Map API the pointer is marked in the map.

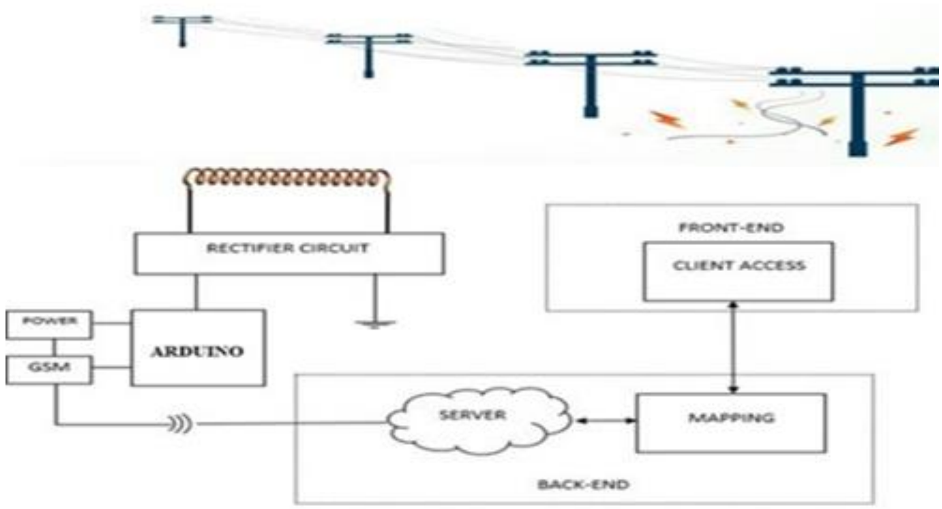

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Figure 1: Block Diagram of the proposed model

The whole web application is based upon MERN stack (MongoDB, Express, React, Node.js) which is a single page application. The user needs to login to the web application and then can register the device which consists of Device ID and Location (Optional hence the device is placed in static location) which is stored in MongoDB database for further reference. The backend processing and validation is done using Postman. The Backend is connected to database using Mongoose framework. The MongoDB database is made active as we are using MongoDB Atlas and then made as Open broadcast. The user validation is done and authentication is done using JW Tokens, which is generated when user is logged in and then is stored in cookies. The post login page is run through middleware so that if authentication of the web application is maintained.

IV. SIMULATION RESULTS

The Back-end server is run using Node.js and React development server in local machine. The MERN Stack is a complete JavaScript Stack. The Front-end of the web application is built using React.js which is a JavaScript Front end framework. The user interface of the Web application has custom hooks and buttons and react supported spinners and toast methods. The Reacttoastify is used to provide a interactive notification and while loading the API contents or values the React hash spinner is used. Whenever the Fault is found, the fault event is triggered and there is no induction of current in the coil.

The status of the line is continuously monitored and the obtained data is passed to the Thingspeak cloud along with its location (i.e., Latitude and Longitude) of the device. The user has to register at first to have access to the functional aspects of the Web application. The received data is stored in MongoDB. The password is encrypted using BcryptJS and then stored in MongoDB database, and then redirected to Login page in which can login using their credentials. After login event, The JWToken is generated and stored in the cookies. The JWToken is obtained with the encryption key which is predefined by the admin by which authentication can be made possible also the details of the user can be obtained

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for further references. The login credentials and its functionalities in the backend is verified using Postman, which can be used to create own APIs. After Login it redirects to Post login page in which the user is provided with the choices to either register a new device or to check the status of the transmission line through previously installed devices at site.

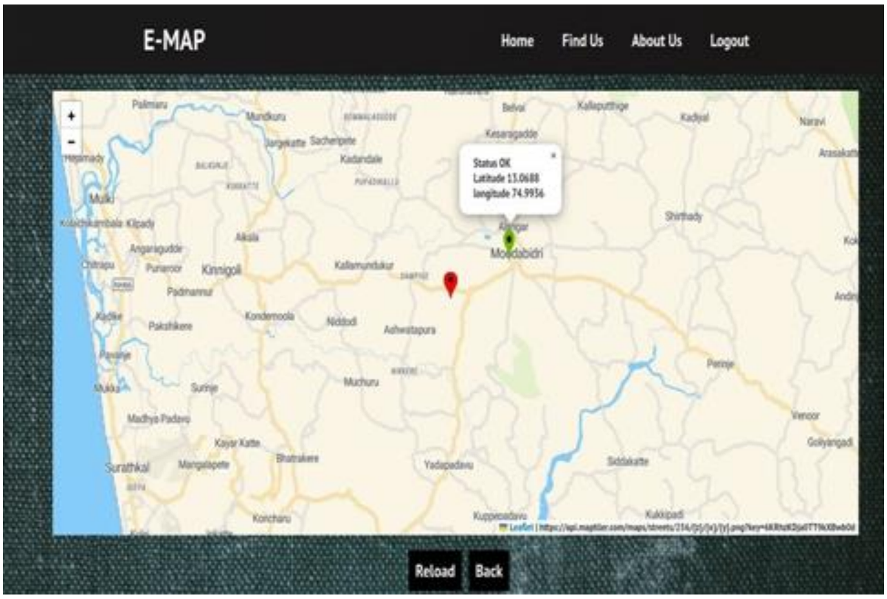

Figure 2: Success status of devices

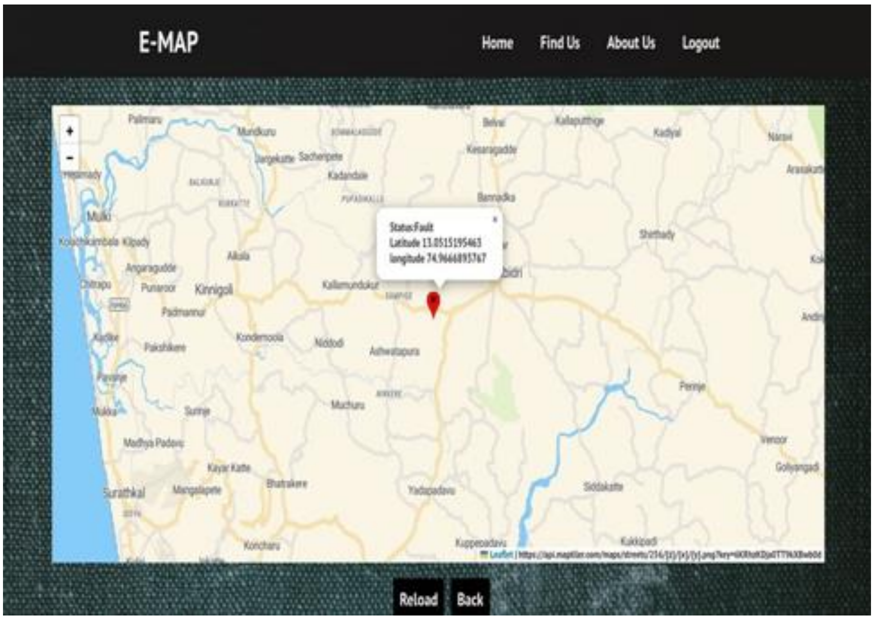

Figure 3: Failure status of devices

The devices present in the site detects the fault and sends the status to Thingspeak cloud. The data is obtained from the cloud using Thingspeak API. The format of the data is JSON. The data is obtained by the Web application using fetch API. The data obtained from the Cloud is then used for Mapping the nodes or devices in the map along with its status.

The following results are obtained from this project

- Fault or cut in transmission line is detected.
- Status is marked and noted.
- Geo-location of the device is obtained.
- Based on the location obtained, a map is made visible for the concerned authorities for immediate action.

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