AMRUTVAHINI COLLEGE OF ENGINEERING, SANGAMNER

DEPARTMENT OF COMPUTER ENGINEERING

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Project Synopsis

on

"GIS based Power Distribution System Using ML"

BE Computer Engineering

BY

Group Id-

Ms. Sanjivani Dhande (4128)

Ms. Apeksha Dhomase (4130)

Ms. Siddhi Jamdade (4165)

Mr. Ashish Walke (4272)

Dr. D. R. Patil
Project Guide
Dept. of Computer Engineering

Dr. D. R. Patil/ Dr. R. G. Tambe
Project Coordinator
Dept. of Computer Engineering

Prof. R. L. Paikrao
H.O.D
Dept. of Computer Engineering

- **Title: GIS based Power Distribution System using ML**
- **Domain and Sub-domain: Machine Learning and Power Distribution**
- **Objectives:**
    1. To manage power distribution of the electrical network remotely.
    2. To develop Machine Learning models to accurately predict consumer power demand patterns, aiding in optimal load management and resource planning.
    3. To identify inefficiencies and potential cost-saving opportunities in the power distribution system.
    4. Optimize power distribution systems using Geographic Information System (GIS) data combined with Machine Learning.
- **Abstract:**

The traditional power distribution network often struggles with resource inefficiency and suboptimal allocation. This results in higher energy losses, longer restoration times during outages, and increased operational costs. Aging equipment and limited visibility into the network exacerbate these issues, leading to decreased reliability. In India, the electric power industries have been developing power transmission system to follow up with a rapid growth of the power demand due to increasing population pressure on this sector. With the advancement of GIS technology, electricity asset system in India is going to be much more benefited in power system planning and management. The integration of GIS with electric utilities is tremendously improving the planning and operation of the power system. The project proposes a traditional approach to optimize power distribution systems using Geographic Information System (GIS) data combined with Machine Learning. A GIS-based power distribution system using machine learning (ML) involves integrating geographical information system (GIS) data with ML algorithms to optimize power distribution. ML can help predict demand, identify potential faults, and enhance energy efficiency. It can analyze historical data to optimize maintenance schedules and predict equipment failures, improving the overall reliability of the power distribution network. The objective is to develop a robust framework that leverages spatial

data from GIS platforms to optimize the operation and maintenance of power distribution networks. The proposed system aims to enhance grid reliability, optimize load balancing, and minimize energy losses. Through the application of advanced neural network architectures, the model learns from historical data and real-time inputs to predict electricity demand patterns and potential fault locations. It contributes to the ongoing efforts towards building a smarter and more sustainable power infrastructure by harnessing the capabilities of GIS and Machine Learning in the domain of energy management.

- **Keywords:**

  1. Power Distribution
  2. ML:- Machine Learning
  3. GIS :- Geographic Information System
  4. MBC :- Metering, Billing and Collections
  5. QGIS :- Quantum Geographic Information System

- **Problem Definition:**

  The adoption of GIS in power distribution aims to enhance overall system efficiency, reliability, and sustainability while providing utilities with data-driven insights for better decision-making and improved customer service. GIS-based power distribution system that integrates Machine Learning Libraries as the underlying technology to optimize and improve the efficiency of power distribution networks. Several usages of GIS in power utilities such as automated route selection for the construction of new power lines which uses a dynamic programming model for route optimization, load forecasting and optimizing planning of substation's location and capacity with comprehensive algorithm which involves an accurate small-area electric load forecasting procedure and simulates the different cost functions of substations.

- **List of Modules:**

  1. Data Collection and Preprocessing
  2. GIS Integration Module
  3. Load Forecasting Module

4. Fault Detection and Localization Module

- **Current Market Survey:**

  In India, the electric power industries have been developing power transmission system to follow up with a rapid growth of the power demand due to increasing population pressure on this sector. The electric distribution system is dedicated to delivering electrical energy to end users. Many companies and electrical departments in India are using GIS techniques for asset mapping and consumer indexing. Use of GIS will simplify easily updatable and manageable database to cable to the needs of monitoring and sustain reliable quality power supply, effectual MBC (Metering, billing and collections), comprehensive energy audit, theft recognition and a decrease of transmission and distribution losses.All these measures will ultimately advance the overall internal effectual and help accelerate attaining commercial feasibility. A new period of higher implication has arrived for the global positioning system (GPS) and GIS functions at electric utilities mapping. Improved hardware, software, and networking technology have made prospects for the utility industry to form and benefit from more comprehensive and sophisticated GIS. GIS applications have changed from their foundation in map production to advanced analysis tools for planning and operations. To a degree never equaled before, utility managers are looking to their GIS programs, occupied with progressively accurate data collected by global positioning system (GPS) technology, before creating any kind of decisions in the urban and rural areas. Power Distribution Company ensures availability of electricity to end consumers.

  1. It deals with HT and LT electrical networks and related consumers spread over wide geographical area.
  2. Its business operation cycle: Power purchase – supply – metering - billing - revenue collection.
  3. In past, Discoms have been using conventional Physical Area Maps for proper O and M and management of the system.

- **Scope of the Project:**

    1. Predicting power demand and load forecasting in specific geographic regions using historical data.
    2. Identifying optimal locations for new power infrastructure, such as substations or transformers, using GIS and machine learning techniques.
    3. Building a system to optimize power distribution routes for efficient energy transfer.
    4. Developing a geospatial visualization platform to monitor and manage power distribution assets.

- **Literature Survey:**

    1. Emanuele Fabbiani "Machine learning approaches for energy distribution and planning" PhD Thesis –cycle XXXIII November 2020
    2. Ning Zhao , Fengqi You , "New York State's 100electricity transition planning under uncertainty using a data-driven multistage adaptive robust optimization approach with machine learning" Available on 17 March 2021
    3. Alessandro Bosisio, Matteo Moncecchi, Andrea Morotti, Marco Merlo "Machine Learning and GIS Approach for Electrical Load Assessment to Increase Distribution Networks Resilience" article Published on 8 July 2021.
    4. Aanand Kumbhar, Pravin G. Dhawale , Shobha Kumbhar, Uday Patil, Pravin Magdum "A comprehensive review: Machine learning and its application in integrated power system " Review article 7 September 2021
    5. WenBin Wang, Jie Wei , Yu Zhu , ShiYang Zhou " Power distribution equipment and defect identification technology based on deep learning" . Journaal of Physics: Conference Series, Volume 2030, 2021 International Conference on Electrical Engineering and Computer Technology (ICEECT 2021) 20-22 August 2021, Qingdao, China.

- **Software and Hardware Requirement of the Project:**
  Software:

  1. QGIS
  2. Python

  Hardware:

  1. CPU / GPU
  2. RAM: 8 GB
  3. 1GB hard drive Space

- **Contribution to Society:**

  1. Reliable Power Supply: By analyzing data from GIS and using machine learning techniques, the project can identify potential faults, predict power outages, and help in quicker restoration, ensuring a more reliable power supply to consumers.
  2. Cost Savings: Improved efficiency and reduced downtime can result in cost savings for both energy providers and consumers, potentially leading to more affordable electricity rates.
  3. Grid Resilience: The project can contribute to making the power grid more resilient to natural disasters and other emergencies, ensuring a stable power supply during critical situations.

- **Probable Date of Project Completion:** April 2024

- **Outcome of the Project:**

  1. By optimizing power distribution based on consumer demand patterns, consumers experience more reliable electricity supply, leading to increased satisfaction.
  2. GIS analytics can segment consumers based on geographical location and usage patterns, allowing power companies to design tailored services and demand response program.

3. By implementing cost-effective strategies, such as load balancing and demand response, utilities can reduce operational expenses and pass on the benefits to consumers. To manage and map the location of millions of connections over transformers remotely to reduce the cost.