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AIR POLLUTION DETECTION USING DEEP LEARNING

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ABSTRACT :

Air pollution during festivals and day-night vehicular activity is a growing threat to urban air quality and public health. Existing monitoring systems often lack real-time capabilities and fail to detect sudden pollution spikes. This study presents a Machine Learning (ML) based system for dynamic air quality monitoring. Advanced sensor networks are used to collect real-time data, which is analyzed using ML algorithms MLP Time-series analysis models the variation in emissions throughout the day. The system offers accurate classification and prediction of pollution levels. It provides timely insights to support pollution control and public health responses. Overall, it aims to deliver a sustainable solution air quality during high-emission events.

Keywords: Air Pollution, Machine Learning, prediction, pollution level.

TRODUCTION :

Air pollution is one of the most pressing environmental challenges of the 21st century, particularly in rapidly urbanizing regions. It is primarily caused by industrial emissions, vehicular exhaust, construction dust, and the burning of fossil fuels. In urban areas, festivals and peak traffic hours contribute significantly to short-term pollution spikes. These elevated levels of pollutants, such as PM2.5, NO_2, and CO, pose severe risks to human health, affecting respiratory and cardiovascular systems. Traditional air quality monitoring systems, though accurate, are limited by high costs and lack of real-time data capabilities. As a result, they often fail to capture sudden changes in pollution levels during specific events or times of the day. Recent advancements in technology have paved the way for intelligent air quality prediction with Machine Learning (ML) algorithms. These systems can collect, process, and analyze environmental data in real-time, enabling faster and more precise pollution detection. Time-series modelling also helps in forecasting pollution trends, especially related to vehicular emissions. Such solutions are crucial for effective environmental management and public health planning. Thw explores the design and implementation of a smart, data-driven air pollution prediction system tailored to detect emissions during festivals and daily traffic cycles.

LITERATURE REVIEW :

Air pollution detection has become a significant research area due to the increasing health risks associated with poor air quality. One recent study proposed a data-driven model using the Gaussian Decoupled Representation Extractor, which improves urban air quality forecasting by separating nonlinear patterns and enhancing predictive accuracy.

Forecasting Urban Agglomeration Air Quality: A Data-Driven Model With the Gaussian Decoupled Representation Extractor – 2023
Another study developed a coupled optimization prediction model that integrates optimization algorithms with machine learning techniques to forecast pollution more reliably under changing urban conditions.

A Novel Coupled Optimization Prediction Model for Air Quality – 2023
A complete framework was introduced to monitor and predict air pollution using IoT sensors and ML algorithms. This system collects real-time environmental data, predicts pollutant levels, and provides alerts to authorities and the public.

A Complete Air Pollution Monitoring and Prediction Framework – 2023
A separate study combined time-series forecasting with deep learning models to monitor daily air pollution variations, especially those linked to vehicular emissions and climatic changes.

PROPOSED SYSTEM:

Smart AI-Based Air Quality Prediction System predicts the air quality index using machine learning techniques and real-time data collection. The system addresses increasing health concerns due to air pollution by analyzing major pollutants like Carbon Dioxide, Nitrogen Dioxide, and Carbon Monoxide released from vehicles, industries, and burning of fuels.

1. Machine learning-based prediction using algorithms MLP
2. Data collection
3. Data preprocessing
4. Test data
5. Prediction

METHODOLOGY :

The aim of this project is to develop a machine learning-based system for predicting air quality levels using weather-related parameters. The system allows the admin to upload datasets, preprocess and extract features, and then classify the data using trained models. Users can input real-time weather data to check the air quality level and receive instant prediction results, enabling proactive measures for health and environmental safety.

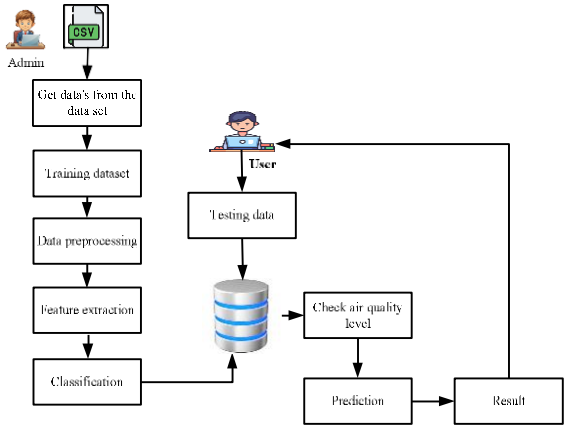

Fig 1 – Architecture Diagram

This module operates to automate the prediction of air quality using machine learning models and user-provided data inputs. The system consists of two main roles: Admin and User**.** The Admin is responsible for uploading datasets, preprocessing data, running predictions, and managing user information. The User interacts with the system by registering, logging in, providing weather input data, and receiving prediction results. This module acts to provide accurate air quality assessments through a structured data flow, enabling informed decisions for better public health and awareness.

Admin Module:

- Login
- Upload Dataset
- Pre-process
- Module Prediction
- View User Information

User Module:

- Register
- Login
- Air Quality Checking
- Result

Software part of the project

Front end – python Backend – MySQL

The next stage will involve uploading the air quality dataset to the system portal. The weather-related parameters included in the dataset will help to perform accurate and customized air quality prediction using machine learning algorithms.

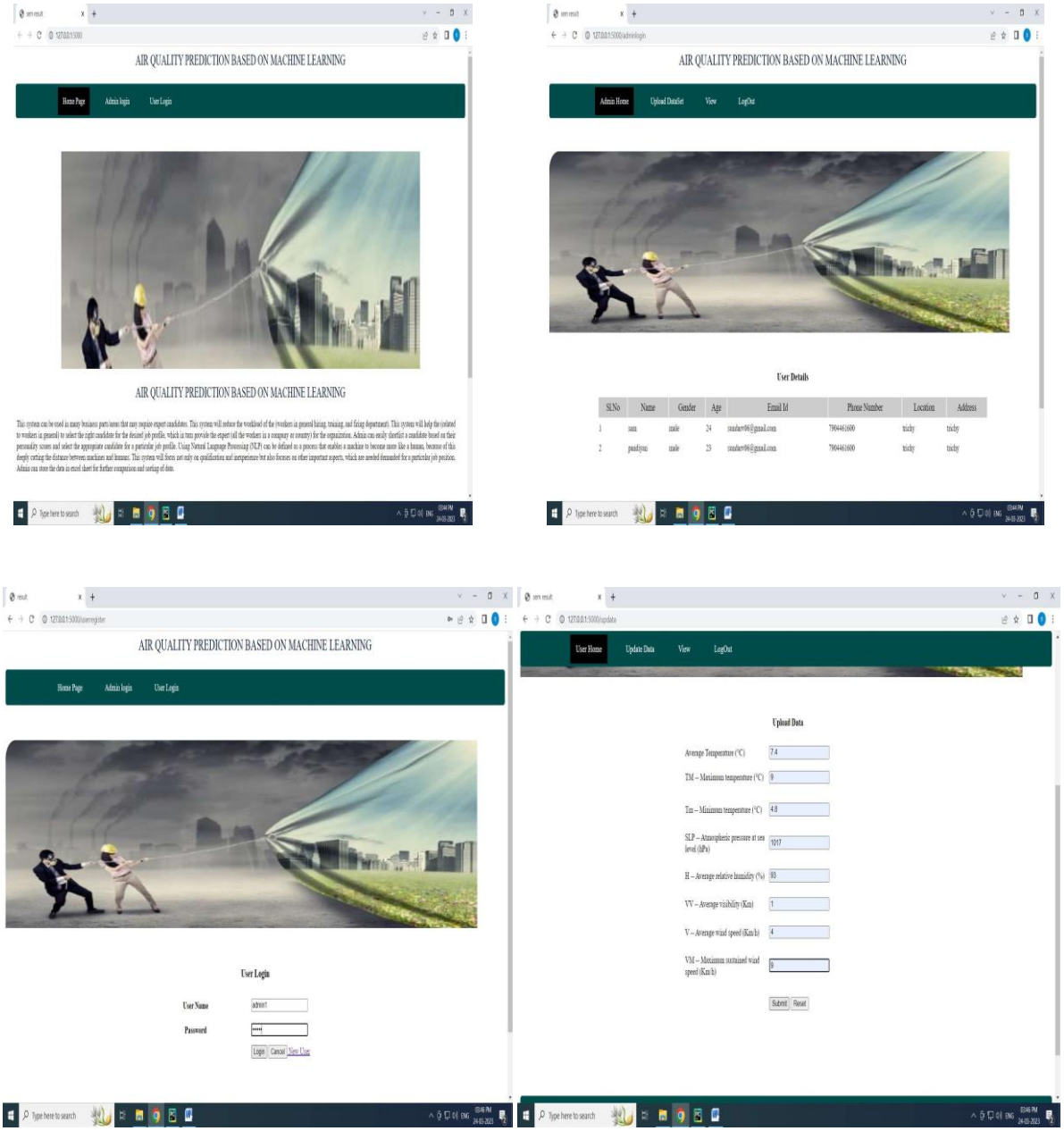

Fig 2 – output image

WORKING :

The working process of the air quality prediction system starts with collecting datasets from sources and air monitoring websites. These datasets include various environmental parameters such as temperature, humidity, wind speed, and levels of pollutants like CO_2, NO_2, and CO. The data is then preprocessed to remove missing or irrelevant values for better accuracy. Important features are extracted from the cleaned data to help the model focus on key factors affecting air quality. The dataset is split into training and testing sets to build and evaluate machine learning models. Algorithms such as Linear Regression, Decision Tree, Random Forest, ANN, and SVM are used for predicting the Air Quality Index (AQI). Users can input real-time weather data through a web or mobile application. The system then predicts the air quality level and provides results to help users and authorities take preventive health measures.

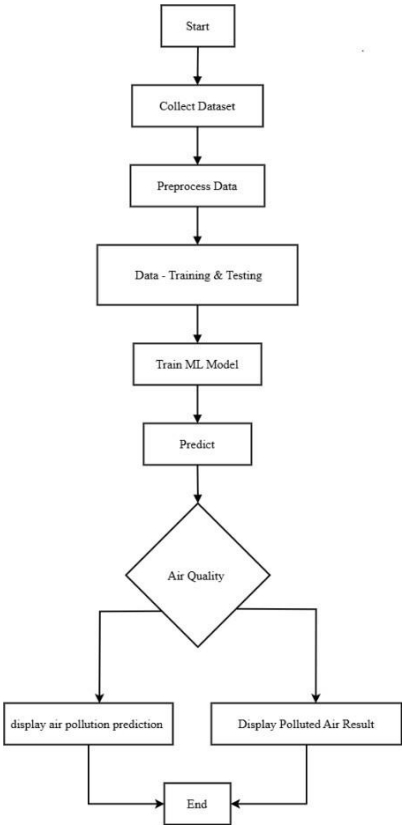

Fig 3 – Flowchart

RESULT :

The result of the air quality prediction system demonstrates the potential of machine learning in environmental monitoring. By utilizing datasets collected from reliable sources the system processes various weather and pollution-related parameters. After preprocessing and feature extraction, the data is classified using trained machine learning models. The system successfully predicts the Air Quality Index (AQI) based on user input values such as temperature, humidity, wind speed, and gas concentrations. Among the algorithms used, models. The results indicate whether the air quality is safe or pollutant, enabling users and authorities to take preventive measures. This prediction system provides instant results through a user-friendly interface. The system helps raise awareness of air pollution levels in real-time. It supports government and public initiatives to reduce health risks related to poor air quality. The model is capable of continuous learning and can be improved over time. Though existing research shows moderate accuracy, this project improves results by applying effective preprocessing and algorithm selection. The comparison between training and testing results shows high model reliability. This system can be used in smart city planning and health advisory systems. Overall, the result proves that machine learning is a practical and scalable approach for air quality prediction.

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