**Air Quality Monitoring and Forecasting System Using Machine Learning.**

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## Title: **Air Quality Monitoring and Forecasting System Using Machine Learning.**

## Project Idea:

Air pollution is a pressing environmental and public health challenge, responsible for a wide range of serious health issues, including respiratory diseases, cardiovascular illnesses, and premature deaths. The harmful effects of pollutants such as particulate matter (PM2.5, PM10), carbon monoxide (CO), nitrogen dioxide (NO2), and volatile organic compounds (VOCs) are well-documented, affecting millions of people worldwide, particularly in urban and industrialized areas. Effective solutions are needed to monitor and predict air quality, enabling timely interventions to protect public health.

This project aims to develop an advanced air quality prediction system using machine learning models trained on historical air pollution data. The system will analyze various air quality indicators and meteorological factors, leveraging data from reliable sources to forecast pollution levels accurately. By utilizing algorithms such as regression models, decision trees, and deep learning techniques, the prediction system will provide real-time and future air quality assessments, helping individuals, organizations, and authorities make informed decisions.

The air quality prediction system will deliver timely insights for mitigating pollution risks, issuing early warnings when pollutant concentrations reach hazardous levels. Users will receive personalized recommendations on protective measures, such as staying indoors or wearing masks during high pollution periods. This proactive approach can minimize health risks, enhance awareness, and promote sustainable practices. Ultimately, the project aims to empower communities to combat air pollution effectively and contribute to a cleaner, healthier environment.

## Relevance to Sustainable Development Goals (SDGs):

This project aligns with Sustainable Development Goal 3 (Good Health and Well-Being) by addressing the harmful health impacts of air pollution, including respiratory diseases, cardiovascular illnesses, and premature deaths. By providing accurate air quality forecasts and timely warnings, the system enables individuals to take preventive measures, reducing exposure to harmful pollutants and protecting public health. It raises awareness about pollution-related health risks, encouraging safer practices and fostering healthier communities.

Furthermore, the project supports Sustainable Development Goal 11 (Sustainable Cities and Communities) by promoting data-driven environmental management strategies. The air quality prediction system leverages machine learning models trained on historical pollution and meteorological data to offer actionable insights for urban planners, environmental agencies, and policymakers. These insights can guide efforts to reduce pollution, enhance urban air quality, and create sustainable, livable cities. By empowering communities and decision-makers, this project contributes to a cleaner, healthier, and more sustainable future.

Literature Examples:

1. Zhang et al. (2018) demonstrated the effectiveness of Long Short-Term Memory (LSTM) networks in predicting air quality trends based on historical pollution data, improving early warnings and policy responses.
2. Borghi et al. (2020) explored the challenges of air quality forecasting, highlighting the importance of data preprocessing and model selection in achieving reliable predictions.

## Describe Your Data:

The project will utilize publicly available air quality datasets from government agencies and environmental organizations. The data, typically in CSV format, will include pollutant concentrations, meteorological variables (temperature, humidity, wind speed), and timestamps. Preprocessing steps will involve handling missing values, normalizing data, and feature engineering to enhance model performance.

## Approach (Machine Learning or Deep Learning):

This project will primarily use machine learning models such as Random Forest, Support Vector Machines (SVM), and Gradient Boosting for air quality prediction. For time-series forecasting, deep learning approaches like LSTMs may be explored to capture long-term trends and seasonal variations. The choice of model will depend on performance metrics such as accuracy and computational efficiency.