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Air Quality Prediction and Control Optimization Using Machine Learning and IoT-Based Solutions

Narcisa Zlatan, Lima Hongou, Sofia Arkhstan

1. Polytechnic University of Bucharest, Management Technology department, Romania
2. Faculty of Engineering, Computer Technology, UCSI University, Kuala Lumpur 56000, Malaysia
3. Department of Computer System, South Ural State University, 454080 Chelyabinsk, Russia

Abstract:

Air pollution has become a pressing concern in urban environments, necessitating intelligent systems for its prediction and mitigation. This study proposes an integrated framework that leverages machine learning algorithms and IoT-based sensor networks for real-time air quality monitoring, forecasting, and control optimization. IoT devices are deployed across key urban locations to collect environmental data, including concentrations of pollutants (e.g., PM2.5, CO, NO_2), temperature, humidity, and traffic patterns. Machine learning models—such as Support Vector Machines (SVM), Random Forests, and Artificial Neural Networks (ANNs)—are applied to analyze the data, predict air quality index (AQI) levels, and trigger responsive actions such as traffic management or emission reduction protocols. The system provides urban planners with actionable insights for adaptive pollution control, contributing to healthier and more sustainable cities. Empirical evaluations demonstrate the framework's effectiveness in improving prediction accuracy and facilitating timely interventions.

Keywords:

Air quality, machine learning, IoT, pollution prediction, urban sustainability, control optimization.

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