Chapter 10
An Air Quality Forecasting Using the Artificial Neural Network in India

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ABSTRACT

Accurate and efficient forecasting of the air quality index (AQI) is adequate to improve public health and supporting societal sustainability, despite the challenges posed by air pollution .In this work presents the importance of accurate AQI predictions using the machine learning (ML) approach called Artificial Neural Network (ANN) for improving public health outcomes. Optimized variational mode decomposition (O-VMD) is used for decomposing the AQI samples into various set of samples. The optimal process is demonstrated by the chameleon optimization (CO). The suggested O-VMD improves the ability of the model in capturing complex features. Then, the ANN is used for predicting AQI on the basis of the decomposed elements on two AQI datasets. The suggested O-VMD-ANN demonstrated improved prediction per-

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formance compared to other ML model and provided better process for proactive air quality controlling and public health protection in India.

1. INTRODUCTION

Air pollution considered as a critical environment challenge which affects the various parts of the globe. This pollution due to when harmful and number of particles like gases, biological elements and particles are released into the atmosphere of Earth. Major pollutants such as Nitrogen Dioxide (NO_2), Carbon Dioxide (CO_2), Carbon Monoxide (CO_2), Sulfur Dioxide (SO_2), and Particulate Matter (PM) (Madan, T. et al., 2020). Like other hazards, air pollution remarkably acceptable early mortality rates in India. Major terms causing air pollution include population density growth, rising average annual temperatures, increase of motor vehicle and industries. Furthermore, the processes of urbanization negatively impact air quality (Bhalgat, P. et al., 2019).

Prediction of the air quality is playing a crucial part in assessing and predicting future pollution levels, environmental conditions, and the evolving trends of key pollutants and their sources. Historically, data collection and forecasting have relied on Internet of Things (IoT) devices and sensors (Gladkova, E., & Saychenko, L. (2022)). This information helps guide the development of strategies to prevent further environmental degradation and improve overall air quality. Predicting smog levels in a timely manner is especially vital, as it enables individuals to take precautionary steps to reduce potential harm. Given the growing concern over air pollution, providing accurate forecasts is becoming increasingly significant. Thus, the ability to accurately predict air quality data is essential (Sarkar, N. et al., 2022).

The term Air Quality Index (AQI) is a numerical analysis utilized for evaluating the air quality by integrating the different pollutants concentrations into a single numerical term. It is exploited for examining the long-term health impacts of air pollution on individuals, analyzing the relation among air quality and health of human. It is essential to analyze several measures based on different levels of air quality, as the appropriate process can assist in improving the present air pollution conditions (Gilik, A. et al., 2022). A proper AQI forecasting is important to control air pollution control, as policymakers depend on it for critical short term criteria, like restricting car traffic closing industries and, long-term criteria, like the sustainable development of society. There are two types of AQI prediction; they are numerical approaches and data driven approaches (Mishra, A. & Gupta, Y. (2024). The numerical approaches are depends on the chemical and physical theories and utilized in the atmospheric field. Then, the data driven approaches are conventional statistical, artificial intelligence and hybrid approaches (Kaur, M, et al., 2023).