Air Quality Prediction Using Hybrid Deep Learning-A Review

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Abstract: In recent years, many countries are facing the problem of air pollution, which effect on the health of the young and old people for breathing problem. For securing people lives by following government's policy, it is important to predict the air quality. It is important to invest more time on forecasting of air quality to provide accurate and relevant solution to achieve acceptable result which helps us to overcome faults. With the help of meteorological data and also knowledge about air pollutants we are building a deep learning-based model which forecast concentrations of ambient pollutants. By applying 1D CNN, Bidirectional LSTM we are actually forecasting this proposed model results which is finally present in the form of different graphs, predicted values and by comparing the actual and predicted data we define he accuracy. Based on the Beijing city dataset, our experimental analysis demonstrate he result and advantages of model.

Key Words: **Air quality prediction, deep learning, formatting, style,1D convolutional neural network, Bidirectional Long Short-Term Memory.**

I. INTRODUCTION

With the high spread of industrialization and urbanization the problem of air pollution has become more and more complex which is affecting humans, trees and animals etc. It is also important factor for global warming. Certain Epidemiological experiments showing the results about certain chemical components such as Sulphur dioxide (SO2), nitrogen dioxide (NO2), ozone(O3) who else is affecting the people which is sensitive in case of people who is having asthma. In urban environments and especially in those areas where population and traffic density are relatively high, human exposure to hazardous substances is expected to be significantly increased. This is often the case near busy traffic axis in city centers, where urban topography and microclimate may contribute to the creation of poor air dispersion conditions giving rise to contamination hotspots. High pollution levels have been observed in street canyons, which is a term frequently used for urban streets flanked by buildings on both sides. Within these streets, pedestrians, cyclists, drivers and residents are likely to be exposed to pollutant concentrations exceeding current air quality standards.

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II. LITERATURE SURVEY

2.1 Deep Air Quality Forecasting Using Hybrid Deep Learning Framework

Air quality forecasting has been regarded as the key problem of air pollution early warning and control management. In this article, we propose a novel deep learning model for air quality (mainly PM2.5) forecasting, which learns the spatial-temporal correlation features and interdependence of multivariate air quality related time series data by hybrid deep learning architecture. Due to the nonlinear and dynamic characteristics of multivariate air quality time series data, the base modules of our model include one-dimensional Convolutional Neural Networks (1D-CNNs) and Bi-directional Long Short-term Memory networks (Bi-LSTM). The former is to extract the local trend features and spatial correlation features, and the latter is to learn spatial-temporal dependencies. Then we design a jointly hybrid deep learning framework based on one-dimensional CNNs and Bi-LSTM for shared representation features learning of multivariate air quality related time series data. We conduct extensive experimental evaluations using two real-world datasets, and the results show that our model is capable of dealing with PM2.5 air pollution forecasting with satisfied accuracy.

2.2 An Air Quality Prediction Model Based on a Noise Reduction Self-Coding Deep Network

For this study, based on an LSTM network, a denoising autoencoder deep network (DAEDN) model was designed to solve the low prediction accuracy of existing air pollutant prediction models. Using the hourly PM2.5 concentration data collected by Beijing's 12 air quality-monitoring stations over 5 years, the prediction model of the study was analyzed and verified. It contains the main input of the model, including historical air quality data, primarily the air quality index AQI and PM2.5, PM10, SO2, NO2, O3, CO, and other pollutant concentrations from the experimental analysis, the following conclusions were obtained: The DAE structure of the DAEDN model input layer could effectively reduce noise and improve prediction accuracy. The model's Bi LSTM structure made good use of historical and future information to eliminate the lag and improve prediction accuracy. The prediction performance of the study's surface DAEDN prediction model was superior to the prediction results of BP, DRNN, and DBN network models. The test results divided by quarters indicated that the prediction accuracy of the model was different in different quarters, but the quarterly accuracy levels basically remained near the accuracy level of the annual average prediction.

2.3 Real-time air quality forecasting, part II: State of the science, current research needs, and future prospects

This paper is giving idea about meteorological forecasts, chemical inputs, and model treatments of atmospheric physical, dynamic, and chemical processes in real-time air quality forecasting (RT-AQF) models Part II specifies about RT-AQF models to address model deficiencies and improve forecast accuracies. Methods like simple statistical techniques has giving result based on data of monitoring site Weather forecasting that affects everyone, RT-AQF has emerged as a new forecasting discipline and is undergoing substantial and rapid advances. Many cities and countries worldwide have successfully launched RT-AQF systems that are based on tools and models with varying degrees of sophistications ranging from the simplest rule of thumb to the most advanced 3D online-coupled meteorology and chemistry models This system will be equipped with many modern technologies to reduce forecasting biases and enhance computational efficiencies including advanced techniques for multi-scale data assimilation The realization of this new generation of RT-AQF system will represent a significant landmark in the history of operational RT-AQF.

2.4 Modelling Air Quality in Street Canyons

As per the survey carried out, it is understood that there is a vast decrease in Natural Ventilation in the Urban Street Canyons. This discussion carries out a Mathematical Model which Calculate the Pollutant Concentrations by solving the Parametric Equations or by applying the algorithm numerically on a set of differential equations that describe in detail the Wind Flow and the Pollutant Dispersion as well as Pre-Concentration Monitoring and Sampling Techniques This paper includes two main datasets Traffic Data and Emissions According to the study carried out, considerable efforts were made to improve the understanding of dispersion and transformation phenomena which indirectly governs the Urban Air Quality. It discusses that according to the contents of the pollutants and the composition of the same, the Highest levels of air pollution often occur in Urban Street Canopy and are impacted badly which are further Concentrated. The Air contains high level of composition of CO, NOx, and Hydrocarbon Particles. Also, the Natural Ventilation of the Urban Streets is reduced mainly due to the Presence of Large number of buildings. Within the Urban Canopy, multiple Air Pollution Hotspots are created due to these toxic contents which are been detected in the Air Further these detected contents are been studied for Forecasting the Air Quality which will involve Deep Learning Technique.

2.5 PM2.5 Concentration Prediction Using HSSM

According to the Study, Prediction of Particular Matter in the air is an Important issue in Control reduction of Pollutants in the air. This Study generally involves Prediction of PM2.5 Concentration using Hidden Semi-Markov Model based "Time Series Data Mining. In this Paper, they Presented Hidden Semi-Markov Models for the prediction of High PM2.5 Concentration and its effect on the Air Quality Contents. Trained HSMM's can be used to obtain High PM2.5 Concentration level, which can be further used for PM2.5 Predictions. Also, in the dataset used, Vector Quantization is used to Discretize the Continuous data. Classification accuracy of PM2.5 is very Promising HSMM's are efficient to provide accurate prediction of extreme concentration levels in prior.

2.6 Real-time Air Quality forecasting, Part 1: History, techniques, and current status

According to the atmospheric science, Real-time Air Quality forecasting has become the new advanced discipline which is responsible for far-reaching development along with the practical applications constitute of Science & Engineering.

It deals with the Scientific, Computational and technical Challenges in the modern era which are related to the air quality time series dataset. Considering all these situations and the parameters it generates the Significant & relevant opportunities with respect to science dissemination which allows for Community Participation's.

This is a two-part study which has special functions or applications w.r.to Air Quality. It provides comprehensive information of the History, Major researches and researchers respectively, Current Status, and the outreach problems faced by them to predict about the future directions of Real time Air Quality Forecasting model.

One of the most important sections in this study deals with reviewing the Major Components and the milestones from the history till date for determining the efficiency of the Real time Air Quality Forecasting. Multiple fundamentals are been introduced with respective techniques of varying degrees. It provides the ability of Sophistication and the appropriate skills which are further described.

III. System Architecture

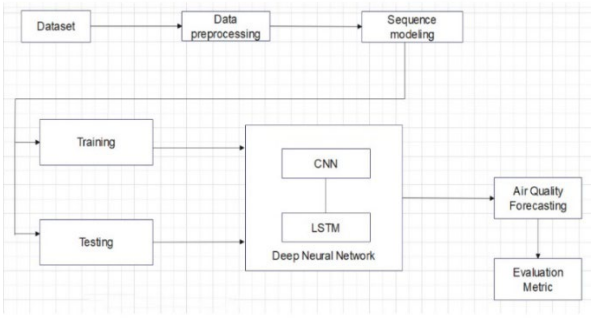

Fig.1. System Architecture

3.1 Data Set

Our experiment uses real-world air quality dataset. The Beijing air quality dataset from UCI, which includes meteorological data and PM2.5 pollution data. This hourly dataset contains the PM2.5 data of the Beijing. Dataset contains various attributes like PM2.5, PM10, CO2, TEMP, etc. on which prediction is performed**.**

IV. Conclusion

Hence, we provided a detailed overview of Deep air quality forecasting using hybrid deep learning framework, its parameters and goals. This document describes the project's target audience and its user interface, hardware and software requirements. We can apply such models for air quality prediction in several environment friendly activities. Our model will be compatible for local as well as global cases. So, by considering all the study work and the detailed analysis, we prefer to choose the Studying of Forecasting the Air Quality in the Surrounding relating with the Computer Science Domain which is Deep Learning. So, this Study will include the New Air Quality Forecasting Framework which will discuss about CNN Bi-LSTM levels for PM2.5 single step forward and multi-Step forward Prediction, which is based on Hybrid Deep Learning Model. It demonstrates the Effectiveness of the model and helps to forecast about the contents in the Air to Predict the Air Quality and discusses about the Approach and the applications of Deep Learning with Neural Networks.

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