Air Quality Prediction using Machine Learning

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# Abstract

**In this paper, it is aimed to predict the Air Quality Index (AQI) by the use of Machine learning algorithms. To reach this, the key parameters have been selected which can affect the Air quality index are temperature, humidity, pressure, wind speed, PM10 and SO 2 respectively. Air quality of certain states in India can be used as one of the major factors determining pollution index also how well the city's industries and population is controlled. Urbanized Air quality monitoring has been a constant challenge with the advent of industrialization. Air pollution causes conspicuous damage to the environment as well as to human health resulting in acid rain, heart diseases, global warming and skin cancer to all humankind. This paper addresses the challenge of predicting the Air Quality Index (AQI), with the goal to reduce the pollution before it gets unfavourable and also suggests mankind to move places in advance, using ensemble techniques for predicting the Air Quality Index (AQI). This paper investigates how effective some available prediction models are in predicting the Air Quality Index(AQI) values provided some input data, based on the pollution and meteorological information in India. We carry out regression analysis on the dataset, and our results shows which meteorological factors impact the AQI values most and how helpful the predictive models are to help in air qualityprediction.**

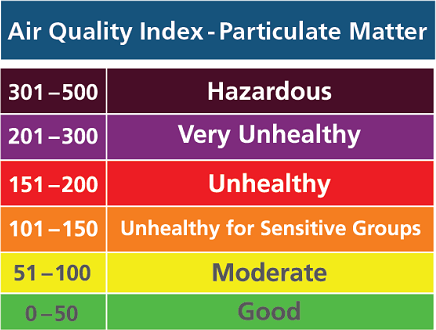
# Keywords-Machine learning, air quality index, random forest regressor

**Introduction:**

Air is one of the most essential natural resources for the existence and survival of the entire life on this planet. As this is the largest growing

industrial nation, as known India is producing record amount of pollutants specifically Co2, pm2.5 etc and other harmful aerial contaminants. Air pollution in cities has become a cause for fear and has been a major topic of concern. All forms of life including plants and animals depend on air for their basic survival. The Indian air quality standard pollutants are indexed in terms of their scale, these air quality indexes indicates the levels of major pollutants on the atmosphere. The main causes associated with air pollution are the burning of fossil fuels, agriculture, exhaust from factories and industries, residential heating, and natural disasters. We collect the data from the Indian government database and start calculating the individual index of the pollutant for every available data points and find their respective AQI for the region. Urbanization is one of the main reasons for air pollution because, increase in the transportation facilities emits more pollutants into the atmosphere and another main reason for air pollution is Industrialization. The prediction involves use of specialized algorithms. By predicting the air quality index, we can backtrack the major pollution causing pollutant and the location affected seriously by the pollutant across India. Some of the other environmental effects of air pollution are haze, eutrophication, and global climate change. By this we can extract various techniques to obtain heavily affected regions on a particular region. PM2.5 refers to tiny particles in the air that reduce visibility and cause the air to appear hazy when levels are elevated. This can be determined based on a data set consisting of daily atmospheric conditions. In present scenario, Indian cities are failing in maintaining the WHO guidelines for monitoring outdoor air pollution for safe levels. The levels of PM10 and PM2.5 are also increased in air and reduced the air quality, results in adverse effect on living beings. This system exploits machine learning models to detect and predict the data set consisting of atmospheric conditions. Air pollution can cause long-term and short-term health effects. It's found that the elderly and young children are more affected by air pollution. The advancement in technology and research,

alternatives to traditional methods have been proposed for evaluation and predications which use of machine learning approaches. Air quality evaluation is an important way to monitor and control air pollution. Air Quality Index(AQI), is used to measure the quality of air. One of the reason why we choose machine learning is to predict air quality index, this ability of adapting of machine learning algorithms. Fine particulate matter (PM2.5) is significant among the pollutant index because it is a big concern to people's health when its level in the air is relatively high. The air quality of a particular city selected by the user and groups it into different categories like good, satisfactory, moderate, poor, very poor, severe based on AQI (Air Quality Index).



A pollution emission from sources such as vehicles and industry is the underlying cause of the greenhouse effect, CO2 emissions are amongst the foremost contributors to the phenomenon. Building a forecasting system, based on the levels of concentration of individual pollutants, that can predict air quality hourly, will make the AQI more flexible and useful for the population’s health. This system exploits machine learning models to detect and predict the levels based on a data set consisting of atmospheric conditions. As the population increases utilization of land has been increased that leads to pollution in other way. Increased consumption of

available resources may lead to destruction for other habitats. To reduce the effects of harmful concentrations with the ability to predict the occurrence of peak values of concentration, various models need to be developed. One challenge in this regard for pollution data is diversity of data that exists. We subsequently identify the accuracy of these models for predication of pollution. Monitoring has become a major job as air pollution has been increasing day by day. Continuous monitoring of air pollution at a place gives us the levels of pollution in that area. Air pollution modeling one can estimate the level of air pollution and assess its impact on environment and human health. Using that information we can take measures or make efforts to reduce the pollution level so that we can breathe in a good quality of air. Air pollution also affects the seasonal rainfall too due to an increase of pollutants in the air. Air pollution plays an important role in health alerts when air pollution levels might exceed the specified levels. Hence, continuous monitoring of the air is necessary. The primary goal is to predict air pollution level in City with the ground data set.

**Methodology:**

1. *Challenges of collecting data and cleaning it*.

Data collection is the most important part of data science from the integrity and correct of data is important to any kind of data work. The criteria that followed for data cleaning are:

* + Validity of data: The data that is obtained should be relevant to the study.
  + Uniformity of data: The data obtained from different resources should ideally be of same type.
  + Consistency: The data collected should have same format.

The data that was used for the study is from govt of India and some of the other 3rd party websites which provide the history of air quality data for different pollutants.

1. *Data analysis process.*

Data analysis is a process of collecting and organizing data to draw helpful conclusions from it. This process of data analysis uses analytical and logical reasoning to gain information from the data.

The objective of data analysis is to find meaning in data so that the derived knowledge can be used to make proper decisions.

Methods of data analysis:

1. Collaborate your needs

Begin to analyze data or drill down into any analysis techniques, it’s crucial to sit down collaboratively with all key, decide on your primary campaign or strategic goals, and gain a true understanding of the types of insights that will best benefit progress or provide with the heights of vision needed to evolve.

1. Establishing questions.

Once core objectives are outlined, consider which questions will need answering to help achieve the mission. Data analysis is the most important data analytics techniques that will shape the very foundations of success.

1. Setting up KPI’s

As the data is ready, started to gather the raw data considering to offer potential value, and established clear-cut questions for insights to answer, a host of key performance indicators (KPIs) that will help track, measure, and [shape progress](https://www.mindtools.com/pages/article/improving-business-processes.htm) in a number of key areas. KPIs are important to both analysis methods in qualitative and quantitative research. KPI is one of the primary methods of analyzing data.

1. *Machine learning* ***algorithms*** *for air quality index prediction:*

**Modelling and analysis**

**Linear regression:**

Linear Regression is an algorithm based on the machine learning are depends on supervised learning which performs a regression task. Depending on independent variables linear regression gives a target prediction value which is most likely used for finding the relationship among variables and forecasting. Depending on the connection among the established and the independent variables, different regression models differ, they are being considered and list of independent variables used.

y = mx+c

In the above expression y indicates labels to data and x indicates the input training data (input parameter). Value of x is used to predict the value of y which gives best fit line for finding the best m and c values during training the model.

c = intercept

m = slope of line

When the best m and c esteems, the best fit line. So when long last utilizing model for expectation, it will foresee the estimation of y for the information estimation of x.

**Random Forest Regressor:**

Random forest consists of a large number of individual decision trees that operate as an ensemble. Each individual tree in the random forest spits out a class prediction and the class with the most votes becomes our model’s prediction. The concept behind random forest is a simple but powerful one.

Need for random forest to perform well are:

1. There must be some actual signal in our features so that models built using those features do better than random guessing.

discretized levels. The process of converting regression tasks to classification tasks is problematic, as it ignores the magnitude of the numeric data and consequently is inaccurate. Other researchers have worked on predicting concentrations of pollutants. It focuses on learning multiple tasks that have commonalities that can improve the efficiency and accuracy of the models. A variety of regularizations can be utilized to enhance the commonalities of the related tasks, including the nuclear norm, spectral norm, Frobenius norm, and so on. However, most of the former machine learning works on air pollutant prediction did not consider the similarities between the models and only focused on improving the model performance for a single task. Therefore, we decided to use meteorological and pollutant data to perform predictions of hourly concentrations on the basis of data models.

**Conclusion:**

The end result of this project will give a complete insight on how the atmosphere was before the pandemic started and the air quality during the pandemic with a detailed pictographic representation on all the pollutants as an individual. This project will also predict the future AQI level by state wise within India using advanced machine learning techniques.

**Future work:**

The current proposed system works on static data, where in the data obtained is from the year 2005 to 2015. The future work would be on streaming data that can actually predict the outcomes of Air Quality Index in real time which can in turn be used to alert people about the air quality in advance so as to prevent from causing health problems.

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