

# Air Quality Database Management System

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## Abstract

There are growing concerns about the Air quality all over the world but in case of India the concerns rise even more as not enough data collection takes place from various locations. This system tries to overcome that problem by effective collection of data and a rating system similar to the 'Relative Strength Index' used commonly in the stock market to identify trends. The identification of the trend will help in comparing data from all station on the same level in spite of the Air quality from two places being in different ranges.

**Keywords**-Air Quality, Pollutants, Rating, Trends.

## Introduction

The world faces a grave danger with rising pollution levels in many third world countries. The situation becomes even grave when not enough data is gathered and some places which are slowly become more and more polluted go unnoticed. Many indexes such as the Air Quality Index, Air pollution index have been created by the WHO and the standards have also been set, but these won't be effective unless there is data from different places being collected frequently. India has much smaller number of stations that measure the pollutant concentration as compared to the United States, Japan and many European countries [6]. India has experienced the most deaths due to air pollutant related diseases in the last decade than any other country in the world and this toll will surely continue to rise because of the negligence and increasing industrialization [7]. With the increase in the amount of data gathered and the number of locations from where the data is being gathered steps needed to be taken to mitigate this danger can be identified by the authorities. The data about the consumption of petroleum products is also collected from all states across India but is never utilized and correlated with the Air quality even though there is an obvious direct relationship.

## Our Contributions

The current System has the below given flaws

- India has just 0.14 station/million person [1] and 216 in total.
- The data for not all pollutants is collected across all stations.
- No utilization of the correlated data of renewable energy and petroleum products.

Our System tries to improve upon this by

- Creating a rating-based system for all available stations to identify the increasing trend of

pollution early.

- Data about the available renewable resources is included to identify states with higher renewable resource but underutilization of the same.
- Data about the consumption of petroleum-based products is collected to identify the states with higher consumption and if possible, replace these products with eco-friendly products.

## Literature Review

Air Quality has been in discussion for several years now. Air Quality has been seen deteriorating at an alarming rate. A lot of analysing techniques have been developed to check for the quality of air. With the increase in number of factories, air quality has gone down at an exponential rate. Air Quality Index is one such technique developed to grade the air quality. These indices are decided differently by each country. This is a more feasible way for common people to get an idea of the air quality of cities. "The air quality index has shown the devastating conditions of metro cities like Delhi. According to the data given by the Central Pollution Control Board; Ministry of Environment, Forest (India)" [1]. This data depicted the increasing levels of NO<sub>x</sub>, SO<sub>2</sub> and PM<sub>2.5</sub> in the city of Bengaluru, Delhi and Chennai from 2015 to 2018. On the basis of the data provided the air quality has been classified as highly polluted, critically polluted, etc. It has become important now to conserve the quality of air. For this each one of us have to contribute our bit. In recent years, the government has tried to demonstrate the quality of air using various indices [2]. The deteriorating quality of air has become fatal in many areas of the country. The average human life has reduced and people living in urban areas are considered to be more prone to lung diseases like lung cancer. The megacities are being choked with the poisonous fumes coming out of the automobiles. A report showed contribution of automobiles towards air pollution was 40 to 80% of the total air pollution [3]. Delhi and Mumbai portray the scenario of city flooded with cars, buses, motorcycles, etc. Rapid development and urbanisation increase the demand of mobility. Thus, the government as well as people will have to come together and work towards attaining a cleaner environment.

There are several websites analysing and comparing the air quality index of major cities. This is easily accessible and quite simple to read [4]. These websites depict the pollutants responsible and categorise the cities that are having very poor quality of air to good quality.

Alternate sources of energy have to be adopted and sustainable development should be brought into practice. Industries should adopt renewable sources of energy which will reduce the burning of fossil fuels. The use of catalyst in fuels and electronic control over exhaust system reduces the poisonous emissions in the air [5]. This would reduce the pollution caused by the automobiles.

Thus, there is a need to continuously keep a check on the air quality and using sensors, this can be achieved easily and effectively.

## Proposed Methodology

The data is generated every hour and hence is a time series data. The hourly data is stored in a different table and using the average of all the values of the day the daily concentration of the pollutants is computed. The data is stored in station\_hour and station\_day table respectively. The pollutants are provided a unique id and information about this is stored in the pollutant table. The

same has been done for all the stations, cities and states to keep the consistency across the whole system. The Solar, Biomass, Hydro and Wind tables store the information about the amount of energy produced by the sources respectively. The Petroleum Products such as LPG, Naptha, Lubricants, Bitumen, Petroleum Coke, ATF, SKO, etc. are provided a unique id in the Petroleum Products table. In the Petroleum Product monthly consumption, the amount of Petroleum Products consumed by each state every month is stored.

The Air Quality assessment table uses the concentration of respective pollutants and irrespective of the absolute value of the pollutant measured at the station assigns it a value in the range 0-100 for better comparison of the Air quality at different stations. It works to identify the trend of the concentration of respective pollutants. This need for this can be further understood using the below example.

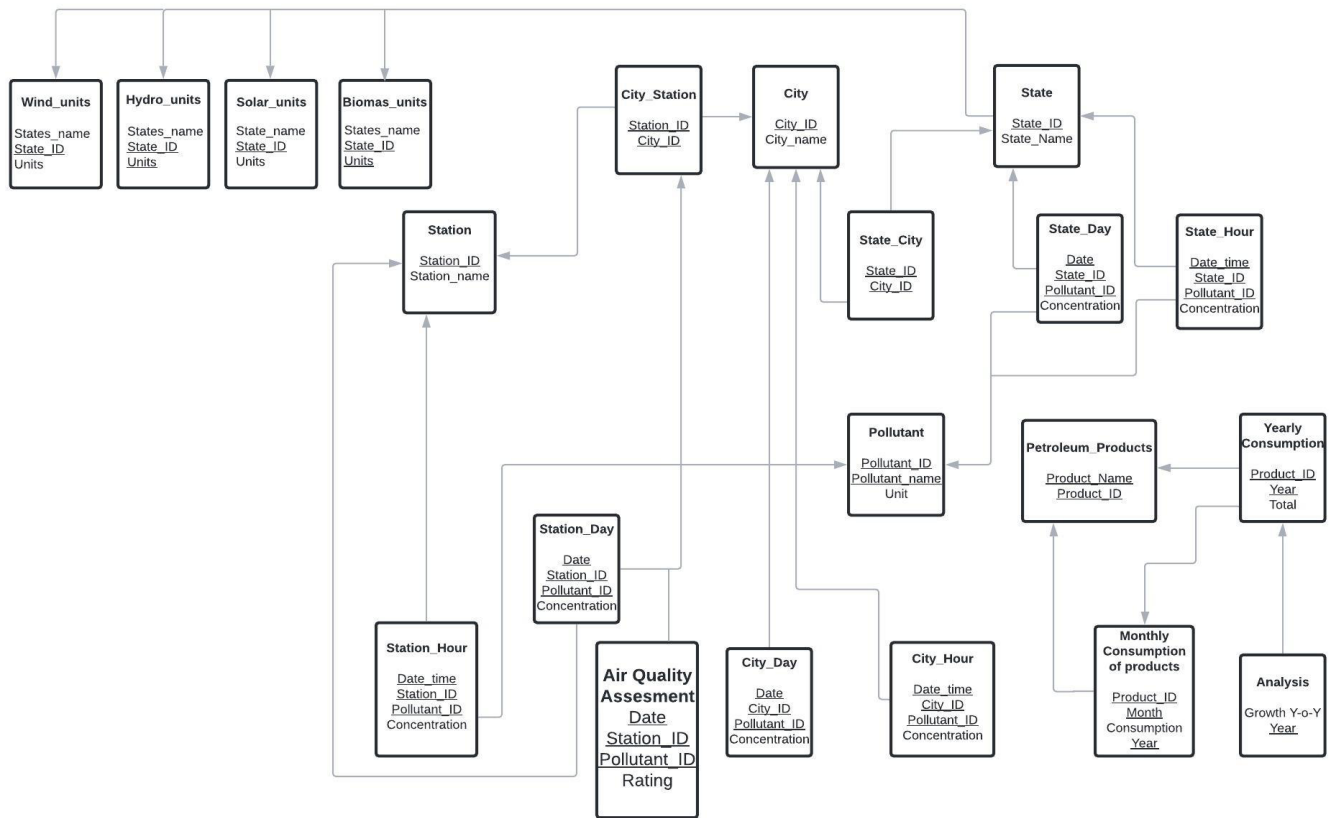
Suppose there are 2 stations that measure the air quality every hour. One of these stations has the concentration of PM2.5 in the range of 400-600 and stays in this range over a longer period of time while the other one in the beginning had concentrations in the range of 50-100 but after a period of time the concentration now is in the range of 150-200. While the absolute concentration of the second station is much less than the first station but the quality of air around the second station has worsened and hence using the system that could be identified and steps can be taken to keep the deteriorating air quality in check.

The method works on the following steps for calculating the rating of any particular day,

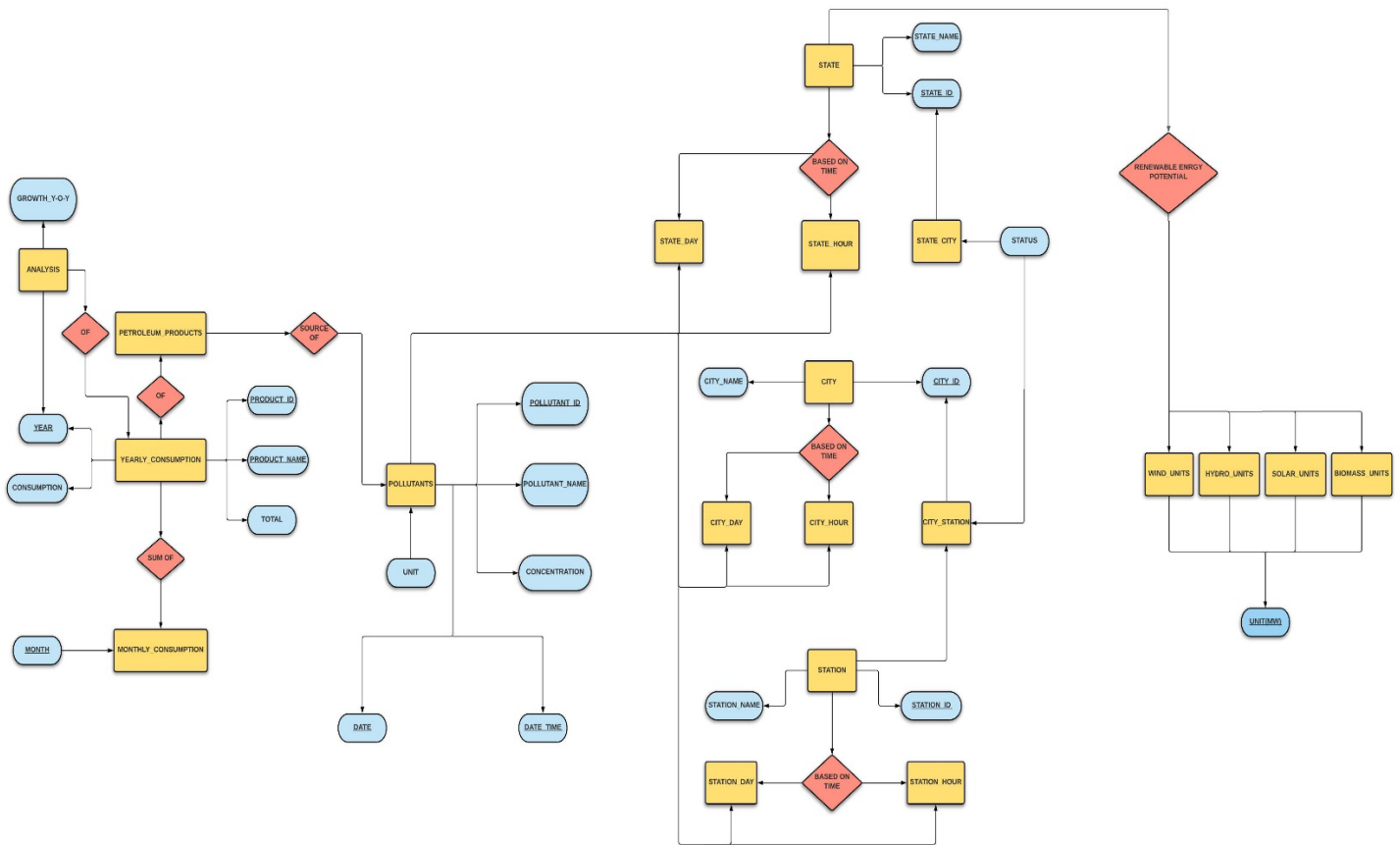
1. Gets the data of the past n number of days.
2. Calculates the ratio of change in concentration of pollutant.
3. Calculates the average of all the increases and average of all the decreases.
4. The rating is calculated using the formula,

$$\text{Rating} = 100 - 100 / (1 + (\text{Average Increase} / \text{Average Decrease}))$$

## Relational Model



## Entity Relationship Model



## Experimental Analysis

FEATURES IN OUR RESEARCH	OUR RESEARCH	RESEARCH PAPER/ LITERATURE-REVIEW/ ARTICLE/ BOOK-1	RESEARCH PAPER/ LITERATURE-REVIEW/ ARTICLE/ BOOK-2	RESEARCH PAPER/ LITERATURE-REVIEW/ ARTICLE/ BOOK-3	RESEARCH PAPER/ LITERATURE-REVIEW/ ARTICLE/ BOOK-4	RESEARCH PAPER/ LITERATURE-REVIEW/ ARTICLE/ BOOK-5
Filtering data of pollutants to only analyze the most influential data.	YES	NO	YES	NO	YES	YES
Data is being collected using optical sensors.	YES	YES	YES	YES	YES	YES
Dashboard to visualize concentration of various pollutants at one glance.	YES	NO	NO	NO	NO	NO
Information about petroleum product usage is used to correlate with air pollution	YES	NO	NO	NO	NO	NO
Data of the potential renewable energy reserves is included to signify the future decrease in Air pollution because of increase in renewable energy usage.	YES	NO	NO	NO	NO	NO

- Like many other works here also the filtering of pollutants' data is done but the pollutants which have major impact have been emphasized. Previously these pollutants were only differentiated on the basis of their types [8] like Ambient Air Pollution (AAP) or Household Air

Pollution (HOAP) but their concentration is what should be monitored properly which is done here to find the most influential pollutant. This way has been used in some studies of air pollution in India [9].

- Optical sensors are used to collect data. These sensors which are placed by the authorities in the region to be monitored collect the data of pollutants and this data can be analyzed.
- Our most unique feature is the real-time dashboard which gets updated on regular basis. It shows the map of India and when we hover on a particular region or state, we can see the concentration of pollutants present in the air at that particular region. This kind of mapping of the data of pollutants at a particular time or year has been done previously [13] but the data at a particular instant of time was studied and not the one which gets updated on regular instant of time. We can find the trends of the pollution causing pollutants with the help of this dashboard.
- Here, data of the potential renewable energy reserves is included to signify the future decrease in Air pollution because of increase in renewable energy usage. Air pollution is mostly caused by those resources which are non-renewable. So, the data of the potential renewable resources is collected which can take the place of the non-renewable resources and the air pollution can be controlled. Those non-renewable resources which have a major role in causing air pollution can be separated and then according to the availability and cost alternate renewable resources can be used instead. In such way the pollution causing resources can be minimized. This is also one of the unique features of our research.
- The petroleum products are one of the major causes of air pollution. So, the data of the amount of petroleum products purchased by the states can be collected as the amount of pollution which they can cause can be known through this. Accordingly, their usage can be monitored by the concerned authorities. These petroleum products are monitored previously but only on the basis of their usage.[10] [9]

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