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Air Pollution Hotspot Detection using Machine Learning

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Abstract: *The air pollution rates now a days are drastically increasing in all the developed and the developing countries which requires a more portable and cost-effective solution. The proposed system includes the design for monitoring air pollution and creating awareness among the public. The proposed system is installed in a particular locality where there is acute air pollution. The level of each hazardous pollutant is monitored at periodic intervals. The Air Quality Index (AQI) for the observed pollutants is determined and awareness is created among the public through an android app which displays the level of each observed pollutant and also the air quality index in that particular location. Thus, the quality of air in that area can be understood by the public by viewing the concentration of the gases in both numerical and graphical format. Further this system is to be extended in future by allowing the public to register themselves in an app which pushes weekly or monthly air quality report through message which reaches the user as a notification that is more comfortable in access..*

Keywords: Hotspot detection, Linear Regression, XML, Android

I. INTRODUCTION

Air pollution is the worst environmental problem and it causes a multitude of adverse effects on human health, water bodies and climate. The main source of air pollution in all major cities is due to vehicles and the second major source remain the industries. The massive use of vehicles has resulted in vital increase of toxins in the atmosphere. This is the cause of environmental pollution affecting the human health. It has also resulted in other respiratory problems like asthma attacks and skin rashes.

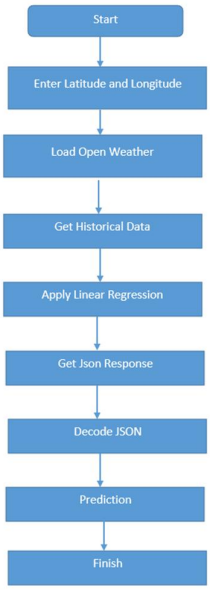

Fig 1: Flowchart of Hotspot Detection System.

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The Central Pollution control board has set a standard to these levels but the public is reluctant to follow them. The pollutants which spoil the air are invisible which has led to the negligence of the people. So, public acknowledgement is the prime requisite of today. Hence the proposed system solves this major issue. The air pollution monitoring system is installed in a particular locality where there are traces of acute air pollution to detect the constituent gases of air which may lead to harmful effects on human health and other living beings. This app uses data from API to predict the level of various harmful gases like NO, No2, O3, NH3, SO2. The previous products did not have an advantage of getting the pollution rates up to date. So, to overcome this, an android app is used, which the public can install it to get regular updates on the quality of air in the area they live. The measured air quality level is also displayed in android application which helps the users in getting updates about the current air quality. Users are able to view the air quality level in numerical format. In addition, the Air Quality Index (AQI) for the current pollution level is determined and displayed in the application. Thus, this application lets the users to take effective measures in advance to protect themselves from harmful effect. The below fig 1. represents the flow of hotspot detection.

II. Literature Survey

The major cause of air pollution in cities is due to vehicles. Vehicular pollution leads to a vital increase in the emission of loads of myriad toxins into the environment. The commercial systems available in the market are devices that use the semiconductor sensors at the smoke emission outlets of vehicles and this system detects the pollutant levels and also indicates this level to the owner of the vehicle with a meter. When the pollution level increases beyond a particular threshold level, an alarm will start ringing in the vehicle to indicate that the limit has been attained and the vehicle will automatically stop running after certain time. This type of individual usage system does not help the public to get into an awareness zone. Bharat stage emission standards are the emission standards set by the Indian Government to regulate air pollutants from internal combustion engines in motor vehicles. Also, over the years, several regulations have been made by the Government to regulate and reduce the emission from vehicles but in vain. Also, other cost-effective measures were introduced to control the air pollution by calculating the levels of each and every pollutant. Based on the observed values, the air quality index for that region is calculated and the values are made available through a web page. But the main disadvantage of this system is that users are not provided with a portable application to view pollution levels then and there and also a pictorial format is missing for easy view. The real time air pollution monitoring system was developed which measures the levels of almost all the pollutants with good accuracy.

III. System Architecture

We are creating an app that will help a person to find what kind of harmful gases he/she is inhaling. Here we take predictions from API and evaluate the data using algorithms like Linear Regression.

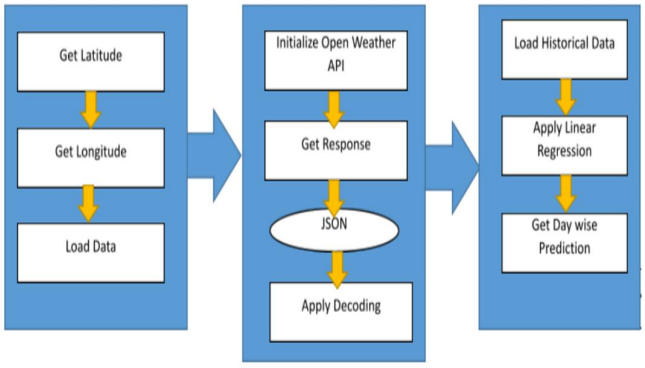

Fig 2: System Architecture of hotspot detection system.

The users can install an android application through which they get the recent updates and graphical content up to date. Then certain time control is assigned based on the standard level of each gas measured and the result can be viewed in android application. The architecture of the air pollution monitoring and awareness creation system in the figure

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architecture for hotspot detection. The concentration level of each gas can be viewed both as a graph and in numerical format. Based on these values the air quality index value is calculated and the nature of the air quality in that area is determined which is also displayed through the app. Additionally, they could also get to know the temperature and weather in that region. The users will not get disturbed with irrelevant data as the values displayed are location specific and help them stay tuned to the current status of air pollution.

IV. OBJECTIVE

The paper aims at designing an air pollution monitoring app which can be installed in an android device and to enhance the app from the previously developed apps beating the earlier disadvantages by developing an android app available for the public. This app can be used by anyone to get live updates about the pollution in their region. It depicts the level of individual gases like NO, No2, O3, NH3, SO2 which measures the concentration of each gas separately.

V. METHODOLOGIES

5.1 Linear Regression Algorithm

Linear regression coined by 'Francis Galton' is defined as the statistical approach that analyzes the linear relationship between a dependent variable and a given set of independent variables. Linear relationship between variables is defined as a graphical representation in which when the value of one or more independent variables will change (increase or decrease), the value of dependent variable will also change accordingly (increase or decrease). This app is developed using a machine learning algorithm I.e., Linear Regression. The proposed system uses the algorithm to train the datasets for further predictions.

5.2 Air Quality Index

Air Quality Index (AQI) is a unit of measurement used to find the quality of air by governmental agencies. It divides the air quality into different categories and tag their levels depending on the number of pollutants present in air. Every country has their own way to calculate AQI so, it becomes harder to create a proper sketch. Here, we are considering USA methods which are considered the most efficient ones.

AQI Values	Levels of Health Concern	1h Average NO_2 Concentration ($\mu g/m^3$)
0 – 50	Good	0 – 53
51 – 100	Moderate	54 – 100
101 – 150	Unhealthy for Sensitive Groups	101 – 360
151 – 200	Unhealthy	361 – 649
201 – 300	Very Unhealthy	650 – 1249
301 - 500	Hazardous	1250 – 2049

Table 1: Categories of AQI, which values and what they mean with respect to health concern using the United States means of measurement and showcasing examples of NO2 concentration for each level (Adapted from the US EPA).

VI. BENEFITS

1. The Air quality standard devised by CPCB, WHO, OSHA or Govt. of India helps us to determine air quality data of an area.
2. The data displayed by the app would help us to determine polluted areas, level of pollution and AQI.
3. This app would help us to determine whether the government programmes for pollution control are working efficiently or not.
4. This app will make the users aware of any health-related issues caused due to the air pollution in their localities.
5. 5. After collecting the data, proper measures can be taken to control the pollution and take care of the environment and living organisms.

VII. FUTURE SCOPE

1. The architecture proposed in the app will help in analyzing the air quality index for particular locality in the real time as well as for future.

2. There will be an option to select a particular area or a place in the future.

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VIII. RESULT AND CONCLUSION

The air quality monitoring app depicts various gases present in the atmosphere displayed on the android app thus making the public get easy access to the pollution level in their area. This app can be accessed by anyone with an android phone to get updates about AQI in their or any other locality. The below Fig 3, shows the login page of the app.

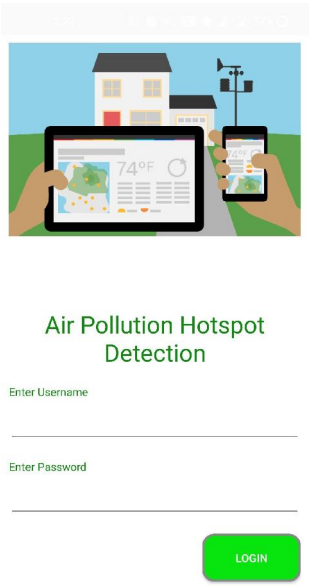

Fig 4: Login page of the application.

The below Fig. 5 represents the contents of the application.

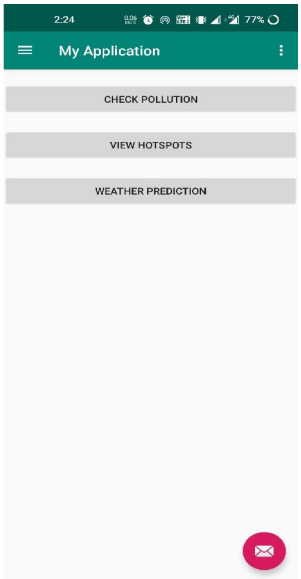

Fig 5: Contents of the application.

The below Fig. 6 represents the pollution of a particular area by taking latitude and longitude as input.

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Fig 6: Details of the Air pollution.

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