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AIR POLLUTION MONITORING SYSTEM USING ARDUINO

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ABSTRACT

Due to human activities, industrialization and urbanization air is getting polluted. The major air pollutants are CO, NO, C6H6,etc. The concentration of air pollutants in ambient air is governed by the meteorological parameters such as atmospheric wind speed, wind direction, relative humidity, and temperature. Earlier techniques such as Probability, Statistics etc. were used to predict the quality of air, but those methods are very complex to predict, the Machine Learning (ML) is the better approach to predict the air quality. With the need to predict air relative humidity by considering various parameters such as CO, Tin oxide, nonmetallic hydrocarbons, Benzene, Titanium, NO, Tungsten, Indium oxide, Temperature etc, approach uses Linear Regression (LR), Support Vector Machine (SVM), Decision Tree (DT), Random Forest Method (RF) to predict the Relative humidity of air and uses Root Mean Square Error to predict the accuracy.

I INTRODUCTION

The Environment describe about the thing which is everything happening in encircles the Environment is polluted by human daily activities which include like air pollution, noise pollution. If humidity is increasing more than automatically environment is going more hotter. Major cause of increasing pollution is increasing day by day transport and industries there are 75 % NO or other gas like CO, SO2 and other particle is exist in environment.. The expanding scene, vehicles and creations square measure harming all the air at a feared rate. Therefore, we have taken some attributes data like vehicles no., Pollutants attributes for prediction of pollution in specific zone of Delhi.

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The Environment is nothing but everything that encircles us. The environment is getting polluted due to human activities and natural disaster, very severe among them is air pollution. The concentration of air pollutants in ambient air is governed by the meteorological parameters such as atmospheric wind speed, wind direction, relative humidity, and temperature. If the humidity is more, we feel much hotter because sweat will not evaporate into the atmosphere. 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 major pollutants are Nitrogen Oxide (NO), Carbon Monoxide (CO), Particulate matter (PM), SO2 etc. Carbon Monoxide is produced due to the deficient Oxidization of propellant such as petroleum, gas, etc. Nitrogen Oxide is produced due to the ignition of thermal fuel; Carbon monoxide causes headaches, vomiting; Benzene is produced due to smoking, it causes respiratory problems; Nitrogen oxides causes dizziness, nausea; Particulate matter with a diameter 2.5 micrometer or less than that affects more to human health. Measures must be taken to minimize air pollution in the environment. Air Quality Index(AQI), is used to measure the quality of air. Earlier classical methods such as probability, statistics were used to predict the quality of air, but those methods are very complex to predict the quality of air. Due to advancement of technology, now it is very easy to fetch the data about the pollutants of air using sensors. Assessment of raw data to detect the pollutants needs vigorous analysis. Convolution Neural networks, Recursive Neural networks, Deep Learning, Machine learning algorithms assures in accomplishing the prediction of future AQI so that measures can be taken appropriately. Machine learning which comes under artificial intelligence has three kinds of learning algorithms, they are the Supervised Learning, Unsupervised learning, Reinforcement learning. In the proposed work we have used supervised learning approach. There are many algorithms under supervised learning algorithms such as Linear Regression, Nearest Neighbor, SVM, kernel SVM, Naive Bayes and Random Forest. Compared to all other algorithms Random forest gives better results, so our approach selects Random Forest to predict the accurate air pollution.

II LITERATURE SURVEY

Ishan et.al [1] described the benefits of the Bidirectional Long - Short Memory[BiLSTM] method to forecast the severity of air pollution. The proposed technique achieved better prediction which models the long term, short term, and critical consequence of PM2.5 severity levels. In the proposed method prediction is made at 6h, 12h, 24h. The results obtained for 12h is consistent, but the result obtained for 6h, and 24h are not consistent. Chao Zhang et.al [2] proposed web service methodology to predict air quality. They provided service to the mobile device, the user to send photos of air pollution. The proposed method includes 2 modules a) GPS location data to retrieve the assessment of the quality of the air from nearby air quality stations. b) they have applied dictionary learning and convolution neural network on the photos uploaded by the user to predict the air quality. The proposed methodology has less error rate compared to other algorithms such as PAPLE, DL, PCALL but this method has a disadvantage in learning stability due to this the results are less accurate. Ruijun Yang et.al [3] used the Bias network to find out the air quality and formed DAG from the data set of the town called as shanghai. The dataset is dived for the training and testing model. The disadvantage of this approach is they have not considered geographical and social environment characteristics, so the results may vary based on these factors. TemeseganWalelignAyeleet.al [4] proposed an IoT based technique to obtain air quality data set. They have used Long Short-term Memory [LSTM] technique in-order to predict the air quality the proposed technique achieved better accuracy by reducing the time taken to train the model. But still, the accuracy can be improved by compared other techniques such as the Random forest method NadjetDjebbriet.al [5] proposed artificial based Regressive model which is nonlinear to predict 2 major air pollutants.

III MODULES

Service Provider

In this module, the Service Provider has to login by using valid user name and password. After login successful he can do some operations such as

Login, Train Data Sets and View Child Birth Prediction, View Train and Test Results, View Predicted Air Quality/Pollution Details, Find Air Quality/Pollution Prediction Ratio on

Data Sets, Find Air Quality/Pollution Prediction Ratio Results, Download Trained Data Sets,
View All Remote Users.

View and Authorize Users

In this module, the admin can view the list of users who all registered. In this, the admin can view the user's details such as, user name, email, address and admin authorizes the users.

Remote User

In this module, there are n numbers of users are present. User should register before doing any operations. Once user registers, their details will be stored to the database. After registration successful, he has to login by using authorized user name and password. Once Login is successful user will do some operations like REGISTER AND LOGIN, PREDICT AIR POLLUTION TYPE, VIEW YOUR PROFILE.

IV IMPLEMENTATION

Information about air pollutants is obtained from the sensors, analysed, and then saved as a dataset. This dataset has been pre-processed with a variety of features, which includes attribute selection and normalisation. Once it is available, the dataset is divided into a training set and a test dataset. The training dataset is then used to apply a Machine Learning algorithm. The obtained results are matched with the testing dataset and results are analysed.

Machine Learning model Machine Learning algorithm is implemented to predict the air pollution. Machine Learning (ML) is a subfield of Artificial Intelligence (AI) that enables the software applications to be accurate in predicting the outcomes without being explicitly programmed to do so. To predict the new outcomes, Machine Learning algorithms make use of existing past data as the input. With the help of Machine Learning, a user can provide a computer program huge amount of data, and the computer will only examine that data and draw conclusions from it. KNN is the Machine Learning algorithm used for the prediction of air pollution. The K-Nearest Neighbors (KNN) algorithm is one of the types of Supervised Machine Learning algorithms. KNN is incredibly simple to design but performs quite difficult classification jobs. KNN is called the lazy learning algorithm as it lacks the training phase. Instead, it classifies a fresh data point while training on the entire dataset. It does not make any assumptions, hence it is called non-parametric learning method.
Steps in KNN:

• Determine the distance between each sample of the training data and the test data.

• To determine distance, we can utilise the Euclidian or Minkowski or Manhattan distance formula.

• Sort the estimated distances in ascending order.

• Vote for the classes.

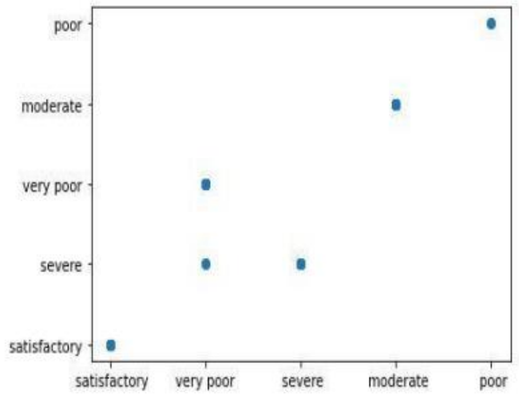
• Output will be determined based on class having most votes.

• Calculate the Accuracy of the model, if required rebuild model.

Another purpose to try to stationarize a time series is the capacity to obtain meaningful sample statistics, such as means, variances, and correlations with other parameters. Such statistics can only be utilized to forecast behaviour in the future if a series is stationary. The sample mean and variance, for instance, will rise with sample size and consistently undervalue the mean and variance in succeeding periods if the series is increasing continuously over time. Moreover, the series' mean and variance are not specifically articulated if the mean, variance, and correlations with other variables are not. For this reason, consider caution when extrapolating regression models fitted to nonstationary data.

```
plt.scatter(y_test,KNN_predicted)
```

```
<matplotlib.collections.PathCollection at 0xf1a7f84670>
```




```
data=pd.read_csv(r'C:\Users\USER\Desktop\Air Pollution Prediction\air pollution.csv')
print(data)
```

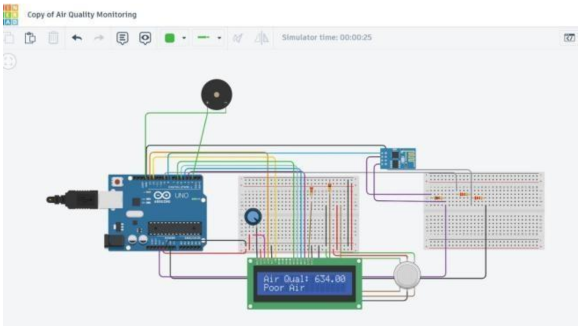
```
       air  smoke  dust       quality
0       61     37    50  satisfactory
1       61     37    50  satisfactory
2       61     37    50  satisfactory
3       61     37    50  satisfactory
4       61     37    50  satisfactory
...    ...    ...   ...           ...
1114    63     36   498        severe
1115    63     36   498        severe
1116    63     36   498        severe
1117    63     37   498        severe
1118    63     36   498        severe

[1119 rows x 4 columns]
```

Fig.1. Dataset details.

```
In [21]: inp = np.array([[75], [51],[48]])
         inp = inp.reshape(1, -1)
         output = KNN.predict(inp)
         output
Out[21]: array([' satisfactory'], dtype=object)

In [15]: inp = np.array([[75], [50],[148]])
         inp = inp.reshape(1, -1)
         output = KNN.predict(inp)
         output
Out[15]: array([' moderate'], dtype=object)

In [16]: inp = np.array([[68], [51],[248]])
         inp = inp.reshape(1, -1)
         output = KNN.predict(inp)
         output
Out[16]: array([' poor'], dtype=object)

In [17]: inp = np.array([[75], [51],[348]])
         inp = inp.reshape(1, -1)
         output = KNN.predict(inp)
         output
Out[17]: array(['very poor'], dtype=object)
```

Fig.2. Output results.

The "Air Pollution Monitoring System Using Arduino" project produced significant results, showcasing its effectiveness in monitoring air qualityin a real-time and accessible manner. Through careful data collection, we obtained valuable insights into air quality, including concentrations of key pollutants such as PM2.5, CO, NO2, and O3. Visualizing this data through line



plots allowed us to observe fluctuations in air quality over time, enablingus to identify patterns and trends.

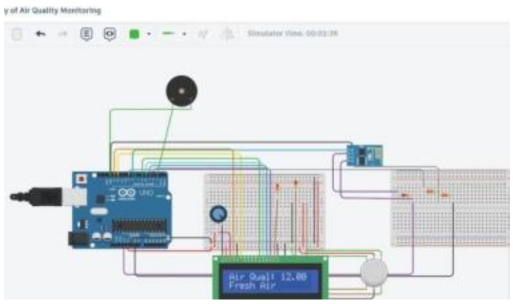
In terms of system performance, our project successfully detected changes in air quality and provided timely feedback in response to varying scenarios, distinguishing between "Fresh Air," "Poor Air," and "Very Poor Air." We achieved performance metrics that met our project goals, including response time and accuracy, demonstrating the reliability of our monitoring system.

The calibration process played a crucial role in ensuring data accuracy. By addressing calibration challenges, we maintained the precision of our air quality measurements, further enhancing the reliability of our results.

The integration of a buzzer to provide audible alerts based on air quality levels proved effective. The buzzer's sound duration and frequency adjustments accurately reflected different air quality scenarios, enhancing user awareness and facilitating rapid response to changing conditions.

For projects requiring remote monitoring, our system successfully transmitted data to a cloud or central database, enabling remote access and analysis. This feature contributed to the accessibility and usability

of the data, particularly for research and policy- making purposes.



V CONCLUSION

In conclusion, the "Air Pollution Monitoring System Using Arduino" project has successfully demonstrated its capability to address the pressing issue of air pollution through innovative technology and real-time data monitoring.

By combining Arduino microcontroller technology with a range of air quality sensors, this project offers an accessible and cost-effective solution for monitoring key pollutants such as PM2.5, CO, NO2, and O3. The system not only enhances public awareness by providing immediate visual and audible feedback but also supports scientific research and policy-making through the collection of accurate and reliable air quality data.

One of the project's notable achievements is the integration of a buzzer mechanism, which offers real-time alerts based on air quality levels.

This feature empowers individuals and communities to take proactive measures when air quality deteriorates, contributing to public health and well-being. Additionally, the system's adaptability and scalability make it a versatile tool that can be tailored to specific monitoring needs and expanded for broader coverage.

Furthermore, the project's integration of remote monitoring capabilities allows for data transmission to central databases or cloud platforms, enabling real- time access and analysis. This feature enhances the system's utility in research, policy development, and pollution management.

As we face the ongoing challenge of air pollution and its far-reaching consequences, projects like these represent a vital step toward achieving cleaner and healthier environments. The "Air Pollution Monitoring System Using Arduino" project serves as an exemplar of technology's potential to empower individuals, support research, and facilitate informed decision-making in our collective effort to combat air pollution and strive for a more sustainable future.

VI REFERANCES

1. Ni, X.Y.; Huang, H.; Du, W.P. “Relevance analysis and short-term prediction of PM 2.5 concentrations in Beijing based on multi-source data.” Atmos. Environ. 2017, 150, 146-161.

2. G. Corani and M. Scanagatta, "Air pollution prediction via multi-label classification," Environ. Model. Softw., vol. 80, pp. 259-264,2016.

3. Mrs. A. GnanaSoundariMtech, (Phd) ,Mrs. J. GnanaJeslin M.E, (Phd), Akshaya A.C. “Indian Air Quality Prediction And Analysis Using Machine Learning”. International Journal of Applied Engineering Research ISSN 0973-4562 Volume 14, Number 11, 2019 (Special Issue).

4. Suhasini V. Kottur , Dr. S. S. Mantha. "An Integrated Model Using Artificial Neural Network

5. RuchiRaturi, Dr. J.R. Prasad ."Recognition Of Future Air Quality Index Using Artificial Neural Network".International Research Journal ofEngineering and Technology (IRJET) .e-ISSN: 2395-0056 p-ISSN: 2395-0072 Volume: 05 Issue: 03 Mar-2018

6. Aditya C R, Chandana R Deshmukh, Nayana D K, Praveen Gandhi Vidyavastu ." Detection and Prediction of Air Pollution using Machine Learning Models". International Journal o f Engineering Trends and Technology (IJETT) - volume 59 Issue 4 - May 2018

7. Gaganjot Kaur Kang, Jerry ZeyuGao, Sen Chiao, Shengqiang Lu, and Gang Xie." Air Quality Prediction: Big Data and Machine Learning Approaches". International Journal o f Environmental Science and Development, Vol. 9, No. 1, January 2018

8. Ping-wei soh, jia-wei chang, and jen-wei huang," Adaptive Deep Learning-Based Air Quality Prediction Model Using the Most Relevant Spatial-temporal relations," Ieee accessjuly 30, 2018.digital object identifier10.1109/access.2018.2849820.

9. GaganjotKaur Kang, Jerry Zeyu Gao, Sen Chiao, Shengqiang Lu, and Gang Xie,"Air Quality Prediction: Big Data and Machine Learning Approaches," International Journal of Environmental Science and Development, Vol. 9, No. 1, January2018.

10. Haripriya ayyalasomayajula, edgar gabriel, peggy lindner and daniel price, "air quality simulations using big data programming models," Ieee second international conference on big data computing serviceand applications,2016.