A Review on Air Pollution Control Using Computer Technology

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Abstract- *An important environmental problem that harms both the ecosystem and human health is air pollution. The use of computer technology is one of the potential techniques to controlling air pollution, among the many strategies that have been suggested and put into practice. This review study seeks to give a thorough overview of several computer-based technologies, such as monitoring, modeling, and prediction, that may be utilized for air pollution control. The potential of computer technology in reducing air pollution is then covered, including how sensors, machine learning algorithms, and unmanned aerial vehicles (UAVs) may be used to check the quality of the air. The many types of air quality monitoring sensors, such as particulate matter sensors, gas sensors, and meteorological sensors, are thoroughly discussed in the study.*

Keywords- Air Pollution, Computer Technology, Monitoring Network, Modeling, Methodology, Prediction Model.

I. INTRODUCTION

According to estimates from the World Health Organization (WHO), air pollution globally contributes to seven million premature deaths per year. Several approaches have been proposed and put into practice to minimize air pollution, including legislation and regulations, technological advancements, and more public participation. One of the most promising methods for lowering air pollution is using computer technology. Recently, researchers have looked into several methods for using computer technology to control air pollution, including monitoring, modeling, and prediction.

The objective of this paper is to provide a comprehensive overview of the existing computer- based air pollution management technologies. We begin by outlining the numerous pollutants, their sources, and how they impact both human health and the ecology. Some potential computer technology applications for lowering air pollution include the use of sensors, machine learning algorithms, and unmanned aerial vehicles (UAVs) for air quality monitoring. We also stress the need of raising public awareness and engagement in campaigns to decrease air pollution, as well as the potential use of mobile applications in this regard. The various types of air quality monitoring sensors, including particulate matter sensors, gas sensors, and meteorological sensors, are thoroughly described in the article. We also go into the usage of machine learning methods for forecasting and modeling air quality.

II. SOURCES AND EFFECTS OF AIR POLLUTION

Burning of fossil fuels and emissions

Burning fossil fuels contributes significantly to air pollution. Examples of fossil fuels that are used to generate energy, power vehicles, and heat buildings include coal, oil, and natural gas. These fuels burn, spewing harmful pollutants into the environment such carbon dioxide, Sulphur dioxide, nitrogen oxides, and particulate matter. The tiny particles pose a serious hazard to human health since they can enter the bloodstream and lungs and cause serious respiratory problems including bronchitis and cardiovascular illnesses.

Use of Air Conditioners

A proportionate increase in power usage brought on by the increased use of air conditioners leads to an increase in the dependency on fossil fuels for supplying energy. Unfortunately, the electrical industry is a major contributor to greenhouse gas emissions. The rise in greenhouse gas emissions is a significant factor in climate change and air pollution, both of which pose a substantial threat to human health. As a result, the increased usage of air conditioners poses a serious threat to public health and contributes to air pollution.

Vehicular Pollution

Airborne pollutants are produced by vehicles, which significantly contributes to environmental deterioration and has detrimental effects on public health. There are a number of strategies that can be used to reduce vehicular pollution, such as enhancing vehicle technology to reduce emissions, encouraging the use of electric and hybrid vehicles, enacting stricter emissions standards and regulations, and promoting

the use of active transportation options like biking and walking. Vehicle maintenance and carpooling are just a few examples of individual behaviors that might help cut down on vehicular pollution. With these initiatives, the damaging impacts of automobile pollution on the environment and human health are to be lessened.[3][6]

III. TECHNOLOGY TO DETECT AIR POLLUTION

Network Monitoring

It was stated to be a GPRS-equipped wireless distributed mobile air pollution monitoring system. As wireless communication and sensor technology advance, the paradigm for monitoring air pollution is rapidly changing. The internet of things (IoT) enables communication and collaboration among objects in a smart environment. Multiple improvements have been made to the air pollution monitoring systems now in use. [1]

Frequency And Parameters Monitored

Three air pollutants have been recognized under N.A.M.P. for regular monitoring at all locations: Sulphur dioxide (SO2), nitrogen dioxides (NO2), and respirable suspended particulate matter (dust, matters) (RSPM/PM10). Along with monitoring air quality, meteorological indicators including temperature, relative humidity, and wind speed and direction were also tracked. To have 104 observations every year, the monitoring of pollutants is done twice a week for a total of 24 hours (4 hours for gaseous pollutants and 8 hours for particulate matter).

Number Of Monitoring Stations

In the country's 28 states and 7 Union Territories, there are 883 operational stations spread over 379 cities and towns.[7]

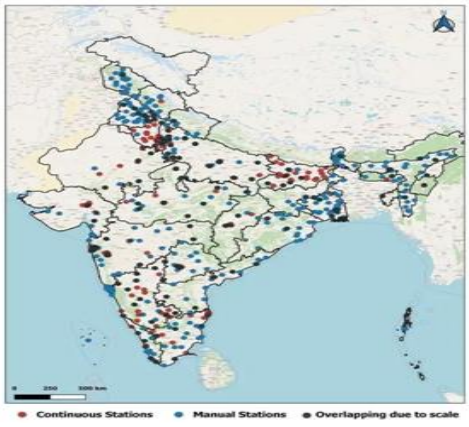

Fig. 1 Tentative geolocations of Manual stations (blue) and CAAQMS (red) across India[2]

Systems for continuously assessing the qualityof the ambient air (CAAQMS):

The Continuous Ambient Air Quality Monitoring System (CAAQMS), a sophisticated air quality monitoring system, is used to measure the concentration of various pollutants in the air. The CAAQMS network of air quality monitoring stations is equipped with state-of-the-art technology to measure air quality indicators in real-time. The device can detect ozone (O3), carbon monoxide (CO), Sulphur dioxide (SO2), nitrogen oxides (NOx), and together with other contaminants, particulate matter (PM2.5 and PM10). A central server receives the data from the repeated measurements and processes it before storing it.

There are several advantages when comparing the CAAQMS system to conventional air quality monitoring techniques. First of all, it provides decision-makers with access to up-to-date information on air quality, enabling them to act quickly to avoid pollution when it becomes an issue.[4]

Modeling Air Quality

The mathematical simulation of how air pollutants scatter in the surrounding environment is known as "air pollution modeling," or "air pollution dispersion modeling". The mathematical equations and techniques used to simulate the dispersal of pollutants are solved by computer programmers called dispersion models. Dispersion models are used to assess or forecast the concentration of air pollutants that will be produced downstream from emission sources such as industrial facilities and vehicular traffic.

For governmental organizations tasked with maintaining and protecting ambient air quality, these models are essential.

Additionally, according to Sharma et al. (2005), the models contribute to the development of effective management strategies that reduce emissions of harmful air pollutants. [8]

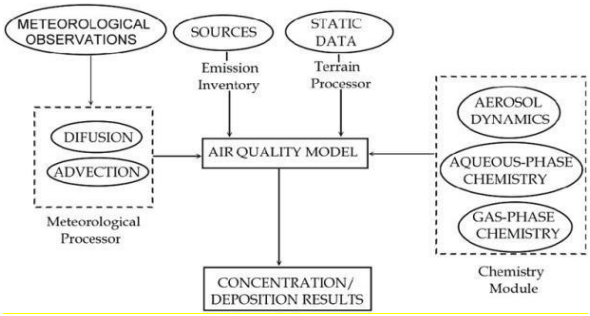

Fig 2 Air Quality Model[9]

Methodology

A 16 by 2 LCD screen, an Arduino Uno microprocessor, a Wi-Fi module 8266, and a MQ135 Gas Sensor were used to build the model. The measured environmental factors made up the top layer. The second tier involved investigating the characteristics and qualities of the sensors. The third layer included decision-making, detection, measurement, threshold valve repair, periodicity of sensitivity, time, and space. The fourth layer was for acquiring sensor data. The fifth layer was the environment with ambient intelligence. The sensor collected data when it was being operated by the microcontroller, then utilized the Wi-Fi module to send it over the internet for analysis.

Users may use their cellphones to monitor the metrics that were measured.[1]

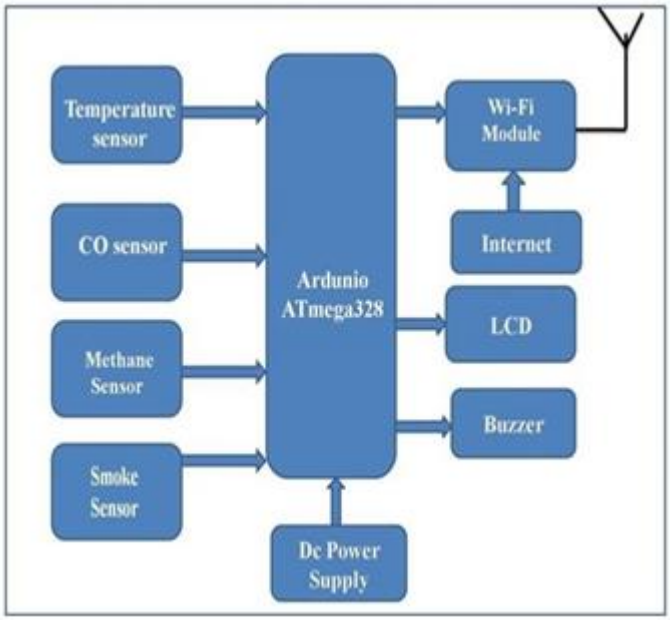

Fig 3 Block Diagram of the Proposed Air Pollution Measuring System[5]

Prediction Model

System Analysis

Fine material is a potentially important substance because it poses a substantial hazard to human health when its concentration in the air is rather high.

It makes reference to minute airborne particles that, at large concentrations, limit visibility and give the impression that the air is foggy. The recommended method, on the other hand, computes the air quality index of all pollutants using the AQI equations, and then employs gradient descent and Box-

Plot analysis to assess the degree of air quality in a specific city. It is feasible to predict the air quality index for the upcoming years under the proposed system using the present AQI values.

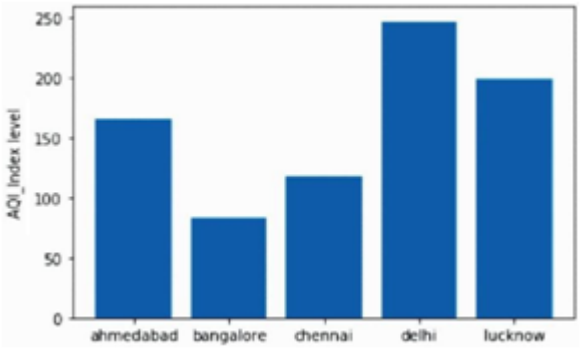

Fig 4 Average value of AQI(2015-2019)
Air quality index

Back Propagation

In artificial neural networks, back propagation is a technique used to determine the number of loads to be employed in the network and the inclination that is required. Back propagation, sometimes referred to as "the retrogressive proliferation of errors," is the process by which defects are handled at the yield and then appropriated backward through the system's layers. It is commonly employed to build sophisticated neural networks. Back spread is a generalization of the delta guideline to multi-layered feed forward systems, which uses the chain concept to repeatedly register angles for each layer. It obviously relates to the Gauss-Newton calculation and is a part of ongoing research on neural back spread.[10]

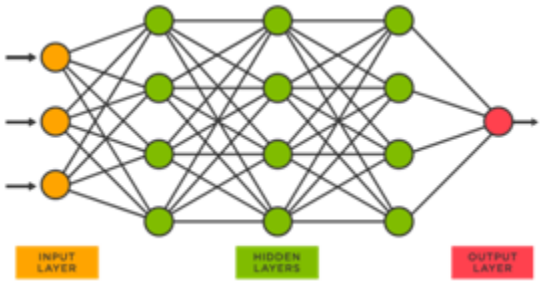

Fig 5 Neural networks [11]

IV. CONCLUSION

The Review offers a thorough analysis of several computer-based air pollution management systems, such as monitoring, methodology, modeling, and prediction. A viable strategy for reducing the harmful effects of air pollution on both human health and the environment is the use of computer technology. According to the reviewed literature, computer-

based technologies like artificial intelligence, machine learning, and simulation models can help with forecasting and analyzing the causes and effects of air pollutants, maximizing pollution control measures, and improving decision-making processes. To fully realize the promise of computer technology in air pollution management, further research and development are still required. Furthermore, it is critical to make sure that these technologies are available, inexpensive, and easy to use for a larger variety of stakeholders, particularly in developing nations where air pollution is a major issue. Overall, the studied literature points to the potential importance of computer technology in tackling the worldwide problem of air pollution and promoting sustainable development objectives.

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