Review of Air Quality Estimating and Monitoring Mechanism

Shirish pandey[1]   S. Hasan Saeed[2]   N.R.Kidwai[3]

[1]Research Scholar Dept of ECE, Integral University Lucknow (U.P.), India,

[2] Dept of ECE, Integral University Lucknow (U.P.), India,

[3] Dept. of ECE, Integral University Lucknow (U.P.), India.

Abstract:

Air pollution is one of the most important environmental issues, pollution is as a result of each natural and man-made assets. Major assets of air pollutants include industries, automobiles, home etc. In polluted locations a continuous monitoring of the Air Quality to degree pollution concentrations to reduce viable terrible effects in the population health is necessary. The impact of air pollution is even more substantial in emerging economies, consisting of China and India. Moreover, the lack of a right air quality monitoring device can positioned the population's health at danger, worsening the impact of the air pollution considering the fact that most people aren't conscious that they are breathing hazardous materials in a polluted environment. This article covers a detailed literature review compiled after survey of various research works going on in recent decades related to efforts made in direction of detection and monitoring of air quality to reduce the impact of pollution due to toxic gases.

Keywords: Aerosol, Exacerbation, Particulate Matter

I. Introduction:

Now a day, the air exceptional deteriorates each day with the improvement of enterprise, specifically in developing locations. The clouds, fogs, haze, dust from unburned fuels in the enterprise and nearby the industry are concrete examples of pollution. The aerosol is dispersed through solid or liquid small particles with a size of one to one hundred nm and is suspended in a colloidal dispersion formed in a gaseous medium. Among them, the haze, lots of very fine dry dirt debris floating in the air, will have critical damage to the human respiration system. Therefore, estimating the air pollutants level is a meaningful and traumatic work. Studies have proven that air pollution has a right away impact on human being's health. The World Health Organization (WHO) expected that 23% of all deaths globally in 2002 were caused by environmental factors [1].World Health Organization (WHO) has additionally indicated that exposure to air pollutants is one of the main threat factors for mortality that is linked to around 7 million deaths in 2012 [2-4]. The results of air pollution on fitness range from subtle signs to more crucial contamination, consisting of shortness of breath, coughing, and aggravation of asthma. Exposure to air pollution is also a first-rate chance element for persistent cardiac and breathing illnesses, including stroke, COPD (Chronic Obstructive Pulmonary Disease) and bronchitis. A special case with great pollution is Salamanca city, Guanajuato. The fundamental causes of pollution in Salamanca are because of fixed emission assets along with Chemical Industry and Electricity Generation, being the most vital pollutants in Air, Sulphur Dioxide (SO2) and Particulate Matter less than 10 micrometers in diameter (PM10). This article makes a specialty of SO2 and Carbon Monoxide (CO) awareness. Although there is already public air pollution tracking stations dispensed throughout predominant cities, these records are insufficient to evaluate the environmental threat for a man or woman in actual-time. Especially for patients who are tormented by persistent respiratory diseases, this information may be important for them to keep away from polluted areas/routes and save you exacerbation or coughing. It has been established, in preceding studies, that frame worn sensors [5-7] can feel physiological hobby data to offer personalized health facts in actual-time. With personalised environmental sensing capability, an incorporated wearable sensor system can assist customers to better understand their surrounding and the capacity environmental influences on their fitness. For this reason improving the pleasant of life inside the long-time period. Work, may be done to make a customisd sensor machine which could display the air high-quality of the encircling environment (e.g. measuring the PM2.5), extract and examine the sensory facts and provide statistics for human beings to assess the ability health

dangers. Particulate matter (PM) is stable or liquid debris located inside the air which includes dust, smoke, dirt, or soot. This debris is available in many styles and sizes and they may be emitted from production, avenue paving smokestacks, fireplace, and so on. Studies have proven that high awareness of PM ought to affect weather and human fitness.

II. Related Work:

There is an opportunity now to shape the future of air quality estimating and monitoring mechanism. **David B. Ramsay et. al., (2018) [1],** recommend for an inclusive, open, dispensed atmosphere that unifies regulatory-grade records with that of cheaper gadgets. This gadget incentivizes transparency and proper information practices. It creates the opportunity for stylish, disbursed air first-class fashions; helps network-driven innovation; and receives actionable records in the hands of individuals who care. This paradigm is not simply the destiny for air first-class, but additionally the future for sensor ecosystems in well-known.

There is a possibility now to form the destiny of air high-quality monitoring the use of the lessons from different industries. They suggested for an inclusive, open, distributed surroundings that unifies regulatory-grade facts with that of extra less expensive gadgets. This machine incentivizes transparency and suitable facts practices, encourages engagement, and hastens studying. It creates the opportunity for sophisticated, allotted air quality models; helps network-driven innovation; and receives actionable information within the fingers of people who care. This paradigm is not just the future for air quality, however also the destiny for sensor ecosystems in well-known. The time is now to create a symphony, now not a cacophony, of air best information. It's an excellent project to provide a first-class-grained and correct air fine monitoring service in city regions restricted to the fee of the professional centers. With the development of semantic web architecture similar to the World Wide Web. It brings new possibility to acquire this goal at low price. However, semantic web architecture are quite special on temporal and spatial distribution, some of this architecture actually have irregular real-time functions, which makes it a hard hassle to use the information accrued from extraordinary gain the equal goal. In this work, we suggest a framework for air first-rate estimation primarily based on multi-supply heterogeneous records accrued from semantic web architecture.

In this work, **Cheng Feng et. Al. (2018) [2],** advised a machine mastering framework which includes multi-source heterogeneous records processing and real-time statistics processing. They attain the high-quality-grained air first-rate estimation based totally on the facts of 5 resources from real world, inclusive of the photograph information provided via the cell phone customers. They divide the information units into 3 sub classifiers primarily based on the temporal and spatial distribution of data. The effects display that the affordable statistics classification can efficaciously enhance the accuracy of the assessment. On the alternative hand, the processing of every sub classifier can be extra flexible. The design of aggregator can efficiently reduce the effect of sparse information on evaluation. [3-4]

Chen, C. C. ET. Al. (2016) [5], indoor air surroundings in Taiwan, formaldehyde awareness remains at a high degree, which is an vital problem affecting indoor air quality, and the formaldehyde issue in scientific building areas is more excessive. The novel formaldehyde sensor based totally on micro electromechanical systems (MEMS), which uses quartz glass as primary material, platinum as micro heater resistance, in addition to warmth sensing layer and Nickel Oxide (NiO) film as a sensing layer. Nickel Oxide (NiO) film changed to form a sensing layer in the approach of sputter deposition. Platinum turned into used as electrode to degree and sense resistance exchange. When there has been formaldehyde fuel within the environment, the electric conductivity at the Nickel Oxide (NiO) film improved, for this reason causing the resistance at the sensing layer to decrease. The sensor displayed the value of formaldehyde awareness. The novel formaldehyde sensor with MEMS was carried out and tested in a big clinical middle (medical area) in southern Taiwan. The formaldehyde awareness in one hundred twenty points in one clinical building was examined. The outcomes confirmed that the indoor formaldehyde concentration changed into among 0.01-2.31 ppm, exceeding the indoor air quality standard .08 ppm.
.

This study evolved a singular formaldehyde sensor based on micro electromechanical systems (MEMS), which makes use of quartz glass as primary material, platinum as micro heater resistance, in addition to a heat sensing layer and Nickel Oxide (NiO) film as a sensing layer. Nickel Oxide (NiO) film becomes used to form a sensing layer inside the approach of sputter deposition. Platinum turned into used as electrode to degree and feel resistance change. When there has been formaldehyde gas inside the environment, the electrical conductivity at the Nickel Oxide (NiO) film expanded, hence causing the resistance on the sensing layer to decrease. The sensor displayed the fee of formaldehyde awareness. [6-7]

The consequences confirmed that the technique can efficiently dissolve indoor formaldehyde. The novel formaldehyde sensor with MEMS can be extensively used to test and improve indoor air quality, and can be blended with smart monitoring systems and clever air conditioning and ventilating device in destiny, to keep indoor air first-class and correctly ventilate the gap. The studies fulfillment can be popularized to industry for immediate utility.

Jian Ma et. Al. (2018), [8] proposed an air pollution estimation method the usage of deep hybrid convolutional neural community from a single photo, e.g., captured by means of a cell phone. The captured photo is entering to the primary community, a very deep network, which solves the side results of expanded intensity (degradation problems) by means of skip connection. This can improve network performance by means of really increasing the depth of the community. Dark channel map is computed and fed right into a secondary network to enrich the functions with implicit representation. They have accrued 1575 pictures of different scenes with extraordinary values of PM2:5 to train the community in the end to-cease fusion mode. Experimental results on synthetic dataset and real captured dataset reveal that our approach achieves brilliant overall performance on class of air pollution levels from a single captured photo.

In this work, they've presented a singular deep novel method for category of pollution tiers based on snap shots. They teach the proposed hybrid convolutional neural community simultaneously the use of RGB pics and dark channel maps, and combine the feature maps ultimately. Their approach is tested with qualitative and quantitative opinions against several today's techniques. Experimental results on both artificial and real captured datasets display that approach has performed the nice type outcomes. Besides, they offer a public dataset which include out of doors pictures and their corresponding PM2:5 values. In the future, greater hazy images with large variety of PM2:5 values from various places may be collected to enhance the type accuracy.

Yue Shan Chang et. Al. (2018), [9], have proposed a semantic ETL (Extract-Transform- Load) framework on cloud platform for Air Quality (AQ) analysis and prediction. They take advantage of ontology to concretize the relationship of PM (Particulate matter) 2.5 from diverse statistics assets and to merge the ones facts with the identical idea but one-of-a-kind naming into the unified database. The computing nodes are used to execute records mining algorithms for predicting Air Quality, and storage modes are used to shop retrieved, preprocessed, and analyzed statistics. They exploit browser to expose the visualized result to illustrate the estimation and prediction. It shows that the large information get admitted to framework at the cloud platform can pertaining well for Air Quality analysis. In the future, more experiments may be conducted using a variety of classification strategies and DNN model to improve the prediction accuracy [10-11].

Ruiz he Zhang, ET. Al. (2017) [12], have shown that air pollution has a poor effect on people's health, in particular for patients with respiration and cardiac diseases (e.g. COPD, allergies, ischemic heart ailment). Although there are already many pollution monitoring stations in most important towns, along with London, these stations are in moderation positioned, and the periodic collection of data is inadequate to offer the granularity had to check the environmental danger for an individual (e.g. to keep away from exacerbation). Wearable devices, alternatively, are extra suitable on this context, imparting a better estimation of the air quality inside the proximity of the character. Therefore, applicable warnings and records on health dangers may be supplied in actual-time. As a evidence of concept, we have advanced a wearable sensor for non-stop tracking of air pleasant around the person, and an initial examine turned into carried out to validate the sensor and check the air best in London underground stations. Based at the PM2.5 (particulate matter with a diameter of 2.5 μm), temperature and place facts, a version is generated for predicting the air quality of each station at exceptional times. Our initial consequences have proven that there are sizable differences in air quality among stations and metro areas. It additionally demonstrates that wearable sensors can offer vital facts for users to make journey preparations that reduce their exposure to polluted air.

In this work, a wearable sensor gadget is evolved to look at the air pollutants impacts on human fitness. Artificial Neural Network is used to estimate the Air Quality and the capacity health impact in London underground stations. The preliminary results display that there may be giant difference in air high-quality at specific time among stations especially due to the variation of the number of passengers in crowded and empty hours. In addition, positive metro lines have surprisingly higher Air Quality than others due to their infrastructural variations. Extent of passengers and the performance in their air flow structures. These consequences demonstrated the idea of customized Air Quality tracking and show the capacity of such

pervasive sensing gadget. By gathering such non-stop data amongst users with a cloud server, correct and real-time air exceptional records may be provided to the users and assist them to better apprehend their surroundings.

M.G. Cortina-Januchs et. Al. (2006) [13] provided a new technique to detect and classify Sulphur Dioxide SO2 attention consistent with the Air Quality Level. In this category, Meteorological Variables are analyzed to make a class decision. The technique includes three steps. In first step, we classify using a Self Organizing MAP (SOM) Neural Networks the pollutant awareness in two groups; these are noise records and verified information. In second step, we create a Representative Feature Vector the use of the information contingency ranges that we recognize a priori. In third step, a new Self Organizing MAP (SOM) Neural Network is trained with the Representative Feature Vector constructed in second step, then the pollutant concentrations and meteorological variables (Validated Data) are self-organized in fourth instructions in keeping with contingency stages. Finally, we obtained the Air Quality Level. Our experiments with this system showcase excellent Classification effects. In this situation a time series obtained from the Environmental Monitoring Network of the Salamanca town, Guanajuato, México is used. The technique furnished true results due to the fact Contingency Levels are regarded, permitting to create a RFV for every level. Thus, less sample are required for training a SOM Neural Network permitting to classified new styles with less computational value. The class blunders depends best at the quantity of statistics, more facts more errors, our method produces errors that are much less than 1%..

 In this work, **Marc Caesar R. Talampas and Kay-Soon Low, (2012) [14],** use maximum chance estimation for figuring out the ground reality fuel awareness in a place by means of fusing facts from co-positioned sensors in a vehicular sensor network(VSN). Through simulations, we show that absolutely the mistakes of the proposed approach have lower mean and standard deviation in comparison with present scenario.

In present work, the maximum likelihood strategy considers that the measured variances of each sensor during primly calibration do not change considerably over time. To enhance the ground truth estimate, an updated measurement of each sensor's variance must be made. The calculation of the updated variance estimation can be made whenever the sensor node experience a fixed ground truth station with which to compare its readings. Each sensor's mean error can also be justified during this time. The simulations conducted also assume that all sensors are available to take part during calibration time and that no correction for sensor drift is performed. For future work, simulations for the case where not all sensors take part in collective calibration and methods for real-time estimation of sensor drift and variance will be searched [15-17]

In this work, **Dem Lee ET. Al., [18] has** shown **that** a rapid growing corrosion testing chamber has been used to produce different corrosive measure for copper and silver compounds. Besides, the weight gain and Coulometric Reduction (CR) methods were also accepted to find corrosive thickness. The measuring results and limitations are explained in this paper. To measure the air quality in different field environments, they also have measured their quality in field environments, including office, data center and soon. The severity levels classification of air quality is followedISA-S71.04 standard and 2011 ASHRAE TC 9.9 Whitepaper. In basic result, corrosion products from air pollutants were successfully measured by CR. The main corrosion products we are copper oxide (CuO and Cu2O), copper sulfurs (Cu2S), silver chlorides (AgCl) and silver sulfurs (AgS). Finally, they find an effective suitable rule base on those evidences to determinate the more accurate failure model and extend the life of the data centers in future.

In this work, **Raoudha Baklouti, et. Al., (2016) [19],** advanced a Wavelet Principle Component Analysis (WPCA) primarily based generalized likelihood ratio test (GLRT) for fault detection of air quality monitoring community (AQMN). The goal of the WPCA-based GLRT is to apply a wavelet transform to similarly decorate the detection overall performance of the principal component analysis (PCA) based totally GLRT method. In the evolved method, PCA model could be built the usage of wavelet remodel at extraordinary scales, after which GLRT will implemented using this version to enhance the fault detection capabilities of the PCA-based totally GLRT fault detection technique. The evolved WPCA-based GLRT method has proven progressed fault detection with lower false alarms quotes, whilst as compared to classical PCA and WPCA techniques.

 In this work **Mikhail G. Grif, Alexander M. Grif   (2018) [20],** proposed an approach for getting real information on urban Air Quality. The city traffic flows based on the regression model built as per satellite navigation data. The modeling of the pollutants distribution from the transport is done by taking into account the topography of the city, 3D-models of the buildings and real meteorological data. The estimation of the stationary source's emissions is carried out by solving the inverse problem using the data from mobile ecometric stations. The detail of the technology's software implementation, as well as the device and component composition of the air pollutants sensor, are given. Studies have proven that the this method of air quality assessment in the city, based on the analysis of city traffic flows in real time, three-dimensional mathematical modelling of the process of spreading pollution taking into account the topography of the city, the actual meteorological information and the use of mobile ecometric stations can show the concentration of pollutants. The technology was implemented by C++, C# and   systems of equations in the work. As a result of the test calculations analysis of the field of pollutants on several model tasks, it was concluded about the adequacy of the mathematical model and its numerical implementation.

III . Result Analysis:

TABLE 1: Quantitative evaluation in terms of percent accuracy

Methods	synthetic dataset	real captured dataset
AlexNet	51.13%	86.75%
VGGNet-19	52.19%	85.00%
ResNet-152	60.00%	91.13%
DenseNet	59.17%	90.11%
Image Net	62.38%	92.19%

IV. Conclusion:

Air pollutants has extreme effect on our daily lifestyles, and a way to quick and without difficulty measure the air quality(pollutants)level with none expensive device is a pretty hard challenge. Air pollution commonly has many resources, including fuel burn, heavy industrial emissions, volcanoes, and so on. This review article focused out severity degrees of air pollutant wealthy in oxides, chlorides and sulfurs can reason excessive harmful effect on human health. After a literature survey of many article it can be concluded that with the more and more extreme environmental pollution, mainly in developing nations, the air high-quality may even immediately or in a roundabout way have an adverse effect on the human life anywhere indoors and outdoors. To ensure the healthy environment surroundings, it is very important to broaden a correct, inexpensive human health friendly technique for the air quality monitoring.
It has been observed that rise in the air pollution is the major problem in developing countries. Pollution has attracted people all over the world due to enhancement of anthropogenic activities. Chemical compounds such as Carbon monoxide (CO), Sulfur Dioxide (SO2) Nitrogen oxide (NO), are formed due to the burning of fossil fuels. Recent study conducted in metropolitan cities which concluded how is rise in pollution harming humans and causing serious health issues. It is important to understand and think of suitable measures to control pollution as condition might become serious in coming years. Pollutants such as CO, SO2, and NO   may leave harmful effect on human health, as cardiovascular and respiratory disease is the results of pollution. A lot of researches are been conducted in India and across the globe to control and find suitable way to get rid of air pollution.

V. Acknowledgement:

References:

[1] David B. Ramsay et. al., "Exploiting New Technology to Dramatically Improve Atmospheric Monitoring", IEEE Pervasive Computing, IEEE Computer Society, volume 18, issue 1268 ,July–September 2018

[2] Cheng Feng et. al., "Air Quality Estimation based on Multi-Source Heterogeneous Data from Wireless Sensor Networks", IEEE Wireless Communications and Networking Conference (WCNC), volume 18, issue 5386, 2018.

[3] K. He, J. Sun, and X. Tang. "Single Image Haze Removal using Dark Channel Prior". IEEE Transactions on Pattern Analysis And Machine Intelligence, Volume 33, Issue 12 PP, 2341–2353 2011.

[4] K. W. Kim and Y. J. Kim. Perceived Visibility Measurement Using The Hsi Color Difference Method. Journal of The Korean Physical Society, Volume 46, Issue 5, PP, 1243–1250, 2005.

[5] Chen, C. C. ET. al., "Application of a Novel Formaldehyde Sensor with Mems (Micro Electro Mechanical Systems) In Indoor Air Quality Test and Improvement in Medical Spaces", Applied Ecology and Environmental Research, volume15, issue2, pp 81-89.

[6] Lee, C.Y., Hsieh, P.R., Lin, C.H., Chou, P.C., Fu, L.M., Chiang, C.M.," Mems-Based Formaldehyde Gas Sensor Integrated With A Micro-Hotplate.", Journal Of Microsystem Technologies .Volume 12,Issue 10 ,PP 893-898, 2006

[7] Molhave, L." Organic Compounds as Indicators of Air Pollution. - Indoor Air", Volume13 Issue 6, PP 12-19, 2003.

[8] Jian Ma et. al., "Image-based Air Pollution Estimation Using Hybrid Convolutional Neural Network", 24th International Conference on Pattern Recognition (ICPR) Beijing, China, August 20-24, issue 2018.

[9] Yue Shan Chang et. al., "Big data platform for air quality analysis and prediction", The 27th Wireless and Optical Communications Conference (WOCC), issue2018.

[10] Srividya K. Bansal, Sebastian Kagemann, "Integrating Big Data: A Semantic Extract- Transform-Load Framework," Computer, Vol. 48, Issue. 3, PP. 42-50, Mar. 2015

[11] Gautam Pant, Filippo Menczer, "MySpiders: Evolve Your Own Intelligent Web Crawlers," Autonomous Agents and Multi-Agent Systems, Vol. 5, Issue 2, PP 221–229, June 2002.

[12] Ruizhe Zhang, et. al., "A Personalized Air Quality Sensing System – A preliminary study on assessing the air quality of London Underground Stations", volume 17, issue5090, IEEE 2017

[13] M.G. Cortina-Januchs et. al., "SO$_2$ classification for air quality levels estimation using artificial intelligent techniques", volume 6, issue 2006, 7-11 November 2006, Guanajuato, México.

[14] Marc Caesar R. Talampas and Kay-Soon Low, "Maximum Likelihood Estimation of Ground Truth for Air Quality Monitoring Using Vehicular Sensor Networks" Tencon ,issue 2012 IEEE

[15] Singapore National Environment Agency, "The Reason We Breathe Easy, "Envision, Vol. 1, PP, 11–13, January 2011.

[16] H. Guo, K. S. Low, And H. A. Nguyen, "Optimizing The Localization Of A Wireless Sensor Network In Real Time Based On A Low-Cost Microcontroller, "Industrial Electronics, IEEE Transactions On, Vol. 58, Issue. 3, Pp.741 –749, March 2011.

[17] H. A. Nguyen, H. Guo, And K.-S. Low, "Real-Time Estimation of Sensor Node's Position Using Particle Swarm Optimization with Log-Barrier Constraint," Instrumentation and Measurement, IEEE Transactions On, Vol. 60, Issue. 11, PP. 3619 –3628, November 2011.

[18] Dem Lee et. al., "A Valid Method to Monitor Gaseous Contamination in Data Centers", IEEE Catalog Number: CFP1559B-ART, ISBN: 978-1-4673-8356-1.

[19] Raoudha Baklouti, et. al., "Fault Detection of an Air Quality Monitoring Network", issue 2017, 17th international conference on Sciences and Techniques of Automatic control &computer.

[20] Mikhail G. Grif, Alexander M. Grif, "Technology for Monitoring Urban Air Quality on The Basis of Satellite Navigation Data, Mobile Ecometric Stations and the Finite Element Method", issue 2018, 14th International Scientific-Technical Conference APEIE 2018