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Smart Technologies for Air Pollution Monitoring System Using WSN

Ms. Harana M. Bodele[1], Dr.G.M.Asutkar[2]

[1]*Research scholar*

PIET ,Nagpur ,India,440019

[2] *Dr. G.M. Asutkar*

V. Principal

PIET, Nagpur, India,440019

Abstract – *Today's major public and environmental issues are air pollution and traffic congestion. The first Air quality joint inter comparison exercise was organised in Aveiro (Portugal) which was focussed on the evaluation and assessment of the environmental gas , particulate matter (PM) and meteorological micro sensors versus standard air quality reference methods. In this paper the review is studied on different hardware and software techniques used for the air pollution monitoring methods using WSN. Due to the advancement in wireless communication wireless sensor networks (WSN)are used in different areas. Here it is focussed basely on the low energy consumption of the PM sensor and other sensors. The parameters which pollute the air are mainly black carbon, particle number concentration, alveolar lung-deposited surface area, mean particle diameter,PM2.10,PM2.5,PM1. Low-cost sensor technology can potentially revolutionise the area of air pollution monitoring and can provide high density spatiotemporal pollution data. Also mathematical and statistical technique for sensor calibration ,fault detection and data quality assurance can help for the low cast air pollution sensor network.*

INTRODUCTION

Wireless Sensor Network is a part of Wireless Network. Wireless Network stands for defining a technology in which two or more systems communicate with each other without wired connection. Wireless Sensor Network consists of many sensors that work to gather information from the real world. sensor need to carry energy in their pocket. A WSN consists of a collection of sensor nodes and a base station (BS) connected through wireless channels with sensing, wireless communications and computational capabilities. The advantages of WSN are ease of deployment, low installation cost, distribution over a wide region and high fault tolerance. The node deployment option affects the performance of routing protocol in terms of energy consumptions. There are three ways in which tiny sensor nodes can be deployed in a WSN environment: Regular Deployment-Sensor nodes can be deployed in a fixed manner and data is routed through a predefined path. once sensor nodes are deployed, WSN performed a specific job. In WSN, energy is a big challenge because nodes are powered by batteries. This energy can be very expensive, difficult or even impossible to renew. So saving energy to maximize network lifetime is one of the critical problems in WSN. In WSN, nodes dissipate energy in processing and transmitting/receiving messages. hierarchical routing or cluster based routing is to efficiently maintain the energy usage of sensor nodes by involving them in multi-hop communication within a particular cluster. The first hierarchical protocol is the Low Energy Adaptive Clustering Hierarchy (LEACH) that was introduced in .Many hierarchical protocols were emerged from LEACH. Degraded air quality is an environmental and health issue affecting citizens around the globe. Although there is significant research and development of microsensors for applications in pollutant monitoring, the interpretation of sensor signals from field campaigns remains limited and challenging.[18]

METHODOLOGY and CONCLUSION

Murat Dener et al. The WSN and Smart other technologies are reviewed in Smart Environment to monitor weather pollution ,radiation levels,electromagnetic levels, advanced lighting systems, noise mapping within the city and waste management. It consist of good agricultural production, environmental protection and new data generation . In the smart grids, it reduced the power and enhanced power management system which monitored and controled the balance between the transfer-distribution and the consumers.[20]. Hirofumi Ohyama et al. retrived lower-tropospheric O3 data from the TANSO-FTS .And TIR spectra were validated with those derived from a tropospheric O3 differential absorption lidar (DIAL) located at Saga, Japan [19],here the DIAL system measured the profiles of O3 from 1 km to 10 km. in day time and up to 20 km in night . then comparison done between the TANSO-FTS and DIAL data, The atmospheric CO column measurements is taken with a ground-based high-resolution FTS within 12 hours. To ensure accurate comparison the DIAL, O3 profiles were smoothed by the TANSO-FTS averaging kernels . The XCO data were calibrated with in situ data from aircraft observations above several TCCON sites, and the uncertainty (2s) of the XCO data was estimated to be 4 ppb [19], The LTOC and the XCO data was retrived from the TIR spectra measured by the TANSO-FTS onboard the GOSAT during the period from April 2009 to July 2015 and from the ground-based high-resolution FTS spectra during the period from July 2011 to July 2015. The TANSO-FTS LTOCs were compared with those derived from the O3 DIAL the mean difference was _2.24 $\pm$ 1.77 DU. mean values of the LTOCs had maximums in June and local minimums in July and November. The monthly mean values of the XCO indicated a broad spring maximum and a broad summer autumn minimum. C. Borrego et al.[19] . The performance of three portable monitors (micro-aethalometer AE51, DiscMini, Dusttrak DRX) was assessed [18] They evaluated the parameters like black carbon, particle number concentration, alveolar lung-deposited surface area, mean particle diameter, PM10, PM2.5 and PM1. and the comparison was done to test the performance with stationary instruments (MAAP, CPC, SMPS, NSAM, GRIMM aerosol spectrometer). Results was good in most portable and stationary instruments, with R2 values having mostly >0.80. Relative difference between portable and stationary instruments was mostly <20%, and <10% between different units of the same instrument. The cluster of ozone, nitrogen dioxide, nitrogen monoxide, carbon monoxide and carbon dioxide sensors was used. For this the sensor used were of metal oxide or electrochemical .[17] They studied wheather the sensors could reach the Data Quality Objective (DQOs) of the European Air Quality Directive for indicative methods (between 25 and 30% of uncertainty for O3 and NO2 . it was found that O3 can be calibrated using simple regression techniques while NO2 a need better agreement between sensors and reference measurements. Here the work accessed wheather carbon monoxide sensors can reach the Data Quality Objective (DQOs) of 25% of uncertainty set in the European Air Quality Directive for indicative methods. Result was found for NO, CO and CO2 that the best agreement between sensors and reference measurements was observed for learning techniques compared to linear and multilinear regression.[9] . Here when operated suitably, CO, NO and NO2 the electrochemical sensors can provide parts-per-billion level mixing ratio sensitivity with low noise and high linearity,making them suitable for urban air quality measurements.[8]. The small, portable gaseous air pollution monitor were used and technologies identified .Then online databases was took for articles containing specific information related to performance, characteristics, and use of the monitors that measure one or more of three criteria gaseous air pollutants: ozone, nitrogen dioxide, and carbon monoxide was studied and comparison between their applications,physical features, sensing capabilities, and costs of the devices done. result found that recent portable monitoring trends are strongly related to associated applications and audiences.. Xiaobing Pang et al. Ozone sensors are used for O3 detection ,these are compact in size, low cost, low power and fast response. Generally O3 sensors use either electrochemical sensors or are based on semiconductor O3 sensors. the performance of electrochemical O3 sensors were investigated in laboratory and ambient air quality monitoring. The result indicated that the miniaturised O3 sensor was a suitable alternative for O3 measurements in both laboratory experiment and air-quality monitoring.[16] The idea of employing sensors in a small space is a common attention from the air quality management community. Effort of scientists and instrument manufacturers have made it possible to reduce the cost of air pollution sensors. Hence at present, the manufacturing cost of these systems does not go high. But technological challenges regarding the use of sensors for air pollution monitoring is to improve their sensitivity, stability and longevity of operation before replacement. Most low cost air pollution sensors are sensitive down to a few hundreds of ppb. but most of the important pollutants concentrations are below this limit, there is a pressing tech to lower these threshold limits . The large amount of data expected to be collected by the sensors is not yet widely available or affordable . The large amount of data is collected by wireless sensor networks has to be routed to a single managing entity and so the network sink, hence the algorithms for data fusion and aggregation are needed to reduce congestion and system overloading .[11] The commercial low-cost sensors are promising, and results showed that some sensors, i.e., NO and PM10, are already capable to offer coarse information about air quality, indicating if the air quality is good ,moderate or if the air is heavily polluted. This type of information can be used for applications which aim to raise the awareness,[12] AIR quality is monitored using a microcontroller and WSN measuring two main gases: Carbone Monoxide (CO) and Liquid Petroleum Gas (LPG). A sample of obtained results from both clean environment and KFU library are shown in table 1 .

Table 1. Clean Air Vs. KFU Library :

		Clean Air	KFU Library
LPG	CO	LPG	CO
2.06	0.03	80.77	1.63
4.41	0.02	85.92	1.87
3.49	0.02	76.59	2.7
2.56	0.04	54.54	4.45
2.2	0.05	49.81	0.68
2.03	0.03	52.55	3.65

2.12	0.02	78.1	0.98
2.12	0.03	68.21	5.94
3.4	0.02	61.71	5.03
4.51	0.02	46.51	1.45
2.21	0.06	96.09	6.04
3.13	0.02	75.38	5.92
2.63	0.03	102.3	4.13

the results showed that there was a big difference in the levels of both gases (LPG and CO) which obtained from the several tests and circuit runs.The acquired results show no risky situation to be considered for further action. WSN provides a real-time information about the level of air pollution in different area also it provide alerts in cases of drastic change in quality of air. This design can be enhanced by adding a wireless network card to the microcontroller circuitry for better and easier control of the sensors readings. Also the circuit can be improved to measure the level of other gases in the air such as Sulfureted Hydrogen (H2S),Ammonia (NH3), Alcohol and many others.[13] Testing the long term stability and the effectiveness of the routing algorithm, several nodes were placed for local temperature and humidity monitoring in wine yards. The downy mildew fungi plasmopara viticola is one of the most problematic infections in wine yards and can conclude in a total loss of wine grapes. The sensor network can help the farmers to detect the regions in which the growth of downy mildew has high probability and makes a local application of fungicides necessary.[14]

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