International Journal of Advance Research in Science and Engineering
Volume No.07, Special Issue No.05, March 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

Real Time Pollution Monitoring Using Wireless Sensor Network

Ashwini Devre[1], Mrunali Gosavi[2], Aishwarya Thakur[3], Bharati Vikhar[4], Prof. Nitin Wankhade[5]

[1,2,3,4,5]*Department of Information Technology*

Nutan Maharashtra Institute of Engineering and Technology, Talegaon, Pune (India)

ABSTRACT

Wireless Sensor Networks are gaining importance in the area of research, mainly of their wide potential applications. Atmospheric contamination in the various elements of air leading to hazardous effects of global warming and acid rains which have become a crucial apprehension for the wellness of the population. An atmosphere pollution monitoring system is extremely important to keep away from such adverse imbalance in nature. In the proposed paper, an attempt is made to develop a real- time pollution monitoring using wireless sensor networks (WSN). With the rapid growth in the industries which are the main sources of air pollutants, the problem of air pollution is becoming a serious concern for the health of the population. The concentration of major air pollutant gases like Carbon dioxide (CO2), Nitrogen dioxide (NO2) and carbon monoxide (CO) from the air are sensed by using the commercially available gas sensors.

Keywords:*Data Aggregation, Light Weight Middleware, Multihop Technique Routing Protocol, Sensor Networks, Sensor Calibration.*

I.INTRODUCTION

Wireless Sensor Network (WSN) is a good research area which is a fast evolving technology and gaining importance due to the number of potential applications. It is an intense wireless network of small, low-priced detectors, which collect and distribute environmental data. With WSNs supervising and controlling of physical environments from remote locations can be acted with improved accuracies [1]. Carbon monoxide is a critical fault characteristic gas dissolved in oil filled power transformers, which can timely and effectively reflect the insulation performance of power transformer insulating paper and paperboard [3].These sensors are capable of data receiving and processing capabilities.

The nodes can measure the conditions of surrounding environments of the sensor network and processes for further work. Such signals when processed notify few results about the object happening in the proximity of the nodes .With the tremendous industrial growth and daily increasing pollution have caused complex and dangerous

consequences like ozone depletion, acid rain, climate change, and because of this it will result in various kinds of diseases like lung cancer, asthma and chronic pulmonary diseases, COPD [5]. This paper employs Wireless Sensor and Actuator Networks (WSANs) for the mentioned purpose. WSANs are ad-hoc networks which comprise numerous nodes (motes) and actuators connected wirelessly together used for the monitoring of remote terrains [1]. An attempt is made to propose and design a system which is economical, consistent, precise and scalable for the real-time pollution monitoring using with WSN. Electrochemical and resistive heating type sensors with proper calibration technologies were used to sense the gases like CO2, CO and NO2.

Air pollution has significant influence on the concentration of constituents in the atmosphere leading to effects like global warming and acid rains. To apply pollution monitoring System to avoid such adverse imbalances in the nature, we proposed sensors based pollution management to reduce the pollution related factors from nature.

II.SYSTEM IMPLEMENTATION

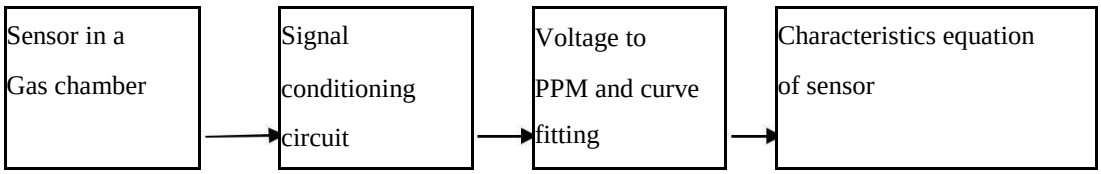

Fig 1: Block diagram of the gas sensor calibration process

Gas sensors are calibrated by exposing them to different concentrations of gas prior for obtaining the most accurate results. Conditioning circuits along with the sensors are positioned in the chamber and readings of regular parts per million (ppm) of the gas are to be noted. Each sensor produces an output voltage equivalent to the concentration of gas and output readings are plotted, calibration equation is obtained to record voltage signals into its equivalent concentrations in ppm. Sensors produce an output voltage which is unstable in nature and having a very low magnitude. Signal conditioning circuits were used to stabilize and increase the strength of output signal obtain from the sensors in the calibration process.

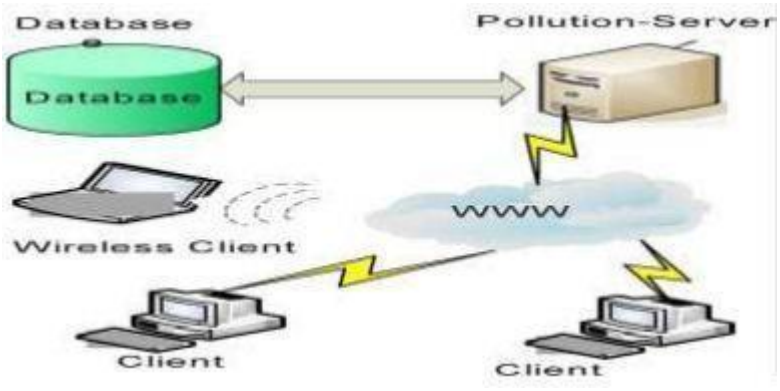

Fig 2. shows the System working.

The first part is the front-end IOT-based monitoring hardware system, and the second part is the back-end software service system which processes the air quality thing data. The front-end monitoring system consist of monitoring sections. The monitoring section is implemented by putting terminal sensor nodes at one fix location and access the database through wireless network. Front-end monitoring platform uses WSN technology as its core technology, and transmits information via TCP/IP protocol. Background service system uses JSP and MySQL languages for thing data processing. At last, JSP pages get real-time air quality information by accessing the database and display it dynamically on the web front page.

III.SENSOR TYPES TO DETECT POLLUTANTS

(1) (2) (3)

1. Nitrogen dioxide (NO2):

It is a gas produced by the rapid oxidation of NO, that is produced by burning fossil fuels in vehicles and industry. It is toxic and affects the respiratory system and encourages the production of nutria acid (HON3) responsible for acid rain Sensitive material of MQ-2 gas sensor is SnO2, which is with lower conductivity in clean air. When the target combustible gas exists, the sensor's conductivity is more; higher along with the gas concentration rising. Convert change of conductivity to correspond to output signal of gas concentration. MQ2 gas sensor has high sensitivity to NO2, Propane and Hydrogen also could be used to Methane and other combustible steam, it is with low cost and suitable for different application.[7] In order to make the sensor with better performance for MQ2 sensor.

Table 1. Health effects & pollutant concentration breakpoints caused by NO2.

Category	**lutant Concentration breakpoints (ppb)**	**Health Effects**
Very good	0-50	No health impacts
Good	51-100	Slight smell
Moderate	111-200	Smell

Poor	201-524	Air smells and looks brown. Some increment in bronchial hyperactivity in asthmatics people.
Very Good	525 or over	ing affectability for asthmatics and individuals with bronchitis.

2. Carbon dioxide (CO2):

This CO2 sensor is designed by DF Robot engineer. The MG-811 sensor is highly sensitive to CO2 and less sensitive to alcohol and CO. The MG-811 sensor has low humidity and temperature dependency. Its structure same as MQ-7 but parts material are different. This sensor composed by solid electrolyte layer, Heater, Platinum Lead, Gold electrodes, Porcelain Tube, 100m double-layer steeliness net, Nickel and copper plated ring. it is a gas naturally present in our atmosphere. Together with water vapor and other gases is one of the greenhouse gases that regulate Earth temperature. Production in excess as a result of increased fossil fuel usage could have a direct impact on climate change.

3. Carbon monoxide (CO):

Various types of sensors are available in the market in which semiconductor sensors are considered to have fast response. MQ7 semiconductor sensor is mainly used for detecting carbon monoxide (CO). MQ-7 gas sensor composed of micro Al2O3 ceramic tube and Tin Dioxide (SnO2). Electrode and heater are fixed into a crust. The heater provides required work conditions for the work of sensitive components. 26 The conductivity of sensor is higher along with the gas concentration rising. When the sensor, heated by 5V it reaches at high temperature, it cleans the other gases adsorbed under low temperature.

The MQ-7 have 6 pins in which 4 of them are used to fetch signals and other 2 are used for providing heating current. MQ-7 sensor consist of 2 parts. One is heating circuit and the other one is the signal output circuit. In which heating circuit is used for time control and signal output circuit is accurately respond changes of surface resistance of the sensor. This Carbon Monoxide (CO) gas sensor (MQ7) detects the concentrations of CO is in the air and gives output reading in the form of an analog voltage. The sensor can measure concentrations of 10 ppm to 10,000 ppm. The sensor consumes less than 150 mA at 5 V.

Table 2. Health effects & pollutant concentration breakpoints caused by CO2.

Category	**Pollutant Concentration breakpoints (ppb)**	**Health Effects**
Very good	0-12	No health impacts
Good	13-22	No health impacts
Moderate	22-30	hanges, but no noticeable damage

Poor	31-49	sign in smokers with heart disease
Very Good	50 or over	ng sign in non smokers with heart disease

IV.METHODS TO DETECT CO2

The characteristic equation for CO2 sensor is

$$P = A*Q + B,$$

where, P is the calculated voltage
Q is the concentration of CO2
Coefficients: A= 0.011992, B = -3.6973

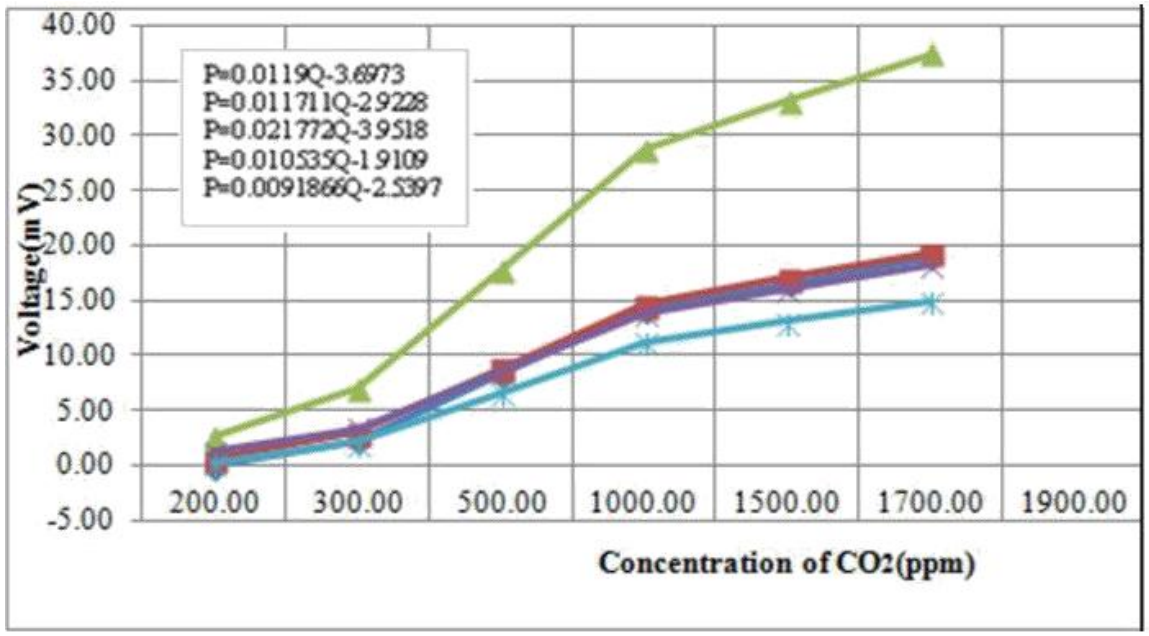

Fig 3: Calibration equation and results for the Carbon dioxide sensors

The MG811 gas sensor used for CO2 detection . MG811 sensor can measure CO2 levels. It is a sensitive low-cost solution for detecting poor air quality in environment. A change of resistance in the presence of these gases generates a signal that is translated into parts per million (ppm) CO2 equivalent units. Also a threshold can be defined to alert that the climate has changed when the limits are exceeded or to decrease ventilation on minimum VOC levels. It is important to mention that the CO2 levels can be affected from changes in the temperature and humidity of the room. The sensor unit monitors CO2 concentration in ppm in the environment

continuously. All the data from the sensor unit are passed to the radio module for initial processing, packet forming and transmission.[7] The protocol supports transmission of real-time sensed data from various sources

V.RESULT

i.Concentration of CO2

Table3: Concentration of CO2

S. No	Date	Concentration
1	2/2/2018	300.00
2	3/2/2018	500.00
3	4/2/2018	1000.00
4	5/2/2018	1500.00
5	6/2/2018	1700.00

Under normal atmospheric conditions, concentrations of the gases are: For CO2 – 450 ppm, NO2 – 0.9 ppm and CO - 0.5 ppm. Experiments were carried out by deploying the sensor nodes in the network, exposing them to different physical environmental conditions like traffic signal, industrial areas .

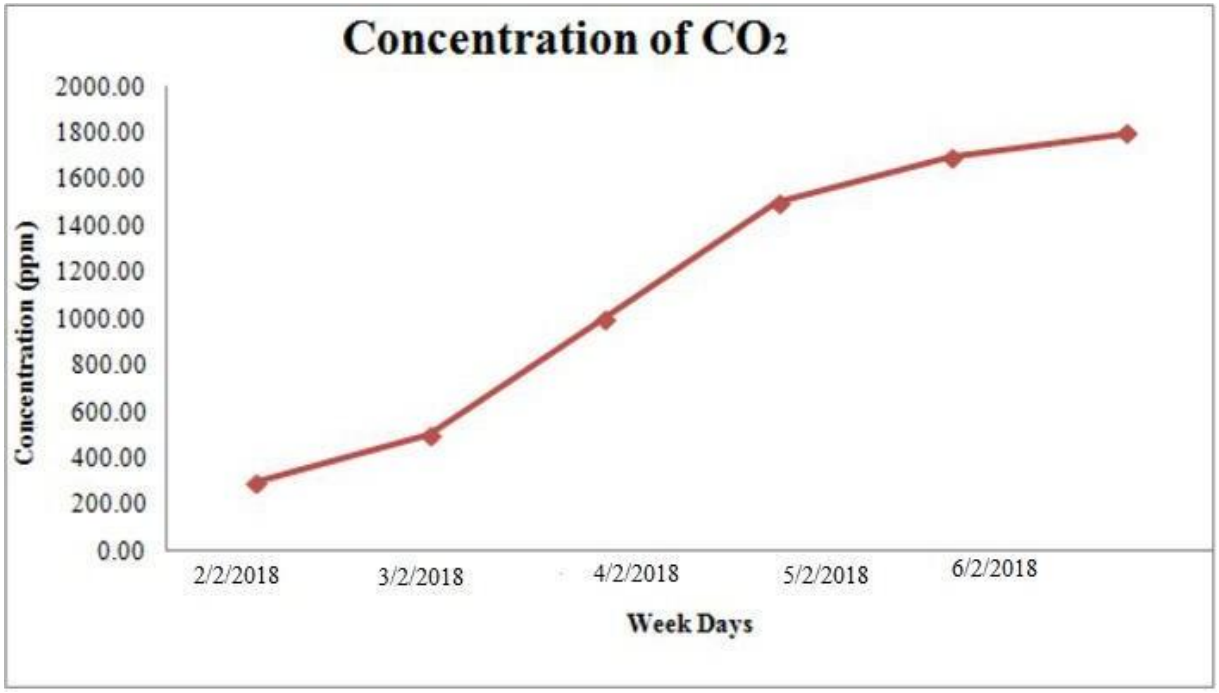

Fig 4: Concentration of CO2 in Weekdays.

It shows the concentration of CO2 in ppm in a week days starting from the Monday to Saturday. On Monday

the Industrial area has power holiday resulting the CO2 concentration is mainly contributed by the traffic pollution only. The concentration of CO2 gradually increases from Tuesday to Saturday which is a combination of both traffic and industrial pollutants and maximum on Saturday.

Carbon dioxide sensors are combined with wifi modules to form wireless monitoring nodes. The data from the sensor are passed to the network, formed into packets and transmitted toward the control room. Each sensor node monitors the area around it continuously.

ii. Concentration of CO

Table 4. Measurements of sensor node.

entration (ppm)	Measurements			average	Relative error
	(1)	(2)	(3)		
15	14.6	16.1	16.2	15.5	4.2%
30	30.5	30.9	31.4	30.9	3.1%
50	49.8	51.6	52.1	51.2	2.3%
100	97.7	101.4	106.5	102.5	1.87%
200	200.8	205.9	202.7	203.1	1.57%
300	299.2	306.6	303.3	303.0	1.01%

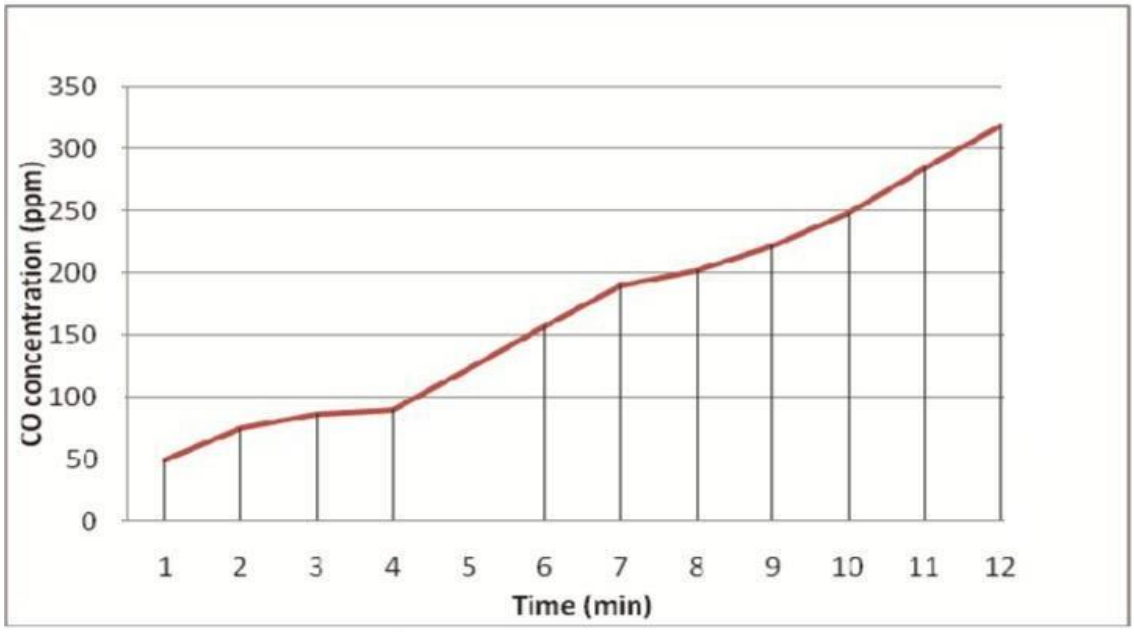

Fig 5. Shows the increasing level of CO concentration with time.

The system was deployed in the environment the CO concentration level is continuously monitored. When the CO concentration crosses the threshold value (which is 300ppm in our case) then it becomes very harmful for health. Carbon monoxide (CO) has been called the "silent" or "invisible killer" because it is a scentless, colorless, and tasteless toxic gas. It is the number one cause of death due to poisoning in America. Any time you burn something—like gasoline, natural gas, wood, oil, propane, or charcoal —carbon monoxide is released into the air. In outdoor spaces, vehicle Exhaust is main source of CO.

A carbon monoxide detector can alert you to high levels of carbon monoxide you're surrounding and help you get to safety immediately. it is produced in incomplete combustion, i.e. when part of the fuel does not react completely due to lack of oxygen. Its danger to human and animals, once it sets in hemoglobin, it prevents oxygen transport, which can be lethal. Although in open space is easily diluted, the CO emission from the engines of cars in congested areas causes may have rates of 50-100ppm, which are dangerous. The system mainly consists of three parts: the sensor nodes, Wifi modules and routers[8]. The sensor nodes monitor CO concentration a time point by Wifi modules; routers receive the information of each point, and transport it to a PC or smartphone. To validate the accuracy of the system, we put the sensor nodes in a closed container ,the temperature was kept between 28 ◦C and 29 ◦C and relative humidity was maintained at 50%–60%.

iii. Concentration of NO2

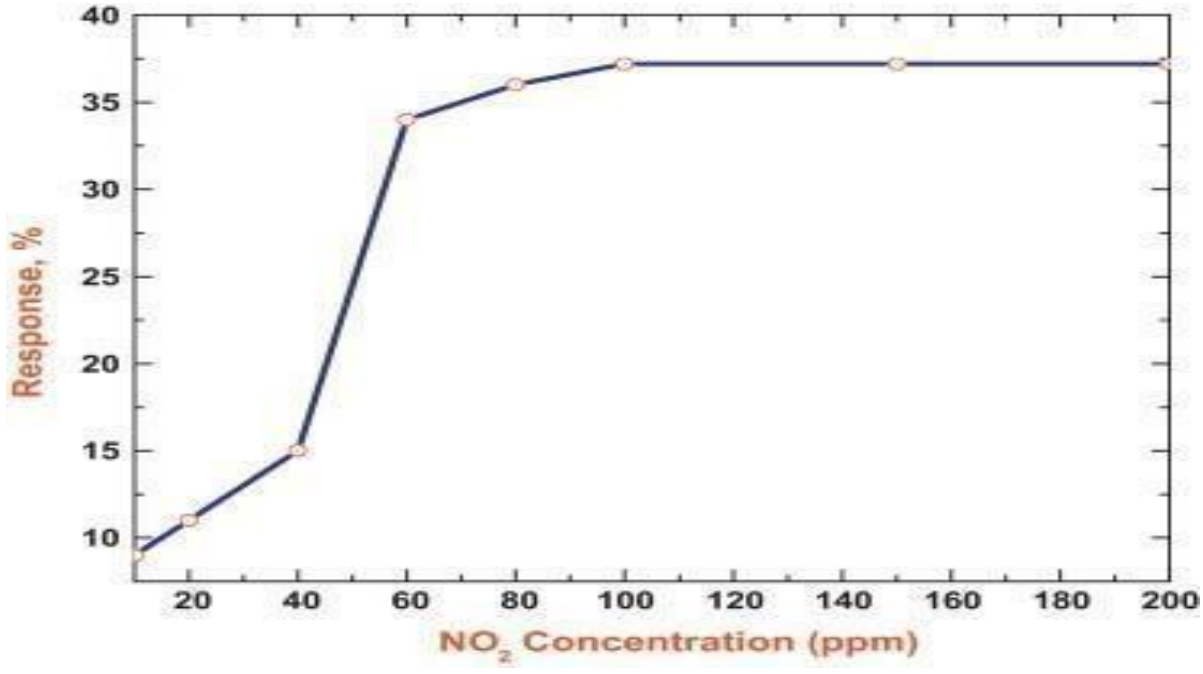

Fig 6 .Shows the increasing level of NO2 concentration with ppm.

When the NO2 concentration crosses the threshold value then it becomes harmful and very dangerous for the surroundings. Nitrogen dioxide sensors are combined with wifi modules to form wireless monitoring nodes. The data from the sensor are passed to the network, formed into packets and transmitted toward the control room. Each sensor node monitors the area around it continuously.

V.CONCLUSION

In this paper, we have represented the level of pollutants and how they are hazardous for the health. The main component used is Wireless Sensor Network (WSN). The problem of air pollution is becoming a serious issue regarding health of the population because of the growth in industries which are source of air pollutants . The concentration of air pollutants like CO2,CO,NO from air are sensed by using gas sensor modules which are available.

In this system network setups can be carried out without fixed infrastructure .It is Suitable for the non-reachable places such as over the sea, mountains, rural areas or deep forests. It gives Accurate and reliable data. It provides Feasibility in maintenance. We can use this system for healthcare monitoring, environmental sensing ,forest fire detection , natural disaster prevention purposes. To achieve this results Internet is required to read the status of sensor and server should run every time.

REFERENCES

[1] H. Karl and A. Willig, Protocols and Architectures for Wireless Sensor Networks, John Wiley and Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex, England, 2005.

[2] Nihal Kularatna, and B. H. Sudantha,An Environmental Air Pollution Monitoring System Based on the IEEE 1451 Standard for Low Cost Requirements, IEEE Sensors Journal, Vol. 8, No. 4, 2008.

[3] Boukerche A, Algorithms And Protocols For Wireless Sensor Networks", John Wiley & Sons, 2009, Canada.

[4] A. Kumar, H. Kim and G. P. Hancke, Environmental monitoring systems: A review, IEEE Sensors J., vol. 13, no. 4, pp. 1329-1339,2013.

[5]J.Y. Kim, C.H.Chu and S.M. Shin, ISSAQ: An integrated sensing systems for real-time indoor air quality monitoring, IEEE Sensors J., vol. 14, no. 12, pp. 4230-4244, 2014.

[6] J. Rezazadeh, M. Moradi, A. S. Ismail, and E. Dutkiewicz, Impact of static trajectories on localization in wireless sensor networks, Wireless Networks, vol. 21, no. 3, pp. 809–827, 2015.

[7] Real time indoor co2 monitoring and control system using wireless sensor networks 1Selvamathi A, 2S.Rathi 1PG Scholar, 2Associate professor,

[8] A real-time monitoring system of industry carbon monoxide based on wireless sensor networks Jiachen Yang 1,Jianxiong Zhou 1,ZhihanLv 2,WeiWei 3 and Houbing Song 4.

[9] Khaled Bashir Shaban, Abdullah Kadri , Eman Rezk ,Urban Air Pollution Monitoring System With Forecasting Models, IEEESensors Journal, Volume:16 , Issue: 8 , April 15, 2016.

[10] Viky V. Bagde, Suresh D. Shirbaha durkar , Automated System for Air Pollution Detection and Control , IJECT Vol. 7, Issue 3, July- Sept 2016.