iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 5 **Issue:** XII **Month of publication:** December 2017

DOI:

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor :6.887
Volume 5 Issue XII December 2017- Available at www.ijraset.com

A Sensor Oriented Framework to Computationally Measure and Provide Solutions for Enhancing Air Quality

A.A. Narasimham[1], Dr. V. Sangeeta[2],
[1]*Department of CSE, Dadi Institute of Engineering and Technology, Anakaplle, Viskhapatnam, Andhra Pradesh, India*
[2]*Prof. Department of CSE, Raghu Institute of Technology, Dakamarri, Visakhapatnam, Andhra Pradesh, India*

Abstract: In recent years the industrialization along with globalization has caused a major destruction to environment which has resulted in many natural disasters around the globe, Air pollution has become a major threat due to its countless impacts on pub lic health, global environment, and worldwide economy. To restrict the hazards of the air pollutants a computational framework has been designed to detect the quality of the breathing air and provide the solutions to limit the ill effects. The proposed air poll ution monitoring system utilizes wide variety of sensors and works efficiently and accurately in different atmospheric conditions and geographical locations.

Keywords: air pollution monitoring system; real-time monitoring; air pollutant sensors; computer workstation; pollutants;

I. INTRODUCTION

Air is important for a living creature to sustain its life on earth. Air is the main source which separates our planets to the remaining planets. But, the inventions and discoveries done by the man for the betterment of human life have become the fundamental compo nents which deliver the pollutants[1] in the air making it un safer for the well-being of human. Over the past few years, people arou nd the globe have faced numerous the dreadful consequences. Detecting the quality of air and determining the steps to decrease the content of toxic wastes from the environment is the first and foremost measure to improve the standard of environment.

Sensors have proven to be prominent electrical instruments which are useful to detect the various conditions like temperature, press ure, motion etc., the usage of sensor technology is been performed in various diverge aspects and research. The wide variety of sen sors which serve many purposes and the accuracy and decrease in cost have made them to involve all engineering fields. Sensor net works are especially effective in those type of applications which involve in validating and measuring under dangerous conditions as people cannot survive their most of the time monitoring. This advent usage of sensors has opened doors to utilize them in air po llution monitoring system.

Traditional monitoring instruments measuring the contents of air and monitor the quality[3] of the Traditionally, air pollution situat ion is monitored by conventional air pollution monitoring systems[2][15] which are able to measure a wide range of pollutants and display the levels of the air pollutants on the monitor. These type of instruments are sufficient to know the quality of air for the awa reness of public and the government organizations. Basing on the results given by the system the officials will either contact the pr ofessional to handle the situation or want to relocate the people from those regions where the living is considered as danger zone.

In order to reduce the amount of time being spent on remedial measures to be taken to enhance the quality of air, the proposed met hodology will help them to get the remedial measures at the same instant along with the measurements of the pollutants. The propo sed framework have a database system which contains the type of measures to be taken to eradicate the poisonous gaseous present in the environment. It has been anticipated that it is an advanced development of the existing monitoring systems. The same type of sensors which the existing systems are working with are only embedded in the system.

The present paper is Organized in IV sections. In section II the various sources and effects of pollutants and the standards of health y air are discussed. Overview of sensors is given in section III. Section IV explains the detailed working of proposed framework fo llowed by conclusion in section IV.

II. STANDARDS OF AIR

Pollutants are generated both by natural and by man-made innovations. Starting from a forest fire to testing of nuclear weapons, th ere are various means of causing air pollution. Recent studies have proved that the immunity power of younger generations are be

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor :6.887
Volume 5 Issue XII December 2017- Available at www.ijraset.com

ing decreasing due to the pollution in air[7]. The pollutants in air gets in to human body easily and thereby causing massive damage to the vital organs[8].

Numerous of pollutants are being identified and many more are to be discovered in near future. Out of many few are listed below and the WHO standards for them are also given in Table 1.

Air Pollutant	Sources	Primary Effects	WHO standards
Carbon Monoxide(CO)	Incomplete combustion of fuels and other carbon containing substances such as motor vehicle exhaust, natural events, such as decomposition of organic matter etc.	Reduced tolerance for exercise, impairment of mental function, impairment of fetal development, death at high levels of exposure, aggravation of some heart diseases.	100 mg/m3 (15 min) 15 mg/m3 (1 h) 10 mg/m3 (8 h) 7 mg/m3 (24 h)
Fine Particulate Matter (PM10)	Stationary combustion of solid fuels, industrial processes, construction activities, industrial chemical reactions etc.	Reduced lung function, aggravation of the effects of gaseous pollutants, aggravation of respiratory and cardio-respiratory diseases, increased coughing and chest discomfort, soiling, reduced visibility	50g/m3 (24h) 20g/m3 (1 year)
Fine Particulate Matter (PM2.5)	Stationary combustion of solid fuels, construction activities, industrial processes, industrial chemical reactions, from pollutants in air from pollutants in air	Reduced lung function, aggravation of the effects of gaseous pollutants, aggravation of respiratory and cardio-respiratory diseases, increased coughing and chest discomfort, soiling, reduced visibility	25g/m3 (24 h) 10g/m3 (1 year)
Lead	Contaminated soil	Increased body burden, impairment of blood formation and nerve conduction	0.5g/m3 (1 year)
Nitrogen Dioxide(NO_2)	Motor vehicle exhaust, high temperature stationary combustion, atmospheric reactions	Aggravation of respiratory illness, reduced visibility, reduced plant growth, formation of acid rain	200g/m3 (1h) 40g/m3 (1 year)

Ozone(O_3)	Atmospheric reaction of organic gases with nitrogen oxides in sunl ight	Aggravation of respiratory and cardiovascular diseas es, irritation of eyes, impai rment of cardiopulmonary function, plant leaf injury	100g/m3(8h)
Sulfur Dioxide(SO_2)	Combustion of sulfur containing fossil fuels, smelting of sulfur-bea ring metal ores, indust rial processes	Aggravation of respiratory diseases (asthma, emphys ema), reduced lung functio n, irritation of eyes, reduce d visibility, plant injury, d eterioration of metals, texti les, leather, finishes, coati ngs, etc.	500g/m3 (10 min) 20g/m3 (24 h)
Visibility Redu cing Particles		Visibility Reducing Particl es	

Table 1. Types of Pollutants

III. TYPES OF SENSORS

Over the past few years, the world of clean technology has seen a major entry of environmental sensor technologies. The field has in cluded many interesting actions on for proving to be more and more important, but the most significant trend in environmental senso rs has been in personal[9][11], portable devices that measure air and water quality from our pockets or wrists. By making these sens ors small and usually Bluetooth or Wi-Fi enabled, merely carrying out normal daily routines could make citizens significantly increa sing the amount and precision of environmental data through crowd sourcing[12].

From smart phone embedded sensors to those you wear or plug in wherever new wave of personal environmental sensors has the pot ential to really change the way that data is gathered, analyzed and consumed. The data coming from the government's environmental sensors at their monitoring stations, doesn't give the whole picture to someone who's living close to an interstate or parking garage or near an industrial facility.

Having specific, real-time information can not only with asthma areas to avoid on any given day, but gives scientists a better picture of where, when and why pollution is happening, which is necessary to take steps to make it better[13]. There are some of the sensor s discussed here, which are helpful regarding air pollution crisis.

A. Air Bot

The AirBot monitors airborne pollutants that can cause breathing problems like asthma[4]. It's pocket-sized so that people could hav e it on them wherever they go, keeping tabs on particulates that could cause respiratory problems. Six prototypes have already been built and yet to be developed fully.

B. Air Quality Egg

It is not wearable, but able to fit in pockets, the egg is an at-home environmental sensor kit that gathers very high resolution readings of NO_2 and CO concentrations from wherever it's placed. The device consists of a sensing system that gets plugged into the wall ou tside the home and communicates wirelessly to the egg-shaped base station inside, which transmits the data to a system, where it all gets mapped for anyone to get a quick look at air quality readings in their town, region or even the globe[5].

C. Broadcom Microchip

This ultra-accurate microchip for smart phones that would take advantage of the huge amount of sensors that smart phones now cont ain to gather precise information on a user's surroundings. This chip is getting strong interest from companies to more information a

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor :6.887
Volume 5 Issue XII December 2017- Available at www.ijraset.com

bout consumers, but also it has great applications for environmental science. The chip can receive signals from global navigation satellites, cell-phone towers, and Wi-Fi hot spots, and also input from gyroscopes, accelerometers, step counters, altimeters and atmospheric pressure sensors.

D. Electronic Nose Sensor

This is a technology, with huge potential applications for the environment, human health and national security. It is a multi-sensor device able to detect small amounts of hazardous airborne chemicals like pesticides, combustion emissions, gas leaks, and chemical warfare agents[6]. Future iterations will include Bluetooth and Wi-Fi capabilities and can automatically upload and sync the data it finds. The developers are also working on getting it down to the size of a fingernail. The designers see the device being used in three different platforms: a handheld device, a wearable device and in a smart phone.

E. iGeigie

It is a portable Geiger counter that docks with an iPhone. By calling the phone, users can listen and that indicate how much radiation is in the area. The major goal of the developers is to create a sensor network for nuclear radiation where data could be mapped and government groups, NGOs and widespread citizen scientists.

F. Lapka Environmental Monitor

The Lapka is a set of environmental sensors that plug into your iPhone and can detect radiation, electromagnetic feedback, nitrates in raw foods, and temperature and humidity[10]. So that, not only can they give you some simple environmental data, but they can also tell you if your food is organic.

G. Pressure Net

It is an Android-powered app that measures atmospheric pressure, and provides those measurements to scientists who in turn use it to better understand what is going on with the weather. The app uses atmospheric sensors that are already in many Android phones. Users are alerted to what data is being collected when the app is open and how it will be used and then they can decide whether they want to participate. The data goes to a website where it could be used to make better weather predictions or aid in studies looking at the effect of atmospheric pressure on other environmental systems.

H. Sensaris

This sensor gives instant air quality measurements and send data to mobile phones, making data transmission easy.

I. Sensordrone

It is a tool that can sense many things in your environment, including gasses, temperatures, humidity and more and pairs with smart phones.

J. WaterBot

This sensor's one end can be dipped into water like in a lake or stream and then it will upload pollution data to the web, so that every one who lives near that water source can stay informed. According to any website, the data will be collected at a high frequency and will be allowing to detect the events that are invisible to others.

IV. PROPOSED FRAMEWORK

The proposed framework is based on the working of existing monitoring systems with the introduction of computational power. The system can be classified into three modules as described below.

A. Base sensor station

The base sensor station is chosen which contains the appropriate sensor for the environment it is being placed and the readings are carefully noted in periodic manner before giving it to the workstation. The measures are taken in advance not to send erroneous measures of the pollutants present in the sample air.

Steps are taken to switch off automatically, in case of thunders and other unpredictable and unconditional weather changes that may occur to protect the equipment of the system which may reduce the damage and future investment.

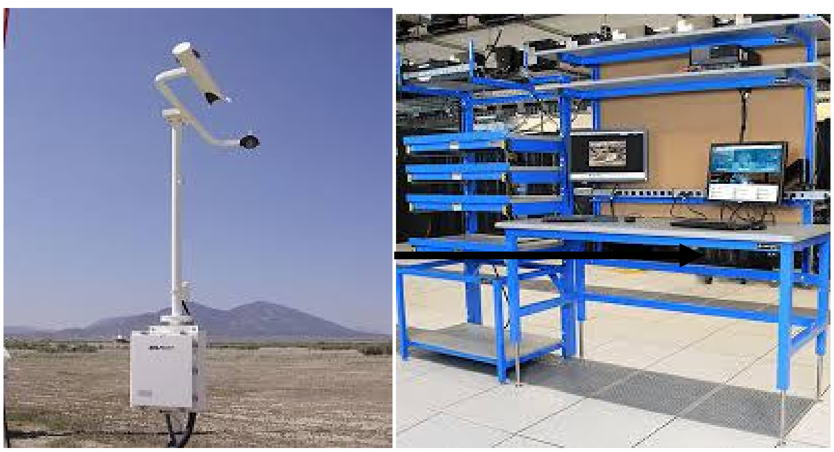
B. Computer work station

The measurement from the base station are being received in wireless or through cables are analyzed here. The threshold values of various pollutants are compared with the received measurements and the possible solutions are mapped by the pre-existing algorith m.

The system is designed in a way that the produced output is sent to the mails of concerning authorities and is saved in local storage for future references. The Workstation needs to be carefully analyze the data before giving the output and a small jitter in receiving is not acceptable and an immediately it sends a negative acknowledgment and prompts the base station for retransmission of the da ta

C. Output

The major difference between the existing and proposed system is that there are two outputs displayed . First, the levels of the poll utants in air and the second is the solutions proposed by the system. The solutions need not be mandatorily a single but could be a s et of suggestions to follow. The overview of the system is given in figure 1.



1.Sensor Base Station

2. Computer workstation

Location	Solution
On Road	Either grow plants of or lo wer the frequency of vehicl es and working hours of in dustries
Indoor	Switch off the electrical ga dgets causing radiation
	Open windows for air venti lation

Pollutant	Levels (ppm)
CO_2	450
NO_2	6
CO	17
PM	59
SO_2	4

3 b) Possible solutions 3a)Pollutant levels

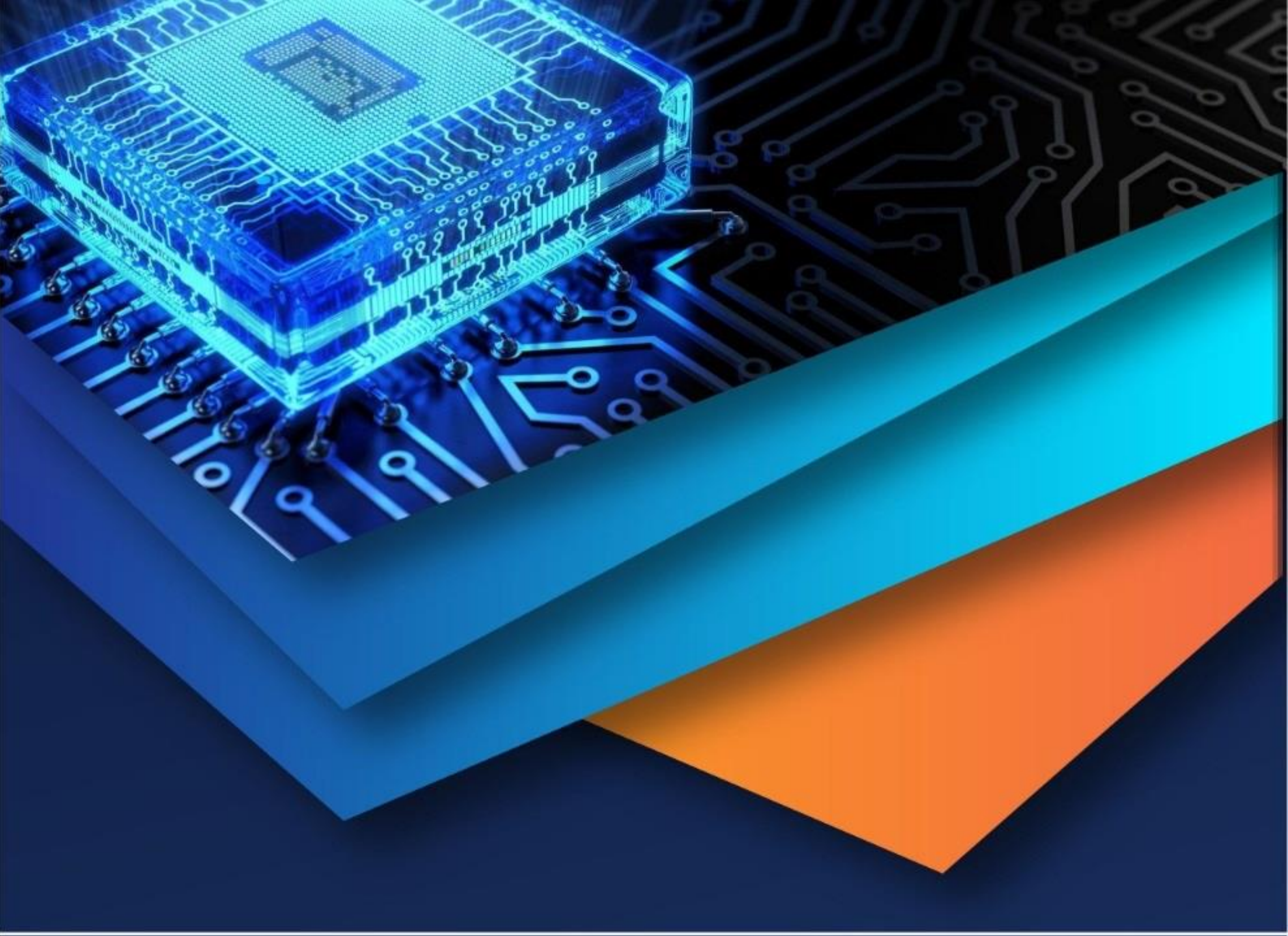
Figure 1. Overview of the frame work

V. CONCLUSION

All the existing systems of air monitoring are limited to the extent that they provide the levels of pollutant contents in the air. The proposed frame work is one step ahead in providing the solutions to implement basing on the level of pollution present in the air. This proposed system merges the computational technology with the electrical methodology to deliver a feasible solution to the pe rsisting pollution havoc. The system van ne made more advanced if soli type and fertility is provided to it such that it can judge th e types of plants to be planted basing on the environmental and available resources for the growth of the plants. However, there ar e still some issues or challenges that need to be addressed like increase in power consumption and transmission interrupts caused between the system and the remote data base. The concept of IOT and cloud computing is attached to carry forward or enhance when building the future systems.

REFERENCES

[1] MarilenaKampa and Elias Castanas. 2008. Human health effects of air pollution. Environmental Pollution 151, 2 (2008), 362 – 367. Proceedings of the 4th Inte rnational Workshop on Biomonitoringof Atmospheric Pollution (With Emphasis on Trace Elements).
[2] Sunyoung Kim, Eric Paulos, and Jennifer Mankoff. 2013b. inAir: A Longitudinal Study of Indoor Air Quality Measurements and Visualizations. In Procee dings of the SIGCHI Conference on Human Factorsin Computing Systems (CHI '13). ACM, New York, NY, USA, 2745–2754.
[3] Stacey Kuznetsov, George Davis, Jian Cheung, and Eric Paulos. 2011. CeciN'Est Pas Une Pipe Bombe:Authoring Urban Landscapes with Air Quality Sensors. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '11). ACM, New York, NY, USA, 2375–2384.
[4] Maria de Fatima Andrade, Prashant Kumar, Edmilson Dias de Freitas, Rita Yuri Ynoue, Jorge Martins, Leila D. Martins, ThiagoNogueira, Pedro Perez-Mart inez, Regina Maura de Miranda, TacianaAlbuquerque, Fabio Luiz Teixeira Gonçalves, Beatriz Oyama, Yang Zhang, Air quality in the megacity of São Paulo: Evolution over the last 30 years and future perspectives, Journal of Atmosphericenvironment, Elsevier, June 2017
[5] Stacey Kuznetsov, Scott E. Hudson, and Eric Paulos. 2013b. A Low-tech Sensing System for Particulate Pollution. In Proceedings of the 8th International Co nference on Tangible, Embedded andEmbodied Interaction (TEI '14). ACM, New York, NY, USA, 259–266.
[6] C Arden Pope III and Douglas W Dockery. 2006. Health effects of fine particulate air pollution: lines that connect. Journal of the air & waste management asso ciation 56, 6 (2006), 709–742
[7] RundongTian, Christine Dierk, Christopher Myers, and Eric Paulos. 2016. MyPart: Personal, Portable,Accurate, Airborne Particle Counting. In Proceedings of t he 2016 CHI Conference on Human Factors in Computing Systems (CHI '16). ACM, New York, NY, USA, 1338–1348.
[8] Yen-Chia Hsu, Paul Dille, Jennifer Cross, Beatrice Dias, Randy Sargent, and IllahNourbakhsh. 2017. community-Empowered Air Quality Monitoring System. In Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (CHI '17). ACM
[9] AIR POLLUTION MONITORING FOR COMMUNITIES, U.S. Environmental Protection Agency Office of Research and Development, Science in Action, August 2016
[10] K.V. Abhijith, Prashant Kumar, John Gallagher, AonghusMcNabola, Richard Baldauf, FrancescoPilla, Brian Broderick, Silvana Di Sabatino, Beatrice Pulvirent i, Air pollution abatement performances of green infrastructure in open road and built-up street canyon environments – Areview, Journal of Atmospheric envir onment, Elsevier, August 201
[11] Tong, H. Dietary and Pharmacological Intervention to Mitigate the Cardiopulmonary Effects of AirPollution Toxicity. BiochimicaetBiophysicaActa. Elsevier S cience Ltd, New York, NY1860(12):12891-8, (2016).
[12] Kaufman, A., R. Williams, T. Barzyk, M. Greenberg, M. OShea, P. Sheridan, A. Hoang, C. Ash, A.Teitz, M. Mustafa, AND S. Garvey. A Citizen Science and Government Collaboration: Developing Tools to Facilitate Community Air Monitoring. ENVIRONMENTAL JUSTICE. Mary Ann Liebert, Inc., New Rochell e, NY, 10(2):1-11, (2017)
[13] Dionisio, K., C. Nolte, T. Spero, S. Graham, N. Caraway, K. Foley, AND K. Isaacs. Characterizing the impact of projected changes in climate and air quality o n human exposures to ozone. Journal of Exposure Science and Environmental Epidemiology . Nature Publishing Group, London, Uk, 27(3):260-270, (2017)
[14] Venkatram, A., V. Isakov, P. Deshmukh, AND R. Baldauf. Modeling the impact of solid noise barriers on near road air quality. ATMOSPHERIC ENVIRONM ENT. Elsevier Science Ltd, New York, NY, 141:462-469, (2016)
[15] MD Taylor and IR Nourbakhsh. 2015. A low-cost particle counter and signal processing method for indoor air pollution. Air Pollution XXIII 198 (2015), 337.



10.22214/IJRASET

INDEX COPERNICUS

45.98

IMPACT FACTOR: 7.129

TOGETHER WE REACH THE GOAL

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY