

## Monitoring of Air Pollution Using Wireless Sensor Network

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**ABSTRACT:** Air pollution monitoring is extremely important as air pollution has a direct impact on human health and environment. In this paper we introduce a wireless sensor network system for participatory air pollution monitoring. The traditional air quality monitoring system, controlled by the Pollution Control Department, is extremely expensive. Analytical measuring equipment is costly, time and power consuming. In contrast to traditional air pollution monitoring stations, we present the design, implementation, and evaluation of low power, low cost WSN based Air Pollution Monitoring System which provides real time monitoring of polluted materials at proper locations by using distributed (real time) air pollution monitoring systems.

**Technical keyword:** GPS, Microcontrollers systems, Air pollution, wireless mobile networks.

### 1. Introduction

Air pollution is a gas (or a liquid or solid dispersed through ordinary air) released in a big enough quantity to harm the health of people or other animals, kill plants or stop them growing properly, damage or disrupt some other aspect of the environment, or cause some other kind of nuisance (reduced visibility, perhaps, or an unpleasant odor).(1,2)

#### Top-ten gases in air pollution:

Any gas could qualify as pollution if it reached a high enough concentration to do harm. Theoretically, that means there are dozens of different pollution gases.

- 1. Sulfur dioxide:** Coal, petroleum, and other fuels are often impure and contain sulfur as well as organic (carbon-based) compounds. When sulfur (spelled "sulphur" in some countries) burns with oxygen from the air, sulfur dioxide (SO<sub>2</sub>) is produced. Coal-fired power plants are the world's biggest source of sulfur-dioxide air pollution, which contributes to smog, acid rain, and health problems that include lung disease.

**2. Carbon monoxide:** This highly dangerous gas forms when fuels have too little oxygen to burn completely. It spews out in car exhausts and it can also build up to dangerous levels inside your home if you have a poorly maintained gas boiler, stove, or fuel-burning appliance.

**3. Carbon dioxide:** This gas is central to everyday life and isn't normally considered a pollutant: we all produce it when we breathe out and plants such as crops and trees need to "breathe" it in to grow. However, carbon dioxide is also a greenhouse gas released by engines and power plants. Since the beginning of the Industrial Revolution, it's been building up in Earth's atmosphere and contributing to the problem of global warming and climate change.

**4. Nitrogen oxides:** Nitrogen dioxide (NO<sub>2</sub>) and nitrogen oxide (NO) are pollutants produced as an indirect result of combustion, when nitrogen and oxygen from the air react together. Nitrogen oxide pollution comes from vehicle engines and power plants, and plays an important role in the formation of acid rain, ozone and smog. Like carbon dioxide, nitrogen oxides are also greenhouse gases (ones that contribute to global warming).

**5. Volatile organic compounds (VOCs):** These carbon-based (organic) chemicals evaporate easily at ordinary temperatures and pressures, so they readily become gases. That's precisely why they're used as solvents in

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many different household chemicals such as paints, waxes, and varnishes. Unfortunately, they're also a form of air pollution: they're believed to have long-term (chronic) effects on people's health and they also play a role in the formation of ozone and smog.

**6. Particulates:** These are the sooty deposits in air pollution that blacken buildings and cause breathing difficulties. Particulates of different sizes are often referred to by the letters PM followed by a number, so PM10 means soot particles of less than 10 microns (10 millionths of a meter or 10 $\mu$ m in diameter). In cities, most particulates come from traffic fumes.

**7. Ozone:** Also called trioxygen, this is a type of oxygen gas whose molecules are made from three oxygen atoms joined together (so it has the chemical formula O<sub>3</sub>), instead of just the two atoms in conventional oxygen (O<sub>2</sub>). In the stratosphere (upper atmosphere), a band of ozone ("the ozone layer") protects us by screening out harmful ultraviolet radiation (high-energy blue light) beaming down from the Sun. At ground level, it's a toxic pollutant that can damage health.

**8. Chlorofluorocarbons (CFCs):** Once thought to be harmless, these gases were widely used in refrigerators and aerosol cans until it was discovered that they damaged Earth's ozone layer.

**9. Unburned hydrocarbons:** Petroleum and other fuels are made of organic compounds based on chains of carbon and hydrogen atoms. When they burn properly, they're completely converted into harmless carbon dioxide and water; when they burn incompletely, they can release carbon monoxide or float into the air in their unburned form, contributing to smog.

**10. Lead and heavy metals:** Lead and other toxic "heavy metals" can be spread into the air either as toxic compounds or as aerosols (when solids or liquids are dispersed through gases and carried through the air by them) in such things as exhaust fumes and the fly ash (contaminated waste dust) from incinerator smokestacks.

#### Causes of air pollution:

- Traffic
- Power plants
- Industrial plants and factories

#### Effects does air pollution:

- Agricultural effects
- Human health

## 2. Existing system

The main pollutant from environment are the oxides of carbon and nitrogen which can be detect easily these day with the help of semiconductor gases sensor. The existing system has air pollution detection and indicates the environment pollution using GPS-GPRS. So Pollution Control Office easily detect large pollution area.

## 3. Problem statement

Low cost WSN based Air Pollution Monitoring System which provides real time monitoring of polluted materials at proper locations by using distributed air pollution monitoring systems.

## 4. Proposed system

The proposed wireless sensor network air pollution monitoring system (WAPMS) comprises of an array of sensor nodes and a communications system which allows the data to reach a server. The sensor nodes gather data autonomously and the data network is used to pass data to one or more base stations, which forward it to a sensor network server. The system send commands to the nodes in order to fetch the data, and also allows the nodes to send data out autonomously.

## 5. System Requirement

**A) Domain:** Android and wireless sensor network

### B) Software Interfaces:

Operating System : Windows/ Android

Language: JDK1.8, ADT ,Eclipse, Xampp  
Server, Assembly language

Data Base : My Sql

Front End : Java

Back End : MySql

## 6. System Architecture:

In block diagram divided into two major blocks are namely: Pollution monitoring Server (Pollution- Server) and Mobile Data Acquisition Unit (Mobile- DAQ). In Mobile - DAQ include sensors, single chip microcontroller, GPS and GPRS modem. The Mobile-DAQ is also connected to a GPS module and a GPRS-Modem.( 3,4,5,6,7)

Each of these components is described in the following.

**a. Sensors:**

The sensor consists of three air pollutions sensors including Sulfur Dioxide (SO<sub>2</sub>), Nitrogen Dioxide (NO<sub>2</sub>), and Carbon Monoxide (CO).

**b. GPS Module:**

GPS mean **Global Positioning System**. The Global Positioning System is a space-based navigation system that provides location and time information in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites. The GPS modem is interfaced with the microcontroller.

**c. GPRS-Modem:**

GPRS means **General packet radio service**. GPRS is a packet-oriented mobile data service used in 2G and 3G cellular communication systems global system for mobile communications (GSM). GPRS usage is typically charged based on volume of data transferred, contrasting with circuit switched data, which is usually billed per minute of connection time.(8,9)

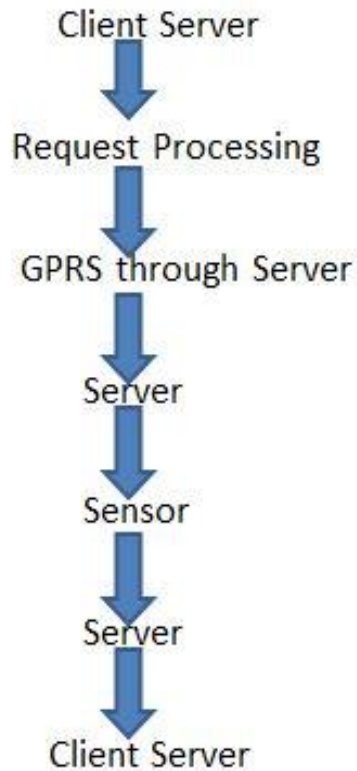
**d. Single-Chip Microcontroller:**

The microcontroller is a single-chip device that has rich built-in resources for digital input/output ports, 16 channels, 8/10 bits analog-to-digital converter, 8 input/output interrupt-driven timers, two RS-232 serial communication ports, and SPI communi- cation ports.

**e. Pollution-Server:**

The Pollution-Server connects to the GPRS-Modem via TCP/IP through the Internet and the public mobile network. The Pollution-Server is standard personal computer with access to the Internet.

**Workflow of System**



**7. Flowchart**

Flowchart explains:

- a. Sensor Nodes sense, collect and transmit data to the Cluster Head.
- b. The Cluster Head collects data and performs two computational operations.
- c. The result obtained by the computational operation is then transmitted to the Sink.
- d. The Sink collects the data and forwards to Database, which sends the data to Application.

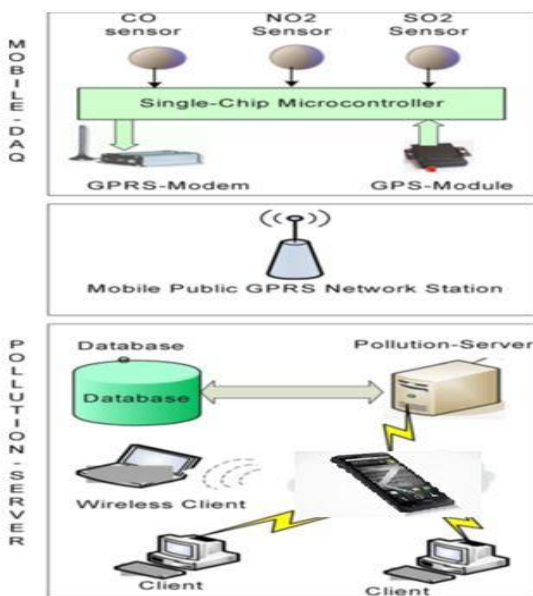


Figure No.1 Single-Chip Microcontroller

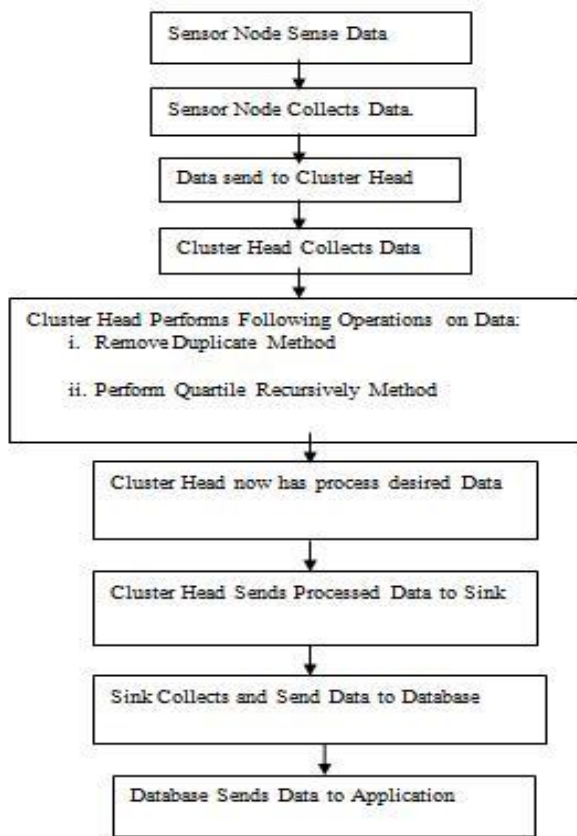


Figure No.3 Flow Chart

## 8. Advantages

- Sensors are easily available.
- Simple, compact and Easy to handle.
- Sensors have long life time and less cost.
- Simple Drive circuit.
- System is Real Time.
- Visual Output.
- Continous update of changes in percentage of air quality.
- It avoid lot of wiring.

## 9. Applications

Some of their daily life applications are used

- Environmental monitoring
- Indoor climate control
- Surveillance

## 10. Conclusion

Thus the several parameters like gas level and purity of water level are monitored continuously and when the standard level exceeds a message is sent to the owner as a

warning and even in the case of failure in the measure taken a message is sent to the pollution control board. Thus the environment is saved from several hazards of pollution.

## 11. References

- [1] Kavi K. Khedo, Rajiv Perseedoss and Avinash Mungur, 'wireless sensor Air pollution Monitoring system', International journal of wireless and mobile networks Ijwmn, vol2, no2, may2010
- [2] Bhalchandra M.Hardas1, G.M.Asutkar2, Dr.K.D.Kulat3 , "Environmental Monitoring Using Wireless Sensors: A Simulation Approach", First International Conference on Emerging Trends in Engineering and Technology
- [3] Sonali Rathi "Air Pollution Monitoring system Using Mobile GPRS Sensor Array" international journal of pure and applied research engineering and technology, volume1 April 2013,ISSN-2319507
- [4] A. R. Al-Ali, Imran Zualkernan, and Fadi Aloul,"A Mobile GPRS-Sensors Array for Air Pollution Monitoring"
- [5] Tajne K.M,Rathore S.S and Asutkar G.M (2011), "Monitoring of Air Pollution using Wireless Sensors",International journal of Environmental Sciences volume 2(2).
- [6] Khedo Kavi K, Perseedoss Rajiv and Mungur Avinash (2010), "Wireless sensor Air pollution Monitoring system", International journal of Wireless and mobile networks Ijwmn, 2(2)
- [7] J. W. Kwon, Y. M. Park, S. J. Koo, and H. Kim, "Design of air pollution monitoring system using ZigBee networks for ubiquitous-city," in Proc. Int. Conf. Convergence Information Technology, 2007, pp. 1024-1031.
- [8] N. Kularatna and B. H. Sudantha, "An environmental air pollution monitoring system based on the IEEE 1451 standard for low cost requirements,"27Monitoring Of Air Pollution using Wireless Sensor Network IEEE Sensors J., vol. 8, pp. 415-422, Apr. 2008.
- [9] J. Liu, "Calibration of a Wireless Sensor Board for Measuring Air Pollution," University of New South Wales, Sydney, Australia, Tech. Rep., 2012