

# Personal Pollution Exposure Estimates using Pollution Sensors and Health Prediction

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**Abstract:** The aim of this paper is to design a wearable air pollution mapping system for an individual. For this it includes interfacing some pollution related sensors (CO<sub>2</sub>, CO and dust sensor) to the user's body which will constantly monitor the surrounding air pollution levels and calculate the exact amount of toxic gases inhaled by the user depending upon the breathing rate of the user. Depending upon these values, the user will be alerted in real time by showing warnings where pollution level has surpassed the permissible limits. The data will be preserved and later analyzed using graphs and diagrams prepared in Excel using Visual Basic. The data analysis will provide the user with health prediction i.e. probability of immediate or long term health effects of various poisonous gases or pollutants.

**Keywords:** air pollution monitoring, personal pollution mapping, real time alerts, data server, health prediction.

## I. INTRODUCTION

Air pollution has grown to be a very serious problem recently. The problem is more severe in large industrial cities. Air pollution has known to have a serious health effects on human body. The World Health Organization data shows millions of people being affected by Air Pollution related diseases. Hence, it becomes very important for an individual to know the amount of toxic gases his body is being exposed to know the ill effects of air pollution on health. Fortunately, we have a number of sites monitoring air pollution index and proportion of toxic gases present in the air in different parts of the cities (Like we do have a site in Shivajinagar area of Pune). But these sites are located at some distance from the actual polluting machines or vehicles. Hence it can never calculate the amount of pollution to which a particular individual is actually exposed (consider a biker driving behind a polluting lorry). The amount of harmful gases actually consumed by the biker will differ a lot from the amount calculated by the pollution monitoring site. Secondly, the general public does not really understand the seriousness and consequences of pollution data displayed by these sites. They have no means to understand the health effects of the pollution levels they are exposed. Hence, these existing pollution monitoring sites shows only the aggregates of the data and are least useful at the individual level.

## II. PROPOSED SYSTEM

The main aim is to design an air pollution mapping for the individual. For this it includes interfacing some pollution related sensors (CO<sub>2</sub>, CO and dust sensors) to the user's body which will constantly monitor the surrounding air pollution levels and exact amount of toxic gases inhaled by the user.

The system exactly calculates the amount of polluted air inhaled by the user. The system will carry out the

analysis and display real time alerts to the user related to the pollution levels. Depending upon the intensity of alerts, the user may consider any alternate option available to avoid pollution. In addition, the data will be preserved which will be available later for analysis using graphs and diagrams prepared in Excel using Visual Basic. The user can have the whole database of daily pollutions levels of the area where user is travelling on a daily basis and also the daily pollutants consumption levels of the user. The data analysis will provide the user with health prediction i.e. probability of immediate or long term effects of various poisonous gases levels.



Fig. 1. Experimental Setup

Also, user can share the data with an expert to know how it may affect in a way to increase in severeness of person already having an air pollution related disease considering the previous records of the user's disease. Also, individuals with heart disease (coronary artery disease or congestive heart failure), lung disease (asthma, emphysema or chronic obstructive pulmonary disease (COPD), pregnant women etc. are very sensitive to toxic gases such as CO, CO<sub>2</sub>. Such system can prove really helpful to these people who are

very susceptible to air pollution related diseases which can severely affect their health.

**III. SYSTEM COMPONENTS**

The system consists mainly of following components:

- 1) Air pollution Monitoring: This part of the system consists of hardware and sensors such as carbon dioxide, carbon monoxide and dust sensor. These sensors are used to check the pollution levels in the surrounding area. Also pollution reading is noted along with time for further analysis.
- 2) Activity monitoring: The body temperature and pulse rate/ respiration rate of the user will be monitored to calculate the breathing rate of the user so as to calculate the exact amount harmful gases consumed by the user.
- 3) Real time alerts: The recorded data will be analyzed in real time also displayed on LCD fitted on the user's module. The buzzer is provided to alert the user in case very high levels of harmful gases present in the surrounding and inhaled by the user.



Fig. 2. CO and CO<sub>2</sub> sensors

The three LEDs (Green, Amber and Red) indicates the severity off pollution level.

- 4) Data record: The data obtained from sensors and user activities will be stored on the device memory along with time. The data will consist of exact amount of toxic gases consumed by the user which is necessary for health analysis.
- 5) VB server: The data saved on the device can be transferred by the user at the end of the day to the database using serial communication. The database will store all the data of the user and can be converted to excel sheet along with graphs and pie charts for detailed analysis.



Fig. 3 . Real time alerts on LCD

- 6) Health Analysis: The VB server will analyze the data available related to the user. Depending upon the user's health history and to the levels of pollution he/she is exposed to (which is available with database) it will provide the health analysis and the prediction of probable disease that the user can develop over a period of time.

	Inhaled dose( $\mu\text{g min}^{-1}$ )			
	FS CO data + constant RMV	FS CO data + real-time RMV	PS CO data + constant RMV	PS CO data + real-time RMV
Jogging	2.6(2.5-2.6)	10.0(4.9-11.4)	55.3(25.3-115.1)	215.5(77.3-479.5)
Bicycling	2.6(2.5-2.6)	6.6(4.1-8.0)	84.4(17.3-247.2)	220.3(36.8-690.1)
Driving	2.6(2.5-2.6)	3.1(2.7-3.4)	94.3 (22.9-477.2)	114(25.1-563.3)

FS- Fixed Site , PS- Participatory system (mobile system)  
RMV- Respiratory Minute Volume (Air inhaled per minute)

Table 1. Experiment Attributes

**IV. CONCLUSION**

This system can be a complete kit for air pollution mapping for an individual. Also it can provide complete analysis of health effects related to air pollution on an individual. In modern day world where patients of air

pollution related diseases are increasing day by day, the system can also prove very helpful to doctors. Doctors can study the health effects when a person is exposed to particular levels of pollution for a defined period of time.

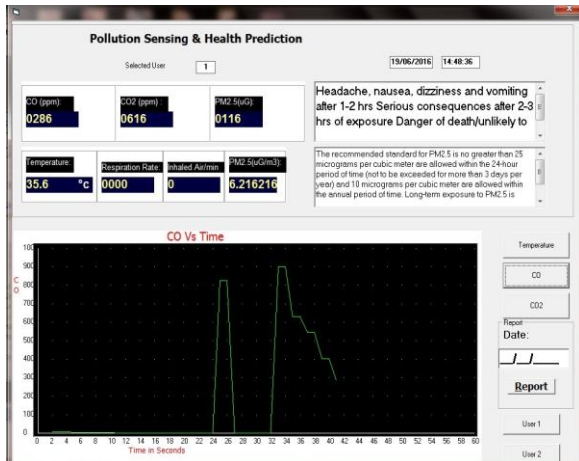


Fig. 4 VB interface to keep record and charts

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