

REAL TIME AIR POLLUTION MONITORING SYSTEM FOR URBAN AREAS

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ABSTRACT

The quality of our air has a direct impact on our overall quality of life, so it is made important to identify the increased pollution in air. Continuous monitoring is important for finding the percentage of air pollution in particular area. This system helps to identify the percentage of CO, CO₂ and O₃ in air. This air Quality monitoring System will transfer and store data over internet. It possible to observe the information of air quality in particular area from anywhere. Stored information can be used for farther analysis. Finally this system also provides facility to alert RTO and Corporation office when critical level of any hazardous gas is observed.

INTRODUCTION

The goal of this air quality monitoring is to protect humans and the environment from harmful air pollution. Air pollution is a major environmental problem in the developing countries. Major cause of air pollution is the automobiles or Vehicle pollution. Heavy transportation may lead to poor air quality, and inhaling pollutants for a long time also causes damages in human health. Air pollution causes increased respiratory illness to the old and young, decreasing visibility, damage to plants and animals and has possibly catastrophic effects on the global scale. To make preventive action plan need detail observation of air pollution in a particular area. The purpose of this system is to collect the information about purity of air at that location. Collected information helps to make proper action plan to reduce pollution. Sensors are connected using interfacing module. After getting measured values from sensors interfacing module will connect system over internet using wireless module. We can observe this information locally on LCD display or from any far away station using internet connectivity. It is essential to provide an alarm for a near future dangerous situation, because prevention is better than cure. It can reduce severe damage and recovery cost, so to indicate the dangerous situation GSM module is include in system which will generate alert message for responsible Authorities like RTO office and corporation office. Also this system will save the measured data periodically at storage space for in further analysis of air pollution over particular duration.

OVERVIEW

A. TYPES OF POLLUTANTS:

In order to understand the causes of Air pollution, several divisions can be made. Primarily air pollutants can be caused by primary sources or secondary sources. The pollutants that are a direct result of the process can be called primary pollutants. A classic example of a primary pollutant would be the sulfur-dioxide emitted from factories.

Secondary pollutants are the ones that are caused by the inter mingling and reactions of primary pollutants. Smog created by the interactions of several primary pollutants is known to be as secondary pollutant.

B. CAUSES OF AIR POLLUTION

Table 1: Air pollution Causes

Causes	Pollutant Released
1. Burning of Fossil Fuels	Sulfur dioxide
2. Agricultural activities	Ammonia
3. Exhaust from factories and industries	carbon monoxide, hydrocarbons, organic compounds, and chemicals
4. Mining operations	dust and chemicals
5. Indoor air pollution	toxic chemicals

C. EFFECTS OF AIR POLLUTION

1. RESPIRATORY AND HEART PROBLEMS: The effects of Air pollution are alarming. They are known to create several respiratory and heart conditions along with Cancer, among other threats to the body. Several millions are known to have died due to direct or indirect effects of Air pollution. Children in areas exposed to air pollutants are said to commonly suffer from pneumonia and asthma.

2. GLOBAL WARMING: Another direct effect is the immediate alterations that the world is witnessing due to Global warming. With increased temperatures worldwide, increase in sea levels and melting of ice from colder regions and icebergs, displacement and loss of habitat have already signaled an impending disaster if actions for preservation and normalization aren't undertaken soon.

3. ACID RAIN: Harmful gases like nitrogen oxides and sulfur oxides are released into the atmosphere during the burning of fossil fuels. When it rains, the water droplets combines with these air pollutants, becomes acidic and then falls on the ground in the form of acid rain. Acid rain can cause great damage to human, animals and crops.

4. DEPLETION OF OZONE LAYER: Ozone exists in earth's stratosphere and is responsible for protecting humans from harmful ultraviolet (UV) rays. Earth's ozone layer is depleting due to the presence of chlorofluorocarbons, hydro chlorofluorocarbons in the atmosphere. As ozone layer will go thin, it will emit harmful rays back on earth and can cause skin and eye related problems. UV rays also have the capability to affect crops.

Several different methods are used to monitor air quality. These range from systems that continuously sample and analyze the air onsite, to systems which require laboratory analysis of an air sample or filter. Methods that require laboratory analysis typically have longer periods over which the air is sampled, which range from one hour to one month. One factor that affects the length of sampling time is the pollutant concentration. When the pollutant being monitored has a relatively low concentration, a longer sampling time may be required. Air monitoring methods can be categories as follows:

- 1. CONTINUOUS MONITORING:** Continuous monitoring equipment provides an almost instantaneous measurement of ambient concentrations for several pollutants. These include carbon dioxide, ammonia, carbon monoxide, hydrocarbons, hydrogen sulphide, and total reduced sulphurs, oxides of nitrogen, ozone, particulate matter and sulphur dioxide.
- 2. INTERMITTENT MONITORING:** In some cases, a more detailed investigation is needed to determine what pollutants are present in the air. In these situations, intermittent monitoring is used. Intermittent monitoring refers to the collection of samples over a period of time commonly ranging from one to 24 hours. These samples are then analyzed at a laboratory to determine air pollutant concentrations. Intermittent monitoring is typically used to identify levels of particulate matter and hydrocarbons in the air.
- 3. PASSIVE MONITORING:** Passive monitoring is named for the technique used to collect samples. This method is often used in rural and remote areas, and requires no power to operate. Pollutants are collected onto reactive surfaces, which are then sent to the laboratory for analysis. The reactive surface of these samplers consists of solid chemical compound or a filter that is impregnated with a reactive solution. Passive monitors usually sample for an entire month. Analysis provides a monthly average for pollutants being monitored. The four pollutants typically monitored using the passive method are sulphur dioxide, nitrogen dioxide, ozone and hydrogen sulphide. One advantage of using a passive sampling system is that a network of many samplers can be used over a large area to determine the type and concentration of pollutants.
- 4. MOBILE AIR QUALITY MONITORING LABORATORY (MAML):** The Mobile Air Monitoring Laboratory is a special vehicle designed to measure air quality. It can be used to monitor air almost anywhere in Alberta as long as the site is accessible by road. The MAML is equipped with a number of continuous monitors which can provide immediate air quality information for the location monitored. This method includes obtaining air quality data from locations that do not have continuous monitoring stations, exploring for new monitoring sites, and responding to community air quality concerns.

Traditionally the air pollution monitoring is done via computerized tomography technique which generate a two dimensional map of pollutant concentration. In this system there is a single laser source located at the centre of the area. This laser beam is rotated and directed towards the circumference of the circle. There is a cylindrical mirror so that incident laser beam is reflected in a fan beam over angle across the circle. The beam from the mirrors is the circular region and strikes a set of detectors lie in same plane parallel to the ground. This technique focus on lower transmitted laser energy increasing the range and ability to monitor the area that contains several pollutant sources

Wireless sensor networks have been deployed for environmental monitoring, which includes collecting the observed data over time across a volume of space large enough to exhibit significant internal variation. Environment Observation and Forecasting System (EOFS) is an application for monitoring and providing a forecasting about environmental phenomena.

SYSTEM MODELLING

The developing system consists of three types of sensors they are the carbon monoxide, carbon dioxide and the ozone these are the gas sensors. Sensors are used to sense and collect the information regarding the pollutants in that area. Then the system also consists of the Black Beagle bone development board which act as a controller. Here the Sensors will sense the pollution then the received information will be processed to achieve a proper Digitized signal by the controller. Then the level of pollutants will be compared to the Air Quality Standard and if any of the pollutant may exceed the standard value then a message will be sent to the RTO office and to the co-operation Head about the increase in the level of pollution so they may take proper measures. Also the data will be displayed on the LCD so that we may get to know the level of pollutant .This data will also be uploaded on the Google drive through Wi-Fi so that timely data may be available to authorities and also to the lay man. we required hardware which can run embedded OS, which makes easy way to create required things. Finally considering all aspects we chose Beagle bone black board. The Beagle Bone Black is the newest member of the Beagle Board family. It is a lower-cost, high-expansion focused Beagle Board using a low cost Sitara XAM3359AZCZ100 Cortex A8 ARM processor from Texas Instruments.

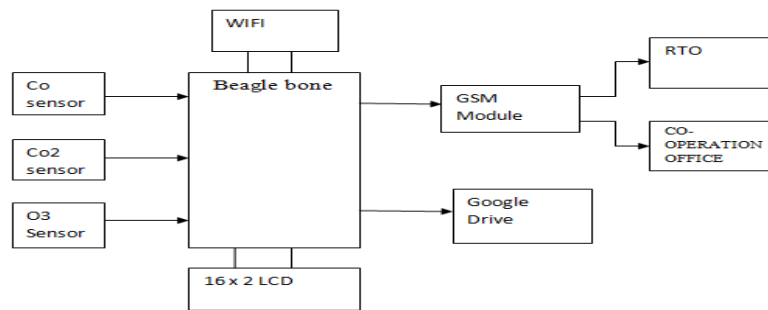


Figure 1: Block Diagram

1. **SENSOR DESCRIPTION:** The gas levels are sensed through the respective gas sensors (here TGS2442, TGS4161) used for sensing and sent to the Beagal bone controller. The sensed analog signals are converted to digital through ADC (inbuilt). The sensed gas levels are displayed in the LCD.
 - CO sensor- MQ7-response: resistance of SnO₂ layer on electrical insulation layer. Response time: tens of seconds;
 - CO₂ sensor- MG811 response: electromotive force which is the result of electrochemical reaction of CO₂ and electrodes made of gold and lithum carbonate with cation (Na⁺) solid electrolyte. Response time: up to 1 minute, recovery time: up to 2.5minutes
 - Ozone Sensor-MQ131 -Semiconductor Sensor for Ozone Sensitive material of MQ131 gas sensor is SnO₂, which with lower conductivity in clean air. When Ozone gas exists. The sensor's conductivity is more higher along with the gas concentration rising. Using simple electro circuit, Convert change of conductivity to correspond output signal of gas concentration. MQ131 gas sensor has high sensitivity to Ozone, also sensitive to CL₂, NO₂, etc
2. **BEAGLE BONE BLACK:** The board uses the Sitara XAM3359AZCZ processor in the 15x15 package. This is basically the same processor as used on the original Beagle Bone. It does use the updated 2.0 revision with several fixes on this new processor as opposed to the original Beagle Bone. Important features from this new processor include:
 - DC Power is the main DC input that accepts 5V power.
 - Power Button alerts the processor to initiate the power down sequence.
 - 10/100 Ethernet is the connection to the LAN.
 - Serial Debug is the serial debug port.
 - USB Client is a mini USB connection to a PC that can also power the board.

- BOOT switch can be used to force a boot from the micro SD card if the power is cycled on the board, removing power and reapplying the power to the board.
- There are four blue LEDs that can be used by the user.
- Reset Button allows the user to reset the processor.
- Micro SD slot is where a micro SD card can be installed.
- Micro HDMI connector is where the display is connected.

CONCLUSION

From above explanation we conclude that this air pollution monitoring system can be used to real time monitoring of hazardous impurities in air accurately. After detecting harmful gas contain air we take preventive action to reduce air pollution.

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