



IoT based Air Pollution Monitoring System

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Abstract

The pollution level has increased with lot of factors like the increase in population, increased vehicle use, industrialization and urbanization which results in harmful effects on human wellbeing by directly affecting health of population exposed to it. The parameters of the environment to be monitored are chosen as temperature, volume of Carbon dioxide, volume of, detection of leakage of any harmful gases for human being. Carbon dioxide, a dangerous parameter is monitored with an extra precaution. To avoid all this things complete termination of all the harmful industries is not possible hence one effective solution is taken by proposed system and that is a amount is paied by those industries according to the level of pollution hence in this way complete termination of pollution is not cover but its concentration is definitely reduced. A text message is sent to the base station through GSM module whenever time of period is completed just like our energy meter. Due to that system industries try to reduce the pollution level because the need to reduce the bill, in this way pollution emitted from industries can be reduced.

1. INTRODUCTION

Nowadays environmental pollution has become a critical issue due to increased demand to products and development. Due to deforestation and industrialization, air quality is constantly degrading year on year. Any type of air pollution has sources of industrial activities is known as Industrial air pollution. Cutting down air pollution is the first step to go green.

Industrial air pollution is major source of total environmental air pollution Stationary emission sources from industries / factories includes pollution from stacks, chimney, diesel generators, boilers etc. They emit majorly Particulate Matter (PM10 & PM2.5), Sulphur Dioxides (SO₂), Nitrogen oxides (NO_x), Carbon monoxide (CO), Carbon Dioxide (CO₂), VOC etc. Hence to reduce this pollution we use this project Pollution Meter. In this system we monitor the

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concentration of harmful gases which are emitted from industrial wastage. And also give bill for producing more pollution in nature. For that gas sensors and temperature sensor is used to sense those parameters and send all data to Internet to pay the pollution bill.

Causes of Industrial Pollution

1. Lack of Policies to Control Pollution: Lack of effective policies and poor enforcement drive allowed many industries to bypass laws made by pollution control board which resulted in mass scale pollution that affected lives of many people.

2. Unplanned Industrial Growth: In most industrial townships, unplanned growth took place wherein those companies flouted rules and norms and polluted the environment with both air and water pollution.

3. Use of Outdated Technologies: Most industries still rely on old technologies to produce products that generate large amount of waste. To avoid high cost and expenditure, many companies still make use of traditional technologies to produce high end products.

4. Presence of Large Number of Small Scale Industries: Many small scale industries and factories that don't have enough capital and rely on government grants to run their day-to-day businesses often escape environment regulations and release large amount of toxic gases in the atmosphere.

5. Inefficient Waste Disposal: Water pollution and soil pollution are often caused directly due to inefficiency in disposal of waste. Long term exposure to polluted air and water causes chronic health problems, making the issue of industrial pollution into a severe one. It also lowers the air quality in surrounding areas which causes many respiratory disorders.

6. Leaching of Resources From Our Natural World: Industries do require large amount of raw material to make them into finished products. This requires extraction of minerals from beneath the earth. The extracted minerals can cause soil pollution when spilled on the earth. Leaks from vessels can cause oil spills that may prove harmful for marine life.

Effects of Industrial Pollution

1. **Water Pollution:** The effects of industrial pollution are far reaching and liable to affect the eco-system for many years to come. Most industries require large amounts of water for their work. When involved in a series of processes, the water comes into contact with heavy metals, harmful chemicals, radioactive waste and even organic sludge.

These are either dumped into open oceans or rivers. As a result, many of our water sources have high amount of industrial waste in them which seriously impacts the health of our eco-system. The same water is then used by farmers for irrigation purpose which affects the quality of food that is produced has already rendered many ground water resources useless for humans and wildlife. It can at best be recycled for further usage in industries.

2. **Soil Pollution:** Soil pollution is creating problems in agriculture and destroying local vegetation. It also causes chronic health issues to the people that come in contact with such soil on a daily basis.

3. Air Pollution: Air pollution has led to a steep increase in various illnesses and it continues to affect us on a daily basis. With so many small, mid and large scale industries coming up, air pollution has taken toll on the health of the people and the environment.

4. Wildlife Extinction: By and large, the issue of industrial pollution shows us that it causes natural rhythms and patterns to fail, meaning that the wildlife is getting affected in a severe manner. Habitats are being lost, species are becoming extinct and it is harder for the environment to recover from each natural disaster. Major industrial accidents like oil spills, fires, leak of radioactive material and damage to property are harder to clean-up as they have a higher impact in a shorter span of time.

5. Global Warming: With the rise in industrial pollution, global warming has been increasing at a steady pace. Smoke and greenhouse gases are being released by industries into the air which causes increase in global warming. Melting of glaciers, extinction of polar bears, floods, tsunamis, hurricanes are few of the effects of global warming.

The issue of industrial pollution concerns every nation on the planet. As a result, many steps have been taken to seek permanent solutions to the problem. Better technology is being developed for disposal of waste and recycling as much polluted water in the industries as possible. Organic methods are being used to clean the water and soil, such as using microbes that naturally uses heavy metals and waste as feed. Policies are being pushed into place to prevent further misuse of land. However, industrial pollution is still rampant and will take many years to be brought under control.

2. PROPOSED SYSTEM

Block diagram of proposed system is as follows.

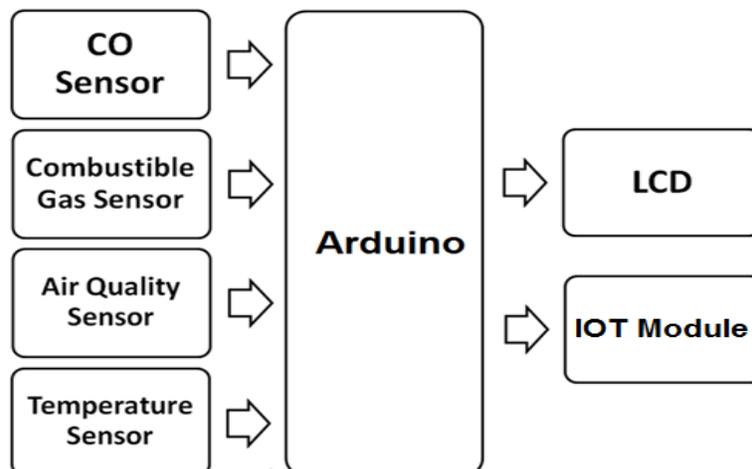


Fig -1 proposed system of pollution meter

Arduino Microcontroller. Then Arduino calculate the amount of pollution and according to rates it finds the bill which is pay by the company.

In resent state we interface LM 35 with Arduino microcontroller and reading of temperature is displayed on LED. By varying temperature we can easily monitor the temperature change.

4. Hardware and Software Used

4.1 Arduino Microcontroller

The Arduino microcontroller is an easy to use yet powerful single board computer that has gained considerable traction in the hobby and professional market. The Arduino is open-source, which means hardware is reasonably priced and development software is free. For advanced Arduino users, prowl the web; there are lots of resources.

This guide covers the Arduino Uno board a good choice for students and educators. With the Arduino board, you can write programs and create interface circuits to read switches and other sensors, and to control motors and lights with very little effort.

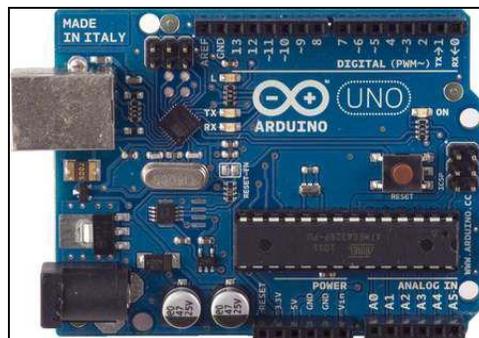


Fig-3 Arduino Microcontroller Board

Installing the Software

Follow the instructions on the Getting Started section of the Arduino web site, <http://arduino.cc/en/Guide/HomePage>. Go all the way through the steps to where you see the pin 13 LED blinking. This is the indication that you have all software and drivers successfully installed and can start exploring with your own programs.

Connecting a Battery

For stand-alone operation, the board is powered by a battery rather than through the USB connection to the computer. While the external power can be anywhere in the range of 6 to 24 V (for example, you could use a car battery), a standard 9 V battery is convenient. While you could jam the leads of a battery snap into the Vin and Gnd connections on the board, it is better to solder the battery snap leads to a DC power plug and connect to the power jack on the board. A suitable plug is part number 28760 .Disconnect your Arduino from the computer. Connect a 9 V battery to the Arduino power jack using the battery snap

adapter. Confirm that the blinking program runs. This shows that you can power the Arduino from a battery and that the program you download runs without needing a connection to the host PC

4.2 ATmega328

The Atmel ATmega328 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega328 achieves throughputs close to 16MIPS per 16 MHz. This empowers system designed to optimize the device for power consumption versus processing speed.

Features

- High-performance, Low-power Atmel AVR 8-bit Microcontroller
- Advanced RISC Architecture
 - 130 Powerful Instructions - Most Single-clock Cycle Execution
 - 32 x 8 General Purpose Working Registers
 - Fully Static Operation
 - Up to 16MIPS Throughput at 16MHz
 - On-chip 2-cycle Multiplier
- High Endurance Non-volatile Memory segments
 - 32 KBytes of In-System Self-programmable Flash program memory
 - 512Bytes EEPROM
 - 1KByte Internal SRAM
 - Write/Erase Cycles: 10,000 Flash/100,000 EEPROM

4.3 MQ-2 (Combustible Gas)

The Grove - Gas Sensor (MQ2) module is useful for gas leakage detecting (in home and industry). It can detect H₂, LPG, CH₄, CO, Alcohol, Smoke, Propane. Based on its fast response time. Measurements can be taken as soon as possible. Also the sensitivity can be adjusted by the potentiometer.



Fig -4. MQ-2(Combustible Gas)

Sensitive material of MQ-2 gas sensor is SnO₂, which with lower conductivity in clean air. When the target combustible gas exist, The sensor's conductivity is more higher along with the gas concentration rising. Please use simple electro circuit, Convert change of conductivity to correspond output signal of gas concentration. Q-2 gas sensor has high sensitivity to LPG, Propane and Hydrogen, also could be used to Methane and other combustible steam, it is with low cost and suitable for different application..

4.4 MQ7 (Carbon Monoxide)

Sensitive material of MQ-7 gas sensor is SnO₂, which with lower conductivity in clean air. It make detection by method of cycle high and low temperature, and detect CO when low temperature (heated by 1.5V). The sensor's conductivity is higher along with the gas concentration rising. When high temperature (heated by 5.0V), it cleans the other gases adsorbed under low temperature. By using simple electro circuit, convert change of conductivity to correspond output signal of gas concentration. MQ-7 gas sensor has high sensitivity to Carbon Monoxide. The sensor could be used to detect different gases contains CO; it is with low cost and suitable for different application.



Fig.-5 MQ7 (Carbon Monoxide)

Specifications:

Table No.1

Parameter	Value
Circuit voltage	5v
Using temperature	-20C to +50C
Storage temperature	-20C to +50C
Relative humidity	Less than 95% RH

The MQ-7 gas sensor is shown as Fig. (Configuration A or B), sensor composed by micro AL₂O₃ ceramic tube, Tin Dioxide (SnO₂) sensitive layer, measuring electrode and heater are fixed into a crust made by plastic and stainless steel net. The heater provides necessary work conditions for work of sensitive components. The enveloped MQ-7 have 6 pin, 4 of them are used to fetch signals, and other 2 are used for providing heating current.

4. 5 LM35 (Temperature Sensor)

The two main types of semiconductor temperature sensors are temperature sensitive voltage sources and temperature-sensitive current sources. An example of the first type is the National LM35. The voltage output from this circuit increases by 10 mV for each degree centigrade that its temperature is increased. If the output is connected to a negative reference voltage V_s, the sensor will give a meaningful

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The ESP8266 is the name of a micro controller designed by Expressive Systems. The ESP8266 itself is a self-contained WiFi networking solution offering as a bridge from existing micro controller to WiFi and is also capable of running self-contained applications. This module comes with a built in USB connector and a rich assortment of pin-outs. With a micro USB cable, you can connect NodeMCUdevkit to your laptop and flash it without any trouble, just like Arduino. It is also immediately breadboard friendly.

Specification:

- Voltage: 3.3V.
- Wi-Fi Direct (P2P), soft-AP.
- Current consumption: 10uA~170mA.
- Flash memory attachable: 16MB max (512K normal).
- Integrated TCP/IP protocol stack.
- Processor: Tensilica L106 32-bit.
- Processor speed: 80~160MHz.
- RAM: 32K + 80K.
- GPIOs: 17 (multiplexed with other functions).
- Analog to Digital: 1 input with 1024 step resolution.
- +19.5dBm output power in 802.11b mode
- 802.11 support: b/g/n.

4.7 Software

Connect your Arduino to the computer with the USB cable. You do not need the battery for now. The green PWR LED will light. If there was already a program burned into the Arduino, it will run.

Start the Arduino development environment. In Arduino-speak, programs are called “sketches”, but here we will just call them programs.

In the editing window that comes up, enter the following program, paying attention to where semi-colons appear at the end of command lines.

```
void setup()
{
  Serial.begin(9600);
  Serial.println("Hello World");
}
void loop()
{
}
```

Your window will look something like this



Fig-8SOFTWARE

- ✓ Click the Upload button  or Ctrl-U to compile the program and load on the Arduino board.
- ✓ Click the Serial Monitor button . If all has gone well, the monitor window will show your message and look something like this

5. RESULT and CONCLUSION

The system to monitor the air of environment using Arduino microcontroller, IOT Technology is proposed to improve quality of air. With the use of IOT technology enhances the process of monitoring various aspects of environment such as air quality monitoring issue proposed in this paper. Here the using of MQ135 gas sensor gives the sense of different type of dangerous gas and arduino is the heart of this project which controls the entire process. Wi-Fi module connects the whole process to internet and LCD is used for the visual Output. The Automatic Air & Sound management system is a step forward to contribute a solution to the biggest threat. The air & sound monitoring system overcomes the problem of the highly-polluted areas which is a major issue. It supports the new technology and effectively supports the healthy life concept.



IOT Based Pollution Monitoring and Metering System	
Temperature(*C)=	37
Air Quality(%) =	15
Combustible Gas(%)=	45
Carbon Monoxide(%) =	45
Unit =	0

Fig-9 Result showing various parameters reading

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This system has features for the people to monitor the amount of pollution on their mobile phones using the application.

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