



AIR-CONTAMINATION DETECTOR: A SMART SYSTEM TO MONITOR & CONTROL AIR POLLUTION

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Abstract: Pollution is one of the significant issues of environment. Amongst several pollutions, air pollution is the one which have been causing harm to the earth since many years resulting into the occurrence of many fatal diseases to the people of different age groups. Based on this scenario, this project aims to monitor the air quality with the help of several sensors like MQ135, BME680 and alert the people through piezo buzzer, LCD and LED when the hazardous gases like Carbon dioxide, NO_x, smoke, benzene etc. exceeds the safety level. By this, people can take necessary action in advance to prevent hazardous diseases caused by air pollution.

Keywords – Air pollution, fatal diseases, air quality, BME680, MQ135, hazardous gases.

I. INTRODUCTION

In the modern era of technology, every corner of our society as well as the world is going through advancements in every sector. There are the needs of intelligent devices in every corner of the world. Now a days, one of the most burning problems of our environment is Air pollution. It is caused when the air gets contaminated due to the presence of several substances in the atmosphere that can cause damage to the humans, other living beings, environment and climate. Increasing or decreasing the composition of gases present in the atmosphere is detrimental to survival. The imbalance in gas composition causes an increase in global temperature called global warming. Moreover, the rapidly increasing human activities such as cutting down trees abruptly, fossil fuel burning etc. play major role in polluting air. When the air quality of an area is poor, it is unhealthy for children and aged people with heart disease, asthma and other respiratory problems. Pollution can be built up in small enclosed areas and local areas where factories are located or a busy road is there that faces huge traffic, can be a cause of poor air quality. As different areas have different levels of air quality, it is necessary to monitor the air quality and understand what is happening.

So, this project aims to build a IOT based system with the help of Arduino UNO that will be capable of monitoring the air pollution. As air pollution involves the mixture of several pollutants like harmful gases such as Carbon Monoxide (CO), Volatile Organic Compounds (VOCs), Nitrous Oxides (NO_x), Sulphur Dioxide (SO₂) and other harmful substances, the system will be able to monitor the excessive presence of all these gases and will notify people.

II. OBJECTIVE

The main objectives of this project are following –

- A combination of advanced detection technology is required to produce an accurate air quality sensing system with advanced capabilities to provide low-cost comprehensive monitoring.
- The sensed data should be displayed in a user-friendly manner on an LCD display and also on webpage. By this people can observe the pollution level from anywhere using their personal devices.
- Data from different areas can be compared to determine air quality and countries.
- Identify air pollution and develop warning systems.
- Provide information to the public on air quality and increase awareness.
- The trends related to hazardous substances emission can be efficiently monitored.

III. LITERATURE SURVEY

Md. Abdullah Al Ahasan et al in July 2018 [1] in his paper depicted an air pollution monitoring system which is being designed using Arduino Uno, MQ-135, a breadboard, and a 16x2 LCD. It is mainly designed to show the air pollution level on the LCD screen and whether it is harmful or not. This will help us to decide whether pollution is negligible or not. As a result, a series of observed values is recorded and it is useful for statistical purpose to study the air pollution level of a particular area thoroughly.

Mursil Mahmud in December 2019 [2] created a smart air pollution monitoring system with a Wi-Fi module to connect to the internet. In this IoT system, the Arduino Uno is programmed in such a way that when the presence of harmful gas goes beyond a certain programmed fixed level value a buzzer generates sound, and the level of air quality will be displayed. Moreover, the whole

generated data showed on a webpage. So that we can access regular updates on air pollution through LCD and Webpage wirelessly, by the Wi-Fi module. In our paper, we have designed a real-time application-based smart air pollution monitoring system with Arduino UNO, ESP8266 Wi-Fi module, MQ-135, BME680 Temperature, Humidity, Pressure and Gas sensor, LCD, Buzzer and IOT all in one to make it simple to understand by users. We have tried to make it convenient and compact for the efficient use in simple way.

IV. BLOCK DIAGRAM

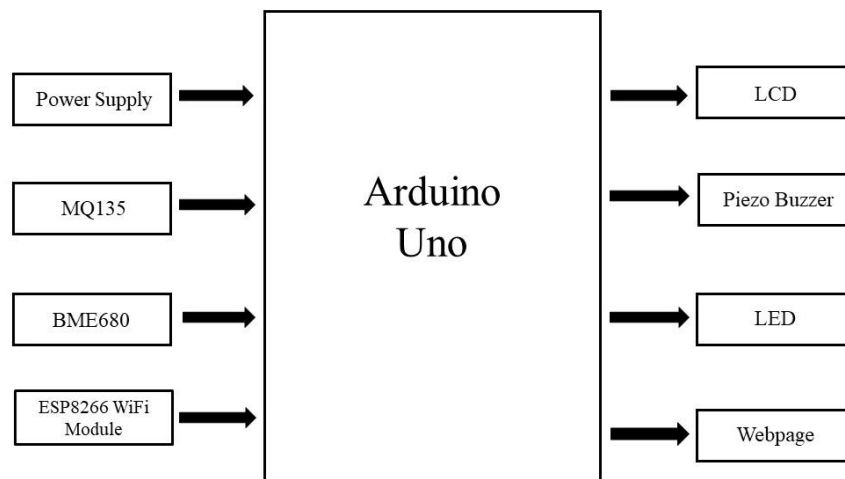


Figure1: Block diagram of proposed system

V. PROPOSED METHODOLOGY

The proposed system is capable of monitoring air pollution. In this project, several sensors will be used to have the idea on quality of air, presence of hazardous gases and presence of humidity. There are certain levels of presence of several gases in the atmosphere. When pollution increases, these safety amounts also exceed. As output, the system will trigger alarm when air quality goes beyond certain safety level i.e., when contamination in the air increases then connected LED will glow red. Also, when the presence of harmful gases exceeds the safety limit, it will be displayed on the LCD monitor that will be connected with the Arduino board. As it is an IoT based system so this device will be given access to Wi-Fi with the help of ESP8266 module and the result can be shown to webpage. The pollution level will be displayed on the webpage so that it can be monitored with ease. People can monitor the pollution level from anywhere using computer or mobile from any corner of the world.

VI. COMPONENTS REQUIRED

We are using following components to build the system –

6.1 Arduino UNO:

It is the main component of the project. Arduino UNO is a microcontroller which is based on ATmega328P. To build our project, we are using Arduino UNO R3 version. There are total 6 analog pins, 14 digital pins (here 6 pins are used for PWM outputs), an ICSP header in this microcontroller. Also, there is a USB connection and a reset button. Arduino UNO is programmable and very easy to use for building any smart device. [3]

6.2 MQ135:

This is also known as hazardous gas detecting sensor. This sensor can sense the presence of several hazardous gases like SO₂, CO, NH₃, Smoke, benzene steam and other gases. It can operate on 5V DC voltage and detect gases up to the range of 10PPM-100PPM. [4]

6.3 BME680:

This is basically four in one sensor as it can measure humidity, temperature, VOC (Volatile Organic Compound) and barometric pressure. This sensor ensures long term robustness, stability and optimized consumption. [5]

6.4 ESP8266:

ESP8266 Wi-Fi module is used to give any system access to Wi-Fi so that the results or outputs can be displayed in any device through Wi-Fi. When ESP8266 Wi-Fi module is connected to Arduino UNO, it runs of 3.3V, although the voltage of this component varies. [6]

6.5 LCD:

We are using LCD to display the output. The full form of LCD is Liquid Crystal Display. There are several types of LCDs which are available. Here we are using LCD with 16x2 display. [7]

6.6 Piezo Buzzer:

Another component that we are using in output module is piezo buzzer. Piezo buzzer will create an alarm to alert people when the contamination in the air increases. It works on the principle of piezo-electric effect. [8]

6.7 Other components:

The other components that we have used are breadboards, jumper wires, LEDs, potentiometer, NPN transistor, resistors, bi-directional logic level converter to complete the entire circuit connection.

VII. CIRCUIT DIAGRAM

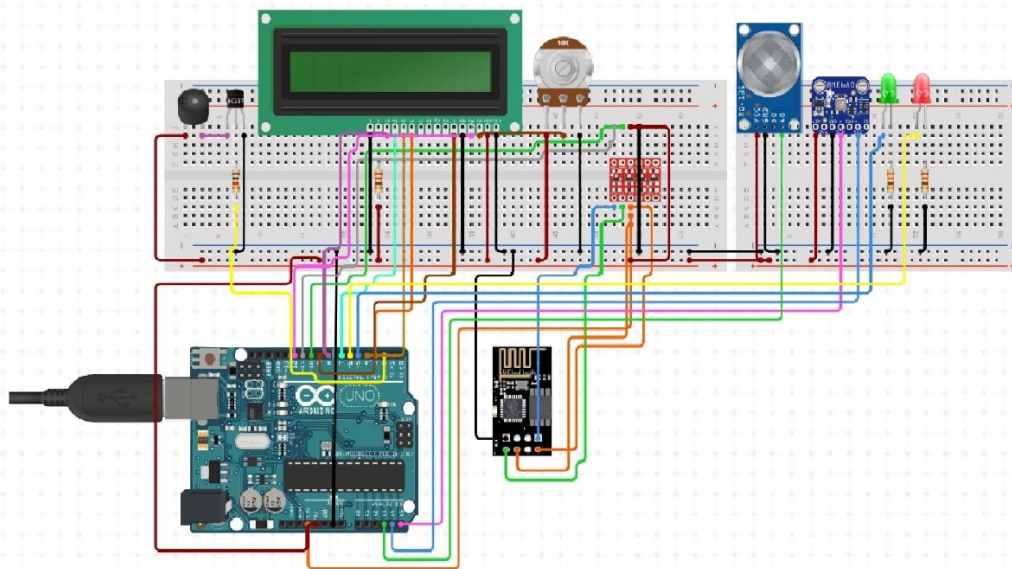


Figure2: Circuit Diagram

VIII. WORKING PRINCIPLE

The figure2 shows the entire connection of the system. Here, we are using Arduino UNO R3 microcontroller. For giving the system input, MQ135 and BME680 sensors are connected to Arduino board. These sensors are capable of sensing the presence of hazardous gases, humidity and temperature in the air. This project aims to monitor the amount of harmful gases present in our atmosphere and alert people about the same. Suppose, the safety range of gases is 1000PPM, then LCD monitor will display “Good Air! Feels safe”. We have to define the safety level of the gases while configuring the system. Here, we are using LCD screen, piezo buzzer and LED for output module. Firstly, when the predefined safety range of gases in atmosphere exceeds, the gas sensor will send the sensed data via Arduino to LCD which will show, “Very bad Air! Be safe”. Along with this, LCD will also display humidity level and temperature of air.

Besides LCD, the piezo buzzer will start alarming in order to alert people and red LED will glow up. The potentiometer and NPN transistor are used to give the components better stability and make system efficient. Here, potentiometer can help to increase the contrast of LCD. [9]

We have connected ESP8266 Wi-Fi module with Arduino board with the help of jumper wires to give the system access to Wi-Fi. The ESP8266 runs on 3.3V and Arduino UNO runs on 5V. Here, the system may get damaged if Arduino UNO gives 5V. So, we are using bi-directional logic level converter to co-ordinate voltage level of the components that lies between 3.3V and 5V components. By ESP8266, we can display the output data same as LCD on website through which people can monitor the pollution level from any corner of the world.

IX. FUTURE ASPECT

To create this proposed system way smarter, there are several future aspects which we have taken into consideration. Those are following –

a. Our work can show vast possibilities of advancements on the device. This device can be used at any time effectively in different locations. This system will be updated with more advanced additional sensors that can detect the existence of more harmful substances.

b. An auto-purifying module can also be implemented in this device so that along with air pollution monitoring it will be able to purify the air automatically whenever the air gets contaminated. Whenever the pollution is controlled, the green LED will glow up and red LED will turn off.

c. As this is an IOT based project and associated with the connection of ESP 8266 Wi-Fi module so our main goal is to develop an advanced website with many unique and smart features that will fetch the result from Arduino. The pollution level will be displayed on the webpage so that it can be monitored with ease.

d. Most interestingly in future, we will try to connect it with AWS IOT database, so that it can work perfectly and give more efficient result.

e. Installation of GPS module for perfect location access.

X. ADVANTAGES

a. As air pollution is very dangerous for all of us and can be fatal too, this system will help people to take precautionary measures in advance.

b. Very much efficient in urban area where people experience contaminated atmosphere all day long. [10]

c. All the components are easily available in the market and easy to use.

d. People can monitor the air quality while staying outdoor and indoor both.

XI. APPLICATIONS

10.1 Monitoring Indoor Air Quality:

Indoor air pollution is the reason of death of nearly 3.2 million persons. [11] Indoor air quality can deviate for many reasons like smoking, burning of fuels etc. So, our system can help to monitor indoor air quality.

10.2 Monitoring Outdoor Air Quality:

Outdoor air pollution is one of the reasons of global warming, fatal diseases and deviation of health of living beings. Based on this, our system can help the environment get healthy and deal with outdoor air pollution.

10.3 Trend Analysis:

The records about pollution can be stored if the system is connected to database. This will help to analyse and monitor the trends of pollution in future.

10.4 Monitoring Particulate Matters:

Particulate matters are microscopic particles of solid or liquid suspended in the air. These can be composed of acid, metal or dirt. Inhaling these particles are very much injurious to health. So, our system may help to detect those particles and can be used in industries.

XII. CONCLUSION

To provide the environment and mankind a sustainability and to solve the burning problems of our environment, it is our duty to find solution instead of focusing on the problem. This IoT based device will be able to monitor and control the air pollution. It will be helpful to prevent indoor and outdoor air pollution. By this, people can stay away from many hazardous respiratory diseases that are caused due to air pollution such as COPD (Chronic Obstructive Pulmonary Disease), IHD (Ischemic Heart Disease), Bronchitis, Asthma, Severe Allergy, Tuberculosis and even Lung Cancer.

Also, if an automatic purifying module is developed with this device, it will be smarter and more beneficial approach. The detailed research and development are required in this field in order to deal with this problem. This will provide the mankind healthier and more sustainable environment and it will lead us to a better pollution free world.

XIII. ACKNOWLEDGMENT

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