Air pollution detection System and measurement of the temperature and humidity by using Arduino

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***Abstract*— The goal of this project is to reduce air pollution in Bangladesh. Air pollution is currently one of the world's most pressing issues. Air pollution can come from both man-made and natural sources. Pollutants in the air and other atmospheric substances have a significant impact on people's health. It is necessary to build a real-time air quality and pollution monitoring system. We created an arduino-based air pollution detector by combining a small, low-cost sensor with an arduino microcontroller unit. The detector's advantages include dependable stability, rapid reaction recovery, and long-life qualities. The aim of this project is to eliminate pollution in the environment, particularly inside the house. If it detects an excessive pollution rate, it will sound the alert.**

***Index Terms*—Air Pollution, Environment, gas sensor, Arduino UNO.**

Codelink:

https://github.com/MehedyHasan10/airPollutionDetection

I. Introduction

Motivation:

In recent years, air pollution has been identified as a key cause of a variety of ailments. Nowadays the air condition is much polluted. Car emissions, factory chemicals, smoke, and dust have all become more prevalent in recent years. That is why today's air conditioning is so dirty. Air pollution has a negative impact on human health, particularly in areas where we take in air for breathing. Some ailments, such as asthma, cough, and lung abnormalities, can be caused by bacteria in our lungs. As a result, we intend to focus on this problem of polluted air detection. We can identify polluted air and minimize pollution by working on this topic, so that we stay safe from air pollution and also we can keep our environment better.

Our project's major purpose is to determine the extent of air pollution. We want to implement a system that will check the level of purity of air particles and gas floating in the air. The light will blink and the buzzer will sound as the concentration of all of these elements in the air rises. By identifying the source of contamination, the pollution can be prevented.

Due to its modest size, we will be able to utilize this product in the future in places such as offices, cars, and so on.

Project Objectives:

Sensors for detecting air pollution used to be large, bulky, and expensive. Most air pollution sensors are now designed to detect the five most common air pollutants: nitrous oxide, carbon monoxide, ozone, sulfur dioxide, and particle matter. Air pollution monitoring is extremely important in today's society since they have such a large impact on human health.

The designed air-quality measurement sensor can detect and monitor air pollution in the surrounding environment. It is suitable for both indoor and outdoor use. With future technology advancements, these sensors will become more affordable and common, as well as portable air quality sensors that individuals can wear to monitor local air quality [3-5].

A brief outline of the report:

The following is a summary of the report's structure. The study's motivation is laid out in Chapter I, which is followed by a brief description of the project. The backdrop of the investigation, including the various air environmental characteristics, is described. Literature review were given in Chapter II. The hardware components utilized in the project are discussed in Chapter III, as well as why the specific hardware and software designs were being used. In Chapter IV, the experiment setup is explained, followed by the outcomes of the experiments. Finally, the project is summarized in Chapter V.

II. Literature Review

[1] Air quality monitoring devices have been created that can measure gas in air temperature in real time and may be accessible over the internet. The monitoring structure is implemented around an Arduino Uno microcontroller that serves as an analog to digital converter as well as a gas sensor. The measurements will take place in a well-controlled and artificially contaminated environment.

[2] As a result of increased industrialization and vast urbanization, air pollution monitoring is becoming one of smart cities' primary issues. In the literature, many air pollution monitoring systems have been presented, with wireless sensor networks emerging as a major solution. As a result, proper sensor placement is required to achieve improved performance at a low financial cost.

The designed scheme uses an effective approach to select the best sensors and send out alerts while ensuring that air pollution is covered. Unlike most existing methods, which rely on simple and general detection models, our method is based on spatial analysis of pollution data, which allows us to consider the nature of the pollution problem.

The air pollution monitoring system is critical for detecting a wide range of gases; also, sensor have a long life span, are readily available, are inexpensive, are simple to use, and are compact. Air quality can be measured indoors. This system features a basic driving circuit, real-time operation, and a visual output. The main goal of this document is to ensure that air pollution is monitored and controlled by taking appropriate measures.

III. Methodology and Modeling

This technology operates by collecting data on particular environmental characteristics such as gas content and the quantity of dust in the air. The system comprises sensors and an additional connection point for an additional gas sensor. The five stationary sensors monitor five types of air parameters: humidity, temperature, CO2, O2, and rain. The additional sensor can be picked from a variety of gas sensors that are compatible with this device, including CO, SO2, and O3. In principle, depending on the sensor type, sensor modules generate either analog or digital data for further processing after detecting air environmental factors.

Working principle of project:

This paper shows how to use the ARDUINO UNO to create an air pollution detecting system. A Gas Sensor, Arduino LED, 16 X 2 LCD, Potentiometer, Jumper Wire, Buzzer, and Breadboard make up this system. We're searching for a sensor that can detect or measure CO2, smoke, NH3, NOx, alcohol, and benzene, among other common air quality pollutants. As a result, the gas sensor is the best option for detecting air pollution. Everything will be controlled by Arduino, and the amount of gas will be sent via a gas sensor. When the air begins to pollute, the buzzer piezo will sound an alert. The amount of smoke or gas in the air will be displayed on the LCD, it will detect whether the air is polluted or not. And the Potentiometer is for giving contrast to the LCD. The gas sensor unit is connected to the Arduino Uno board with jumper wires. The analog pin on the sensor unit is connected to analog pin 0 and the digital pin to digital 8 on the arduino board, while the +5V and GND (ground) pins on the sensor unit are connected to the 5V Vcc and GND (ground) pins on the arduino board, respectively.

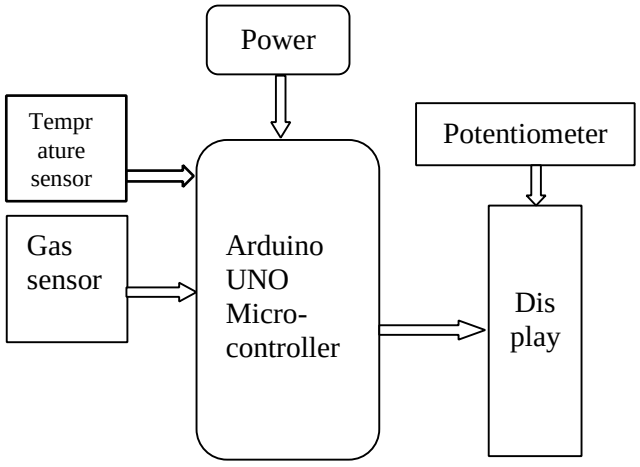


Fig: Block diagram, working principle.

Fig: flowchart.

Process of Work:

The MQ135 is the key chip in the system for gas sensing analysis. The Arduino, sometimes known as the Genuino Uno, is a contemporary microcontroller board that is based on the ATmega328P. A USB link or a power wire connects it to a computer. To become operational, it must be linked to an AC-to-DC converter or a battery supply. The MQ135 gas sensor device is connected to the Arduino Uno board using jumper wires. The analog pin of the sensor is then connected to analog pin 0 and the digital pin to digital 8 on the Arduino board, while the +5V and GND (ground) pins on the sensor unit are connected to the 5V Vcc and GND (ground) pins on the Arduino board, respectively. The Arduino Uno board is then attached to the computer through a USB connection.

Description of important components:

Arduino Uno: The Arduino Uno is a micro-controller board based on the ATmega328. It has 20 digital input/output pins (of which 6 can be used as PWM outputs and 6 can be used as analog inputs), a 16 MHz resonator, a USB connection, a power jack, an in-circuit system programming (ICSP) header, and a reset button. It contains everything needed to support the micro-controller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

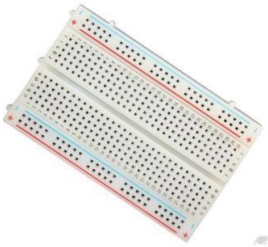
Gas Sensor: The Grove - Gas Sensor module can be used to detect gas leaks. H2, LPG, CH4, CO, Alcohol, Smoke, and Propane can all be detected. Due to its quick response time. As quickly as feasible, measurements can be collected. The potentiometer can also be used to modify the sensitivity. It has features like, Wide detecting scope, Stable and long life, Fast response and High sensitivity.

16 X 2 LCD: This 16x2 LCD modules are very commonly used in most embedded projects, the reason being its cheap price, availability, programmer friendly and available educational resources.

Buzzer: An arduino buzzer is also called a piezo buzzer. It is basically a tiny speaker that you can connect directly to an Arduino. We can make it sound a tone at a frequency you set. The buzzer produces sound based on reverse of the piezoelectric effect.

LED: It is a semiconductor light source that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons.

Breadboard: It is a solderless construction base used for developing an electronic circuit and wiring for projects with microcontroller boards like Arduino.



Jumper Wire: This Jumper Wires are simply wires that have connector pins at each end, allowing them to be used to connect two points to each other without soldering. It is typically used with breadboards and other prototyping tools in order to make it easy to change a circuit as needed.

Implementation:

To implement this project, all the equipment will setup according to the diagram which will be given later. Then we have to insert the code into the Tinkercad circuit to run the project. Whole embedded system has been designed by using Tinkercad. The simulation circuit for the proposed system was designed by using Arduino Uno (as a microcontroller), Gas sensor (to detect the air quality), 16*2 LCD Display Module (for showing message), Potentiometer and 3 Arduino LED red, yellow, green light(for giving alert), a small breadboard and jumper wires also used. From LCD pins VSS(Ground), RW(Read/write) and Backlight cathode were connected to Arduino GND(ground). And LCD pin, VDD were connected to Arduino 5V power pin. It is the power source of the LCD. And other pins were connected with Arduino Digital I/O pins. The middle pin of the Potentiometer were connected LCD pin VE. Which will give contrast to the LCD. If there is no potentiometer the LCD screen always will be shown white and it will not show any messages. In the gas sensor the bottom three pins were connected to Arduino 5V power pin. And in upper three pins one was connected to the ground and another one was connected with Arduino analog pin A0. Which will give the output to the sensor. In buzzer, one part was connected with ground and another one was connected to Arduino which will relay when the alarm will relay when the alarm will go on and off. Finally three LED were connected with Arduino pins and ground, which will provide alerts. All remaining pins were connected to the Arduino to relay the output of the sensor. The code used in the simulation were written in C++ language. Where, three conditions were build. In the first condition if the sensor value is less than or equal to 500 the LCD will show Fresh air and the green LCD will be turned on. In the second condition, if the sensor value is in between 500 to 650 the LCD will show polluted air and the buzzer will provide a signal and the yellow light will turned on. In the last condition, if the sensor value is greater or equal to 650 the LCD will show highly polluted and the buzzer will provide a hazard sound and the red LED will be turned on and provide the risk signal.

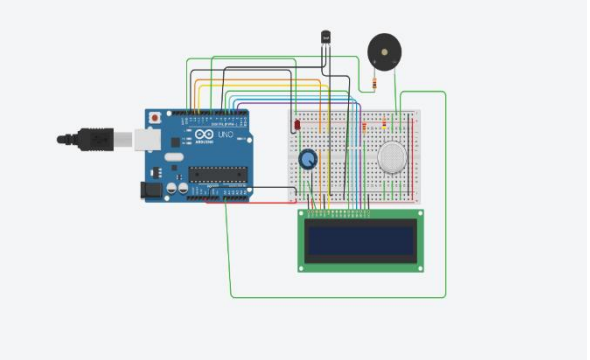


Figure: Simulated circuit.

Test setup:

Data was collected utilizing a gas sensor and several sorts of materials in this study. Multiple Correlation and Neural Networks were used in the data analysis and interpretation. In particular gas amount conditions, the system was configured to detect and provide an alarm and also alert. We gathered information by taking various values. We used an Arduino UNO and a sensor to detect the air pollution. If some additional sensors were fitted, the system would be safer, but it would cost more money. As a result, we are optimistic that our task will be to pass the difficult engineering certification.

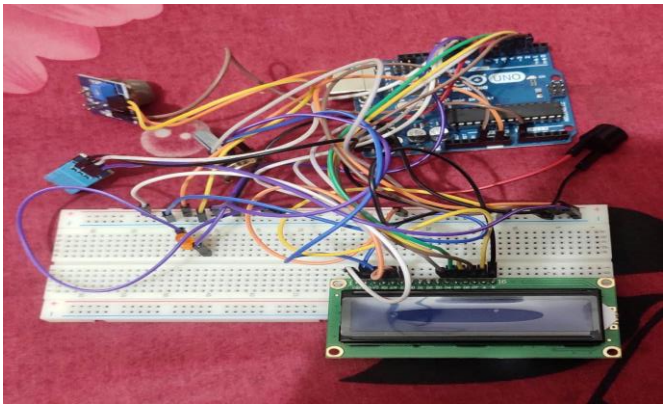
IV. Cost analysis

Item	Quantity	Price (Taka)
Gas Sensor	1	188
Arduino UNO R3	1	1050
16x2 LCD	1	450
Breadboard	1	90
Jumper Wires	1	90
Buzzer	1	15
LED	1	5
Potentiometer	1	188
DHT11	1	155
LCD display	1	255

Here, the total price is 2,486 Taka.

IV. RESULTS AND DISCUSSION

Simulation:



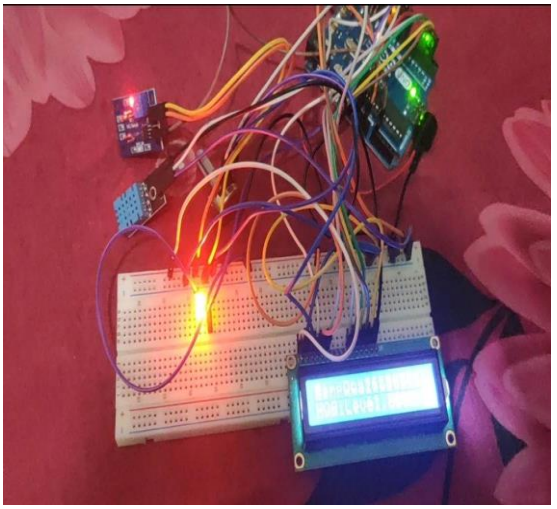


Fig: when air ppm is greater then 350ppm

Experimental results:

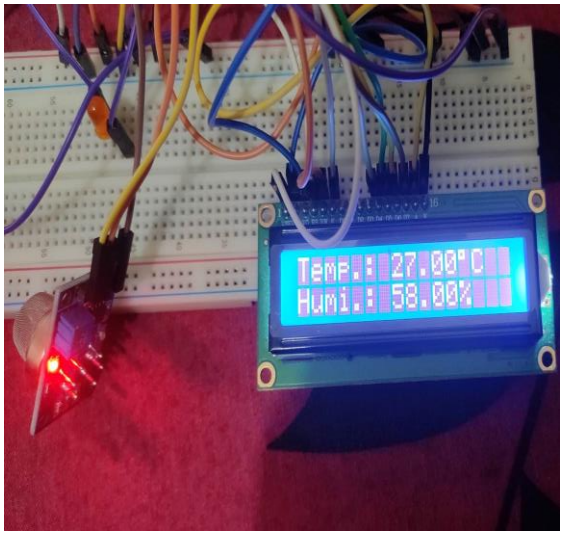


Fig: Show Temp & Humi

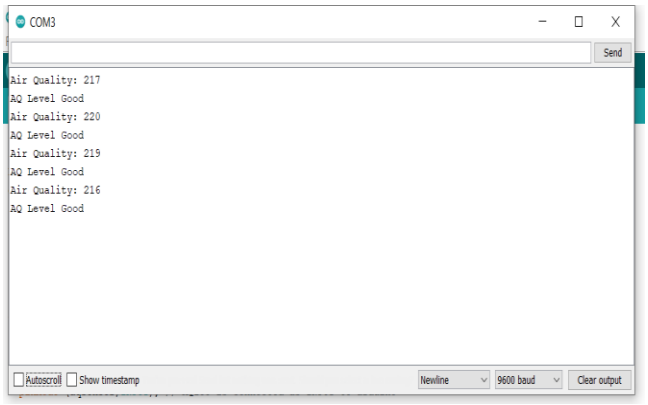


Fig: Arduino editor and coding Output Result

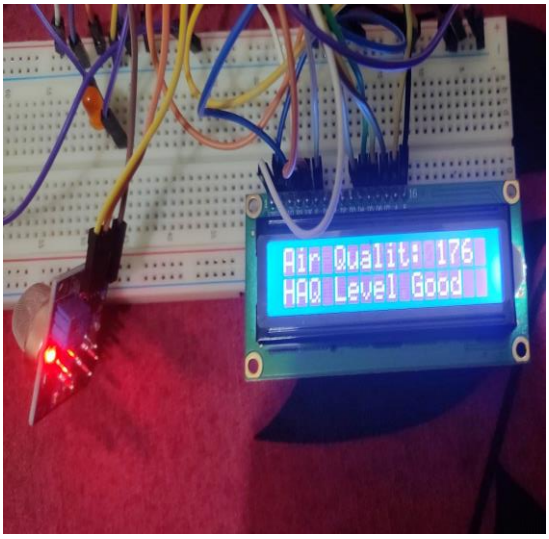


Fig: Show Air Quality

Sensor value(ppm)	LCD display	Buzzer
180 ppm (when sensor value<=250 ppm)	Air is Good	No sound.
258 ppm (when sensor value<=250 ppm)	Air is not Good	sound

Fig: Result analysis

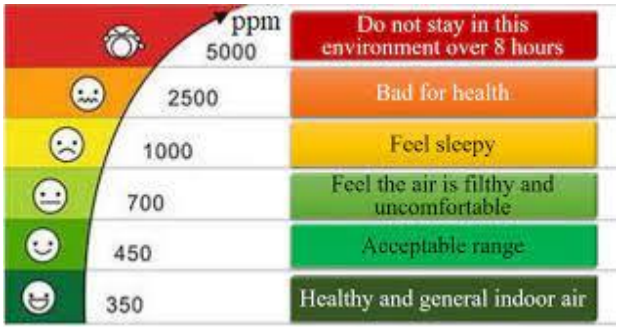


Fig: PPM rang Chart

Comparison between numerical and experimental results:

In this article, we utilized a gas sensor to display environmental air quality and deliver an alarm sound and signal when the air becomes contaminated. Arduino is a single-board microcontroller that can readily handle various peripherals at a reasonable cost. The main purpose of this study was to detect the air quality in a certain region and send out a signal and alarm to make people aware of air pollution. The numerical and experimental results are nearly identical, as we can see.

V. CONCLUSION

We have created an Arduino based discuss contamination finder which may be an exceptionally successful discuss pollution monitoring framework. Based on the execution we will say that it is easy to utilize, and usefulness is comparable to the costly existing discuss contamination locators. It may be a microcontroller based versatile framework. It is effective and user-friendly discuss quality discovery framework.

Now-a-days, there are numerous discuss contamination control frameworks within the showcase. But they are exceptionally expensive.

Not each family can bear them. In differentiate, our venture is exceptionally cheap. To set up the complete framework it'll fair fetched 968 Taka.

Which is in budget extend for nearly each family. On the off chance that ready to effectively provide the item and its benefits to everybody, at that point it can be a progressive arrangement to dodge discuss contamination.

In this project, a simple Air pollution detector system have been developed for house environment to save human life and avoid unwanted air pollution. The whole project was simulated successfully using the Tinkercad online site. The result analysis was quite accurate.

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