Air Quality Index Measurement

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***Abstract*- Air quality indices are commonly used to indicate the level of severity of air pollution to the public. It is infeasible and perhaps impossible to formulate a universal technique for determining air quality index, one that considers all pollutants and that is appropriate for all situations. The intended use of the air quality index is to identify the vulnerable zone. There are mainly two approaches viz. single pollutant index and multi-pollutant index to determine the air quality index. Every index has its own characteristic strengths and weaknesses that affect its suitability for particular applications. An air quality index (AQI) is used by government agencies to communicate to the public how polluted the air currently is or how polluted it is forecast to become. Public health risks increase as the AQI rises. Different countries have their own air quality indices, corresponding to different national air quality standards.**

Index Terms- Sensor, Aurdino, Health Effects

I. INTRODUCTION

Air pollution has been consistently ranked by the Environmental Protection Agency (EPA) and its Science Advisory Board to be among the top five environmental public health risks. Average person spends an estimated 90% of their time so that poor indoor air quality (IAQ) poses a substantial risk to public health. Poor air quality may cause increased short-term health problems such as fatigue and nausea as well as chronic respiratory diseases, heart disease, and lung cancer. It is estimated that annual costs and productivity losses in US is $10 to $20 billion related to sick building syndrome, which is defined to describe acute health and discomfort effects that appear to be linked to poor air quality and the time spent in a polluted areas. In this project, we are going to present an indoor air quality monitoring system. So that a common man can also have an idea about the amount of toxic gases present in the air.

II. CIRCUIT DIAGRAM

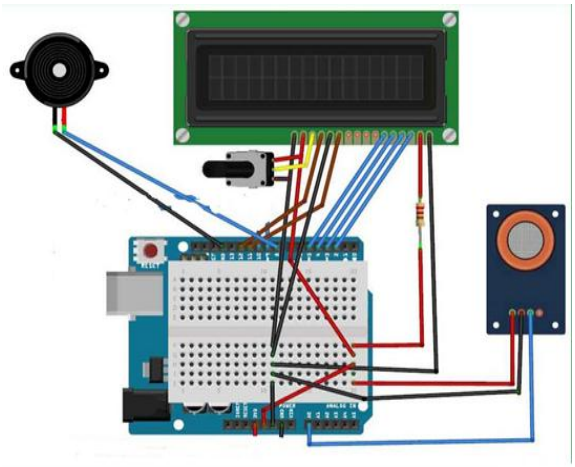

Fig. 1. Circuit Diagram

A. Working

The MQ135 sensor can sense NH3, NOx, alcohol, Benzene, smoke, CO2 and some other gases, so it is perfect gas sensor for our Air Quality Monitoring Project. When we will connect it to Arduino then it will sense the gases, and we will get the Pollution level in PPM (parts per million). MQ135 gas sensor gives the output in form of voltage levels and we need to convert it into PPM.

We will connect MQ135 Sensor to Aurdino. Connect the VCC and the ground pin of the sensor to the 5V and ground of the Arduino and the Analog pin of sensor to the A0 of the Arduino. The sensor will take sufficient samples defined by the user depending upon samples and after producing the average of the samples we will get to know the Air Quality.[2][3]

B. MQ135(Gas Sensor)

Fig. 2. MQ135

The MQ-135 Gas sensors are used in air quality control equipments and are suitable for detecting or

measuring of NH3, NOx, Alcohol, Benzene, Smoke, CO2. The MQ-135 sensor module comes with a Digital Pin which makes this sensor to operate even without a microcontroller and that comes in handy when you are only trying to detect one particular gas. If you need to measure the gases in PPM the analog pin need to be used. The analog pin is TTL driven and works on 5V.[1]

III. AURDINO UNO PIN FUNCTION

Fig.3. Structure of Board

Functional Parts 555 Timer IC

1) General Pin functions

- LED: There is a built-in LED driven by digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.
- VIN: The input voltage to the Arduino/Genuino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.
- 5V: This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 20V), the USB connector (5V), or the VIN pin of the board (7-20V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage the board.
- 3V3: A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.
- GND: Ground pins.
- IOREF: This pin on the Arduino/Genuino board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs to work with the 5V or 3.3V.[1]
- Reset: Typically used to add a reset button to shields which block the one on the board.

2) Special Pin Functions

Each of the 14 digital pins and 6 Analog pins on the Uno can be used as an input or output, using pin Mode(),digital Write(), and digital Read() functions. They operate at 5 volts. Each pin can provide or receive 20 mA as recommended operating condition and has an internal pull-up resistor (disconnected by default) of 20-50k ohm. A maximum of 40mA is the value that must not be exceeded on any I/O pin to avoid permanent damage to the microcontroller. The Uno has 6 analog inputs, labeled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the analog Reference () function.

In addition, some pins have specialized functions:

- Serial / UART: pins 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.
- External Interrupts: pins 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value.
- PWM (Pulse Width Modulation): 3, 5, 6, 9, 10, and 11 Can provide 8-bit PWM output with the analog Write() function.
- SPI (Serial Peripheral Interface): 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library.
- TWI (Two Wire Interface) / I²C: A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library.
- AREF (Analog Reference): Reference voltage for the analog inputs[1][2]

IV. AIR QUALITY INDEX FOR INDIA

The National Air Quality Index (AQI) was launched in New Delhi on September 17, 2014 under the Swachh Bharat Abhiyan.

The Central Pollution Control Board along with State Pollution Control Boards has been operating National Air Monitoring Program (NAMP) covering 240 cities of the country having more than 342 monitoring stations. An Expert Group comprising medical professionals, air quality experts, academia, advocacy groups, and SPCBs was constituted and a technical study was awarded to IIT Kanpur. IIT Kanpur and the Expert Group recommended an AQI scheme in 2014. While the earlier measuring index was limited to three indicators, the new index measures eight parameters. The continuous monitoring systems that provide data on near real-time basis are installed in New Delhi, Mumbai, Pune and Ahmedabad.[1][3][4]

There are six AQI categories, namely Good, Satisfactory, Moderately polluted, Poor, Very Poor, and Severe. The proposed AQI will consider eight pollutants (PM10, PM2.5, NO2, SO2, CO, O3, NH3, and Pb) for which short-term (up to 24-hourly averaging period) National Ambient Air Quality Standards are prescribed.[24] Based on the measured ambient concentrations, corresponding standards and likely health impact, a sub-index is calculated for each of these pollutants. The worst sub-index reflects overall AQI. Likely health impacts for different AQI categories and pollutants have also been suggested, with primary inputs from the medical experts in the group. The AQI values and corresponding ambient concentrations (health breakpoints) as well as associated likely health impacts for the identified eight pollutants are as follows:

Air Quality Index Category, Pollutants and Health Breakpoints

Air Quality Index (AQI) Values	Levels of Health Concern	Colors
When the AQI is in this range:	*...air quality conditions are:*	*...as symbolized by this color:*
0 - 50	Good	Green
51 - 100	Moderate	Yellow
101 - 150	Unhealthy for Sensitive Groups	Orange
151 - 200	Unhealthy	Red
201 - 300	Very Unhealthy	Purple
301 - 500	Hazardous	Maroon

Fig.3. Air Quality Index

Associated Health Impacts with different AQI

- Good(0-50): Minimal Impact.
- Satisfactory(51-100): May cause minor breathing discomfort to sensitive people.
- Moderately polluted(101-200): May cause breathing discomfort to people with lung disease such as asthma, and discomfort to people with heart disease, children and old adults.
- Poor(201-300): May cause breathing discomfort to people on prolonged exposure, and discomfort to people with heart disease.
- Very poor(301-400): May cause respiratory illness to the people on prolonged exposure. Effect may be more pronounced in people with lung and heart diseases.
- Severe(401-500): May cause respiratory impact even on healthy people, and serious health impacts on people with lung/heart disease. The health impacts may be experienced even during light physical activity.[1][4]

VI. PROGRAM

```
// Program: Air quality index measurement
int num_Measure = 128 ; // Set the number of measurements
int pinSignal = A0 ; // pin connected to pin O module sound sensor
long Air_quality ;  // Store the value read Sound Sensor
long sum = 0 ; // Store the total value of n measurements
long level = 0 ; // Store the average value
void setup ( )
{
 pinMode (pinSignal, INPUT); // Set the signal pin as input
 pinMode(8,OUTPUT);
 Serial.begin (9600);
}
void loop ( )
{
// Performs 128 signal readings
for ( int i = 0 ; i <num_Measure; i ++)
```

```
{
 Air_quality = analogRead (pinSignal);
  sum =sum + Air_quality;
}
level = sum / num_Measure; // Calculate the average value
level=map(level,0,1023,0,250);
if(level<12)
{Serial.println("good :" ) ;
  Serial.print (level);
  Serial.println ("ppm");
}
else if(level>=12 && level<55)
{
  Serial.println("Moderate :" );
  Serial.print (level);
  Serial.println ("ppm");
}
else if(level>55 && level<=150)
{
    Serial.println(" unhealthy:");
    Serial.print (level);
    Serial.println ("ppm");
}
else if(level>150 && level <=250)
{
    Serial.println("very unhealthy :");
    Serial.print (level);
    Serial.println ("ppm");
}
else
{
 Serial.println("Hazardous :");
 Serial.print (level);
 Serial.println ("ppm");
}
if(level>0 && level<55)
{
 digitalWrite(8,LOW);
 }
else
{
 digitalWrite(8,HIGH);
}
  sum = 0 ; // Reset the sum of the measurement values
delay(100);
}
```

VII. DESIGN OF AQI

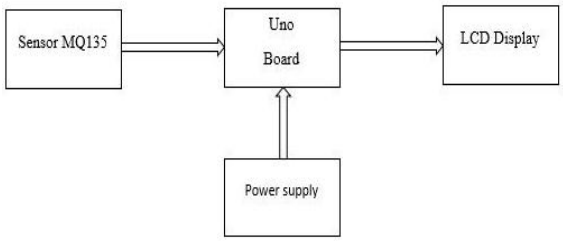

Fig.4. Block Diagram

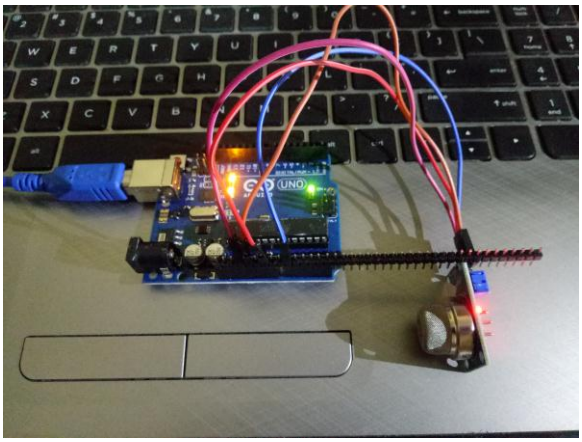

Fig.5.Design of circuit

VIII. RESULT AND DISCUSSION

At present the existing system is manually and human controlled system once we have setup the module at polluted places such as industrial areas, heavy traffic roads were the amount of gases released by vehicles is more, then accordingly it gives as reading on the LCD display so that a common man can see it, avoide going in that area. It checks Determining whether an area is meeting the standards, Evaluating changes in air quality as a result of state implementation plans.

IX. CONCLUSION

1. The idea of Air quality Index measurement using Aurdino has been undertaken.
2. Again, it can be implemented by using IOT so that humans can get the readings on their android phone.
3. Overall it is very useful project in rural areas. The mechanism works on a simple principal and there is not much of complexity needed in the circuit.

4. It is low cost project, easy to implement and there is no problem with sensor in detecting gases and it have long life.
5. System is Real time.

REFRENCES

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