AIR QUALITY MONITORING

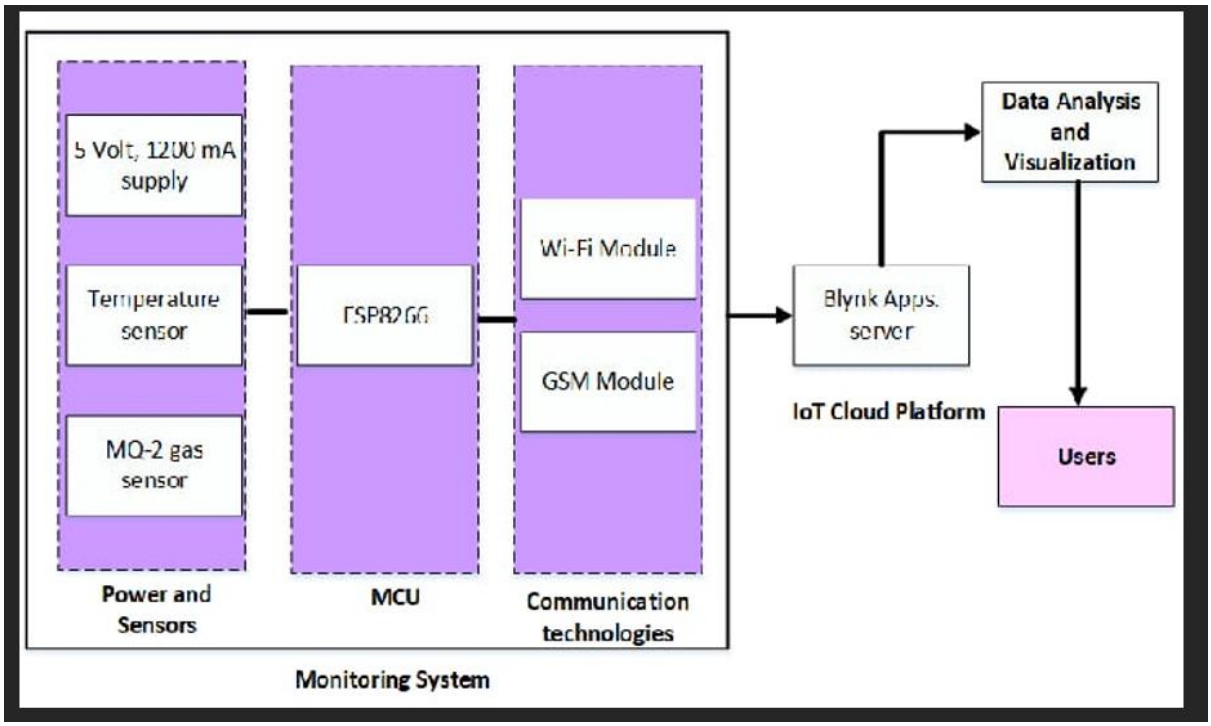
- Air quality monitoring involves measuring and assessing the level of pollutants and particulate matter in the atmosphere to ensure the safety of the air we breathe. It typically utilizes sensors and data collection systems to track parameters such as

- Air Quality Index (AQI): Calculating an AQI to provide an easy-to-understand summary of overall air quality.

- Gases: Monitoring of gases like nitrogen dioxide (NO2), sulfur dioxide (SO2), carbon monoxide (CO), ozone (O3), and volatile organic compounds (VOCs).

- Meteorological Data: Weather conditions like temperature, humidity, and wind speed/direction to understand their influence on air quality.

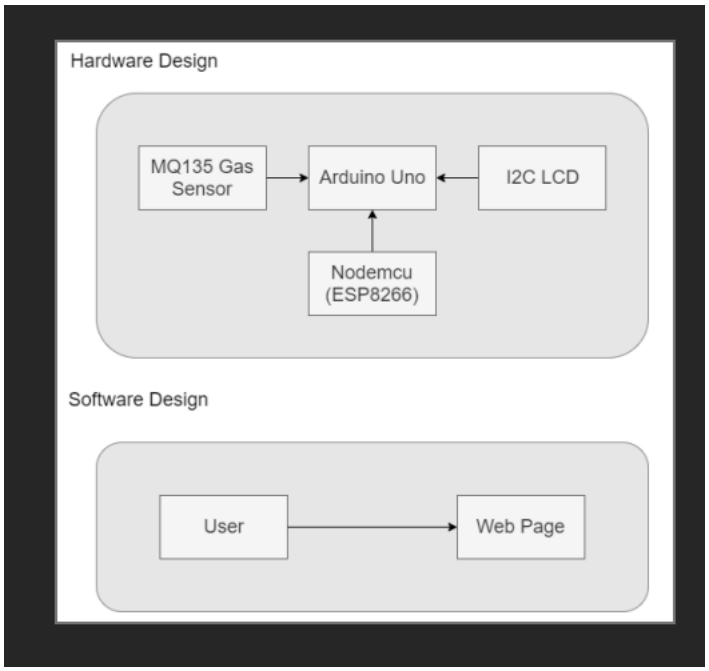
- Particulate Matter (PM): PM2.5 and PM10 measurements to assess fine and coarse particulate pollution



Project Design

The development of this system via XAMPP platform allows the air quality level in parts per million (ppm) data to be stored in an online database, thus allowing the public to continuously monitor the air quality level and avoid themselves to be exposed rapidly to these harmful gases. The developed hardware system consists of the MQ135 gas sensor. The gas sensor is able to sense the present of gases through the chemical reaction when the gases flows close to the sensor. The reading of air quality level appears on an I2C LCD

- **Figure 1** shows the block diagram of project design. There are two mains part of the design which are hardware design and software design.
- **Figure 2** shows the flowchart of the hardware design and software design.

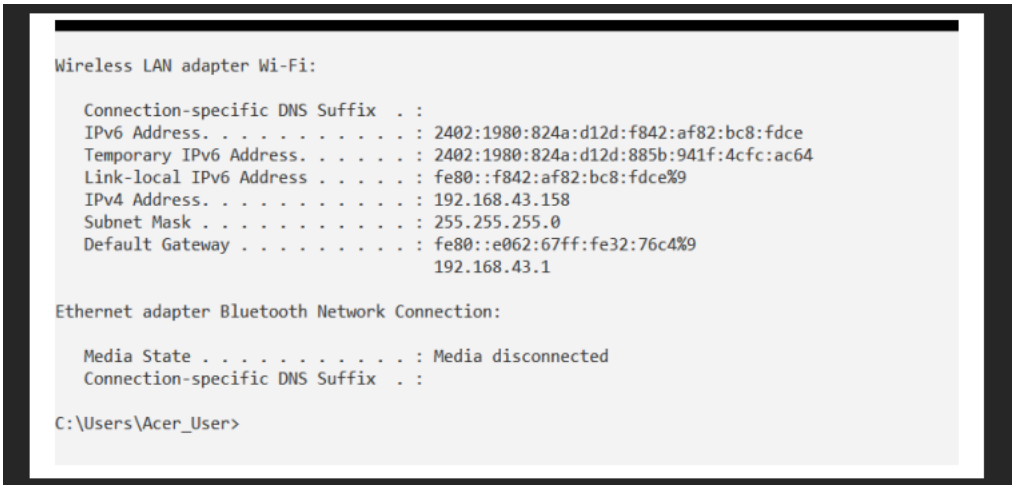


Hardware Development

A few of suitable components with high performance were used for hardware development. All of the components were at a reasonable cost to integrate to the web server platform of air quality monitoring system.

Software Development

The software implemented and programmed for this project include the Arduino Software IDE which allows the Arduino program to be uploaded to the Arduino board, as well as the XAMPP online platform which allows users to monitor data on a web page interface. The Arduino Software IDE is used for writing of the Arduino programming language or code whereby the program can be uploaded to the Arduino board via the Atmega8U2 chip and USB connection to the computer. This allows the board to perform the functions specified in the program, by which the output data or results of this particular program were displayed in the Serial Monitor feature that is incorporated in the Arduino software. Arduino is an easy tool for fast prototyping which allows the development of projects that are fully-functional at a low cost. Arduino board can apply and adapt to various needs and challenges differentiating its offer from simple 8-bit boards



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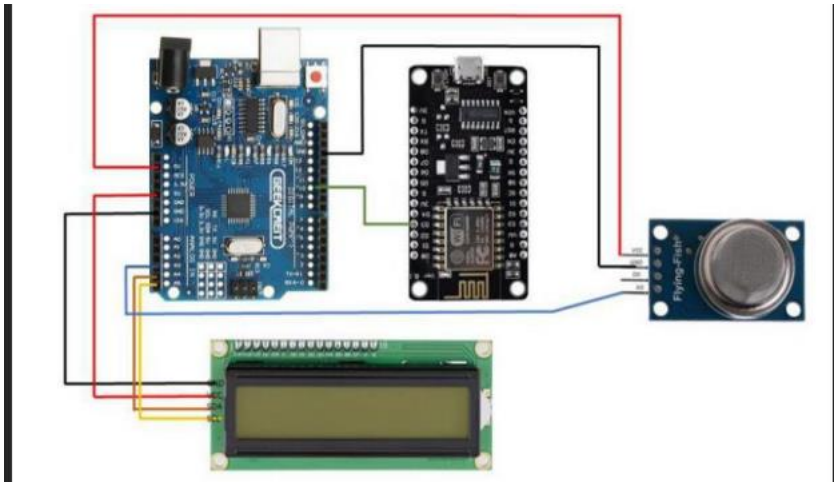


HARDWARE REQUIREMENTS

- **For Different Parameter Sensing**

Temperature and Humidity sensor (DHT11)

- **Air Quality sensor (MQ 135)**
- **2n2222 Transisitor**
- **DC Fan**
- **Potentiometer**
- **16x2 LCD Panel**
- **NodeMCU**
- **Arduino Uno**

For Power Supply

Step down transformer (12-0-12 V,1 A)

- **Diodes**
- **Voltage Regulator (7805)**
- **Capacitors (0.01 micro Farad, 470 micro Farad)**
- **Wires**

SOFTWARE REQUIREMENTS

- **Arduino (Version 1.8.2)**
- **THINGSPEAK website**

COMPONENT DESCRIPTION

Temperature and humidity sensor (DHT11)

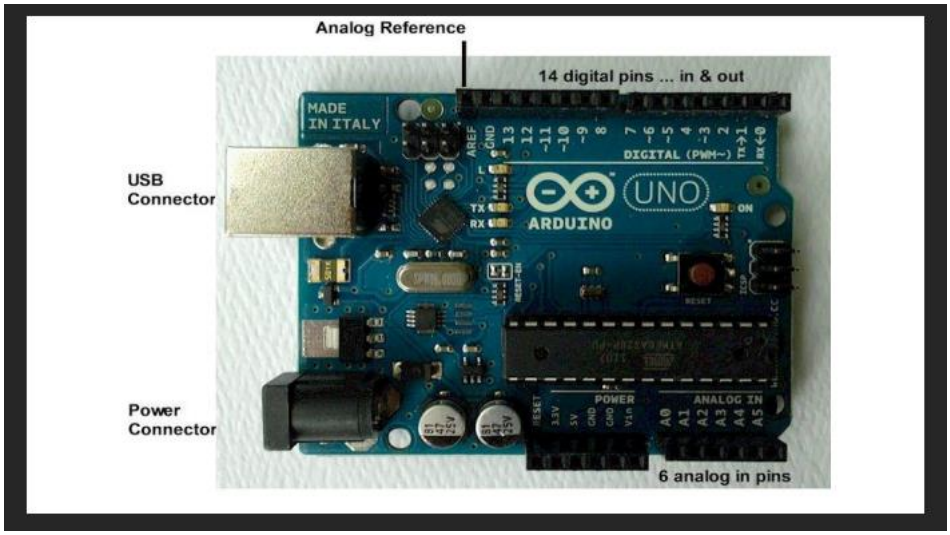
DHT11 digital temperature and humidity sensor is a composite Sensor contains a calibrated digital signal output of the temperature and humidity. Application of a dedicated digital modules collection technology and the temperature and humidity sensing technology, to ensure that the product has high reliability and excellent long-term stability.

Pin Description

- **1, the VDD power supply 3.5～5.5V DC**
- **2 DATA serial data, a single bus**
- **3, NC, empty pin**
- **4, GND, used to connect the module to system ground**

Arduino Uno

Arduino is an open source computer hardware and software company, project, and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world.



Coding

```
#include "MQ135.h"

#include <SoftwareSerial.h>

#define DEBUG true

SoftwareSerial esp8266(9,10); // This makes pin 9 of Arduino as RX pin and pin 10
of Arduino as the TX pin

const int sensorPin= 0;

int air_quality;

#include <LiquidCrystal.h>

LiquidCrystal lcd(12,11, 5, 4, 3, 2);

void setup() {

pinMode(8, OUTPUT);

lcd.begin(16,2);

lcd.setCursor (0,0);

lcd.print ("circuitdigest ");

lcd.setCursor (0,1);

lcd.print ("Sensor Warming ");

delay(1000);

Serial.begin(115200);

esp8266.begin(115200); // your esp's baud rate might be different

  sendData("AT+RST\r\n",2000,DEBUG); // reset module

  sendData("AT+CWMODE=2\r\n",1000,DEBUG); // configure as access point

  sendData("AT+CIFSR\r\n",1000,DEBUG); // get ip address

  sendData("AT+CIPMUair_quality=1\r\n",1000,DEBUG); // configure for multiple conn
ections

  sendData("AT+CIPSERVER=1,80\r\n",1000,DEBUG); // turn on server on port 80

pinMode(sensorPin, INPUT);        //Gas sensor will be an input to the arduino

lcd.clear();

}

void loop() {
```

```
MQ135 gasSensor = MQ135(A0);

float air_quality = gasSensor.getPPM();

if(esp8266.available()) // check if the esp is sending a message

  {

    if(esp8266.find("+IPD,"))

    {

     delay(1000);

     int connectionId = esp8266.read()-48; /* We are subtracting 48 from the outpu
t because the read() function returns the ASCII decimal value and the first decima
l number which is 0 starts at 48*/

     String webpage = "<h1>IOT Air Pollution Monitoring System</h1>";

       webpage += "<p><h2>";

       webpage+= " Air Quality is ";

       webpage+= air_quality;

       webpage+=" PPM";

       webpage += "<p>";

     if (air_quality<=1000)

{

  webpage+= "Fresh Air";

}

else if(air_quality<=2000 && air_quality>=1000)

{

  webpage+= "Poor Air";

}

else if (air_quality>=2000 )

{

webpage+= "Danger! Move to Fresh Air";

}

webpage += "</h2></p></body>";

     String cipSend = "AT+CIPSEND=";
```

```
      cipSend += connectionId;
      cipSend += ",";
      cipSend +=webpage.length();
      cipSend +="\r\n";

      sendData(cipSend,1000,DEBUG);
      sendData(webpage,1000,DEBUG);

      cipSend = "AT+CIPSEND=";
      cipSend += connectionId;
      cipSend += ",";
      cipSend +=webpage.length();
      cipSend +="\r\n";

      String closeCommand = "AT+CIPCLOSE=";
      closeCommand+=connectionId; // append connection id
      closeCommand+="\r\n";

      sendData(closeCommand,3000,DEBUG);
     }
  }
lcd.setCursor (0, 0);
lcd.print ("Air Quality is ");
lcd.print (air_quality);
lcd.print (" PPM ");
lcd.setCursor (0,1);
if (air_quality<=1000)
{
lcd.print("Fresh Air");
```

```
digitalWrite(8, LOW);
}
else if( air_quality>=1000 && air_quality<=2000 )
{
lcd.print("Poor Air, Open Windows");
digitalWrite(8, HIGH );
}
else if (air_quality>=2000 )
{
lcd.print("Danger! Move to Fresh Air");
digitalWrite(8, HIGH);   // turn the LED on
}
lcd.scrollDisplayLeft();
delay(1000);
}
String sendData(String command, const int timeout, boolean debug)
{
    String response = "";
    esp8266.print(command); // send the read character to the esp8266
    long int time = millis();
    while( (time+timeout) > millis())
    {
      while(esp8266.available())
      {
        // The esp has data so display its output to the serial window
        char c = esp8266.read(); // read the next character.
        response+=c;
      }
    }
```

```
    if(debug)
    {
      Serial.print(response);
    }
    return response;
}
```

CONCLUSION

IoT-based air pollution monitoring system is a revolutionary solution that can provide accurate and real-time data about the air quality in a particular area