VIT-AP
UNIVERSITY

ENGINEERING CLINICS

AIR QUALITY MONITOR

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ABSTRACT

The level of pollution is increasing rapidly due to factors like industries, urbanization, increasing in population, vehicle use which can affect human health. IOT Based Air Quality Monitoring System is used to monitor the Air Quality over a web server using Internet. Nowadays air pollution has turned out to be one of the significant issues because of increment in the quantity of vehicles and during the time spent industrialization and urbanization. This expansion in the level of contamination brings about destructive consequences for prosperity. This project explains the depiction and execution of an Air Quality detection system. The innovation grasped here, is a hands-on execution of the idea of Internet of Things. This detailed work is an exploration of the possibilities of consumption of this innovation, in this world, where natural well-being is turning into a genuine risk. The work is actualized utilizing microcontroller board of Arduino. In this project I am going to make an IoT based Air Quality Detection Monitoring System in which I will monitor the Air Quality over a web server using ESP8266 Wi-Fi device and will a trigger alarm when the air quality goes down a certain level means when there is number of harmful gases is present in the air like CO2. It will show the air quality in PPM (Parts Per Million) as like “Fresh Air”, “Poor Air”, “Danger Air” on LCD and webpage so that I can monitor it very easily.

Keywords: Air Quality, MQ135 Sensor, IOT, Arduino Node MCU, ESP-8266 wifi module

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INTRODUCTION

Air pollution is the biggest problem of every nation, whether it is developed or developing. Health problems have been growing at faster rate especially in urban areas of developing countries where industrialization and growing number of vehicles leads to release of lot of gaseous pollutants. Harmful effects of pollution include mild allergic reactions such as irritation of the throat, eyes and nose as well as some serious problems like bronchitis, heart diseases, pneumonia, lung and aggravated asthma. According to a survey, due to air pollution 50,000 to 100,000 premature deaths per year occur in the U.S. alone. Whereas in EU number reaches to 300,000 and over 3,000,000 worldwide. IOT Based Air Quality Monitoring System monitors the Air quality over a web server using Internet and will trigger an alarm when the air quality goes down beyond a certain threshold level, means when there are sufficient number of harmful gases present in the air like CO2, smoke and NH3. It will show the air quality in PPM on the LCD and as well as on webpage so that it can monitor it very easily. The system will show temperature and humidity. The system can be installed anywhere but mostly in industries and houses where gases are mostly to be found and gives an alert sound when the system crosses threshold limit.

BACKGROUND

The Air Excellence Guide (AEG) may be a common indicator of air quality. The Air Quality Indicator (AQI) is calculated and supported on air pollutants like CO and NO2 compounds that consume opposing possessions happening the atmosphere and human health. The Air Quality Indicator may be a range that represents the very finest meditation of a specific air unused matter at a particular time. I propose an air quality as well as air pollution monitoring system that allows us to monitor and check live air quality as well as air pollution in an area through Internet of Things (IoT). It uses air sensors (Gas Sensor MQ135) to sense presence of harmful gases/compounds in the air and constantly transmit this data. In addition, system keeps measuring air level and reports it. The sensors interact with Arduino Uno (Microcontroller) which processes this data and transmits it over the application. This allows authorities to monitor air pollution in different areas and act against it [1]. In addition, authorities can keep a watch on the air pollution near schools, and hospitals areas. Normally, little concentrations area unit measured exploitation ppb (parts per billion), that represents units of mass of a material per one billion units of total mass. Parts per million (ppm) may be similar and unremarkable used unit to measure concentrations of pollutants. It determines the requirements of a new system and analyze on product and resource requirement, which is required for the successful system. The product requirement contains input and output requirements it gives the wants in term of input to produce the required productivity. The resource requirements define in brief about the hardware that are needed to achieve the required functionality. In this project I am going to make an IoT based Air Pollution Detection Monitoring System in which I monitor the Air Quality over a web server using ESP8266 Wi-Fi device and a trigger alarm when the air quality goes down a certain level means when there is amount of harmful gases is present in the air like CO2. It shows the air quality in PPM (Parts Per Million) on LCD and webpage so that I monitor it very easily.

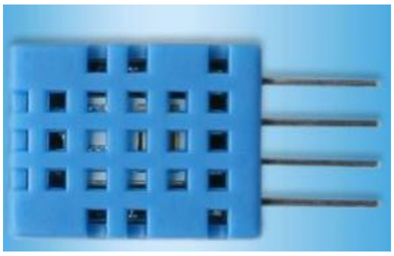
COMPONENTS

- NodeMCU
  Description:
  NodeMCU is an open source IoT platform. It includes firmware which runs on the ESP8266 Wi   Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module. The term "NodeMCU" by default refers to the firmware rather than the development kits. The firmware uses the Lua scripting language. It is based on the eLua project, and built on the Espressif Non   OS SDK for ESP8266.

- ESP8266 Wi-Fi device
  Description:
  The ESP8266 is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability. The chip first came to the attention of Western makers in August 2014 with the ESP-01 module, made by a third-party manufacturer Ai-Thinker. This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections using Hayes-style commands. However, at first there was almost no English-language documentation on the chip and the commands it accepted. The very low price and the fact that there were very few external components on the module, which suggested that it could eventually be very inexpensive in volume, attracted many hackers to explore the module, chip, and the software on it, as well as to translate the Chinese documentation. The ESP8285 is an ESP8266 with 1 MiB of built-in flash, allowing for single-chip devices capable of connecting to Wi-Fi.

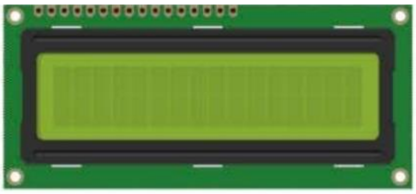
- Air Quality Sensor – MQ135
  Description:
  Air quality click is suitable for detecting ammonia (NH3), nitrogen oxides (NOx) benzene, smoke, CO2 and other harmful or poisonous gases that impact air quality. The MQ-135 sensor unit has a sensor layer made of tin dioxide (SnO2), an inorganic compound which has lower conductivity in clean air than when polluting gases are present. To calibrate Air quality, use the on-board potentiometer to adjust the load resistance on the sensor circuit.

- Temperature and Humidity sensor – DHT11
  Description:
  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. The sensor includes a resistive sense of wet components and an NTC temperature measurement device, and connected with a high-performance 8-bit microcontroller.



- Buzzer
  Description:
  A Buzzer or beeper is an audio signaling device. Whenever the air pollution goes above the threshold level the Buzzer starts beeping indicating Danger.

- LCD Panel
  Description:
  A liquid-crystal display (LCD) is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals. Liquid crystals do not emit light directly, instead using a backlight or reflector to produce images in color or monochrome. [1] LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden, such as preset words, digits, and seven-segment displays.



PROBLEM DEFINITION

Air pollution is one of environmental issues that cannot be ignored. Inhaling pollutants for a long time causes damages in human health. Traditional air quality monitoring methods, such as building air quality monitoring stations, are typically expensive. This project is suitable for air quality monitoring in real time. Design a working model which will sense quality of air and displays value in ppm, Sense the humidity is present in air and display in the form of percentage, Sense the temperature and display it in degree Celsius.

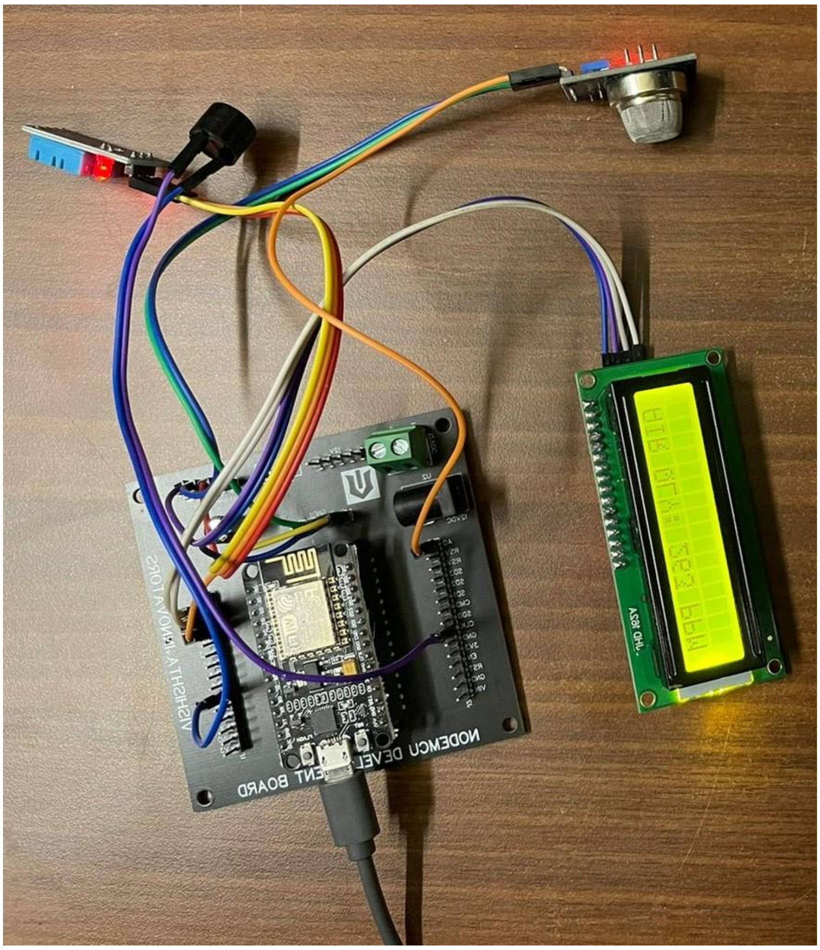
OBJECTIVES

The air quality monitoring program design dependent upon the monitoring specific objectives specified for the air quality management in the selected area of interest. Defining the output influence, the design of the network and optimize the resources used for monitoring. It also ensures that the network is specially designed to optimize the information on the problems at hand. There might be different objectives for the development of the environmental monitoring and surveillance system. Normally, the system has to provide on-line data and information transfer with a direct /automatically/ on-line quality control of the collected data. Several monitors, sensors and data collection systems to be applied to make on-line data handover and control likely. The main objectives stated for the development of an air quality measurement and surveillance program might be to facilitate the background concentration(s) measurements, monitor current levels as a baseline for assessment, check the air quality relative to standards or limit values, detect the importance of individual sources, enable comparison of the air quality data from different areas and countries, collect data for the air quality management, traffic and land-use planning purposes, observe trends (related to emissions), develop abatement strategies, determine the exposure and assess the effects of air pollution on health, vegetation or building materials, inform the public about the air quality and raise the awareness, develop warning systems for the prevention of undesired air pollution episodes, facilitate the source apportionment and identification, supply data for research investigations, develop/validate management tools (such as models), develop and test analytical instruments and to support legislation in relation to the air quality limit values and guidelines. The relationships between the data collected and the information to be derived from them must be taken into account when a monitoring program is planned, executed and reported. This emphasizes the need for users and potential users of the data to be involved in planning surveys, not only to ensure that the surveys are appropriate to their needs but also to justify committing the resources.

METHODOLOGY & PROCEDURE

Connections:

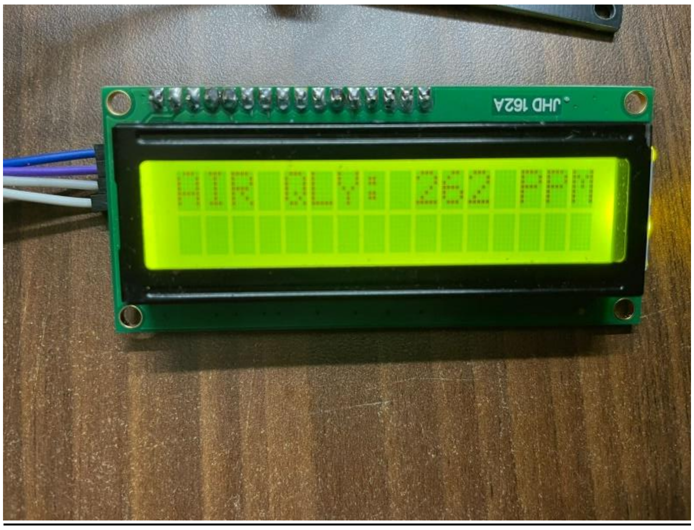
- D1/SCL of Arduino NodeMCU is connected to SCL of LCD Panel.
- D2/SDA of Arduino NodeMCU is connected to SAD of LCD Panel
- D3 port of Arduino NodeMCU is connected to Digital pin of DHT11 Sensor
- D7 of Arduino NodeMCU is connected to buzzer
- A0 port of Arduino is connected to D0 port of MQ135 Sensor
- CLK of Arduino is also connected to buzzer
- GND1 of Arduino NodeMCU is connected to
  - GND of DHT11
  - CND of MQ135
  - GND of LCD
- 5V port of Arduino NodeMCU is connected to
  - VCC of DHT11
  - VCC of MQ135
  - VCC of LCD

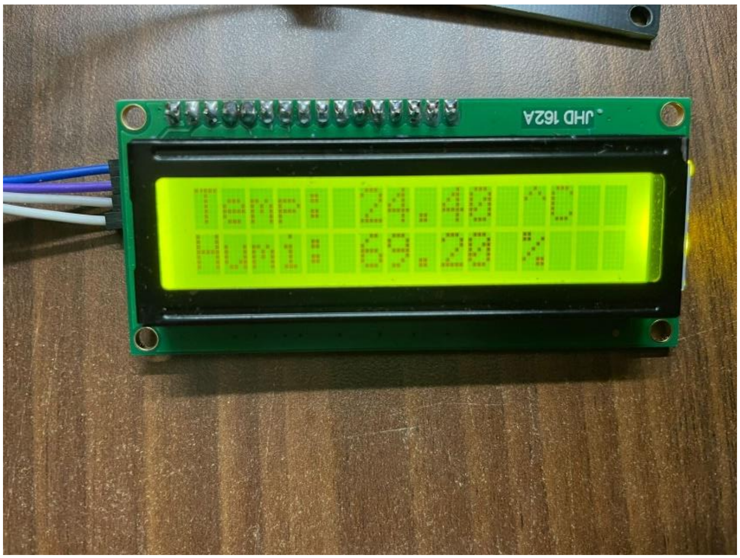


RESULTS & DISCUSSION

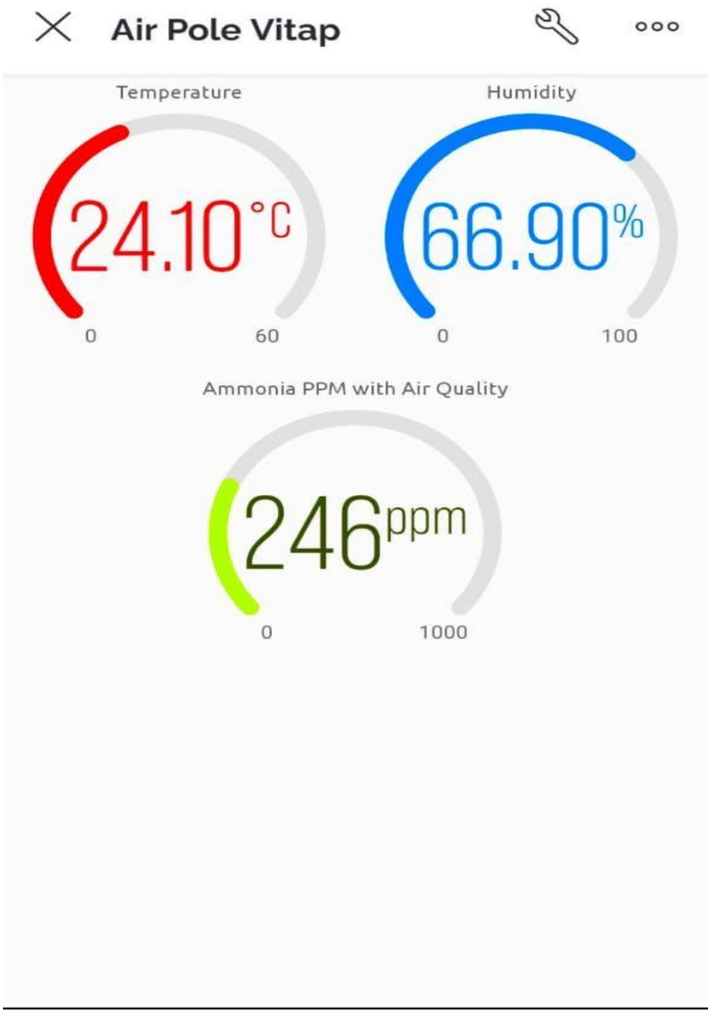
The MQ135 sensor can sense NH3 and some other gases, so it is perfect gas sensor for my Air Quality Monitoring Detection System Project. When I connect it to Arduino then it senses the gases, and I get the Pollution level in PPM (parts per million). MQ135 gas sensor gives the output in form of voltage levels and I need to convert it into PPM. The safe level of air quality is below 300PPM and it is not exceeding 300 PPM. When it exceeds the limit of 300 PPM, then it starts cause Headaches, sleepiness and stagnant, stale, stuffy air and if exceeds beyond PPM then it can cause increased heart rate and many other diseases. So if it exceeds 300PPM buzzer warning is given. Temperature and humidity readings are given by DHT11 sensor.

Working model:





OUTPUT IN BLYNK IoT



CONCLUSION

The smart way to monitor environment and air as well as sound pollution being a low cost but efficient and embedded system is presented in this paper. In the proposed architecture functions of different sensors and their working procedure were discussed. How they work, their functionality, their optimal uses and their data taking procedures and comparison with standard base data’s are also discussed here. The noise and air pollution monitoring system was tested for monitoring the gas levels on different parts of the country. It also sent the sensor parameters to the data server. Our project device showed that it is effective and cheap and with some highly working sensors it can really be a reliable one to everybody and its data’s will be a key to take some necessary steps for the betterment of the society as it will help to identify the affected area so that we can take early steps to reduce damages for the next generation.

FUTURE SCOPE

Our work can demonstrate vast opportunities to work on the device, on the app and also on the field using the device that we have worked with. The device can be used any time efficiently in different locations of a city and then research with the achieved data for that particular area in that city. The device can be updated with additional sensors that can sense data from the existence of other gases such as O2 and H2. These gases will provide the condition of the atmosphere and authority can take into further decisions accordingly. The sensors that we have been worked with can also be reset according to most recent time update. The android app which we have developed for turning on and off the device can be updated with newer features by implementing necessary codes. In future time, our device can be kept testing for checking whether the sensors still runs properly and give real time data. The webpage that we have designed, there is more opportunities to add options like related tables, pie chart, diagram that will be implemented by back-end programming(server side) so that those options can be visible to the administrator and user as well.

REFERENCES

[1] Anuj Kumar, I.P. Singh, and S. K. Sud, “Indoor Air Quality Estimation by Using Smart sensing System”, Proceedings of the International Multi Conference of Engineers and Computer Scientists ,Hong Kong, vol.II, IMECS 2009, March 18-20, 2009.
[2]Nodemcu with Arduino, Serial Communication, Control and Monitoring (electroniclinic.com)
[3] https://create.arduino.cc/projecthub/abid_hossain/air-quality-monitor-5f6afe
[4] https://playground.arduino.cc/Main/DHT11Lib
[5] https://www.epa.gov/air-research/air-monitoring-measuring-and-emissions-research

CODES IN APPENDIX

```
#define BLYNK_TEMPLATE_ID "TMPLYKUVkcfs"
#define BLYNK_DEVICE_NAME "air pole vitap"
#define BLYNK_AUTH_TOKEN "qDBfBe9FrRHGUCXCdxspCiNlFlo-Z1CJ"

#include <Wire.h>
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27, 16, 2);

#define BLYNK_PRINT Serial
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>
#include <DHT.h>

char auth[] = BLYNK_AUTH_TOKEN;
char ssid[] = "Airpole";
char pass[] = "makeindia";
//------------------------------------ pins
#define DHTPIN D3
//------------------------------------
#define DHTTYPE DHT11
DHT dht(DHTPIN, DHTTYPE);
BlynkTimer timer;
#define buz D6
int SW1=0;
BLYNK_CONNECTED()
{
  Blynk.syncVirtual(V0);
  }



float h,t;


void setup()
{
  // Debug console
  Serial.begin(9600);
  Blynk.begin(auth, ssid, pass);
  pinMode(buz,OUTPUT);
  digitalWrite(buz,LOW);
  dht.begin();
  lcd.begin();
  lcd.backlight();
  lcd.print("   WELCOME TO    ");
  lcd.setCursor(0, 1);
  lcd.print("      VIT-AP      ");
  delay(3000);
  lcd.clear();
}

int mq135,rmq135;
void loop()
{
  Blynk.run();

  rmq135 = analogRead(A0);
  mq135 = map(rmq135,180,1023,0,1000);
```

```
 h = dht.readHumidity();
 t = dht.readTemperature(); // or dht.readTemperature(true) for Fahrenheit
 Blynk.virtualWrite(V1, t);
 Blynk.virtualWrite(V2, h);
 Blynk.virtualWrite(V3, mq135);


 Serial.print("MQ135:");
 Serial.println(mq135);

 temp();
 delay(2000);
 lcd.clear();

 gas();
 delay(2000);
 lcd.clear();

 if(mq135>=300)
 {
  digitalWrite(buz,HIGH);
  delay(1000);
 }
 else
 {
  digitalWrite(buz,LOW);
 }
}

void temp()
{
 lcd.setCursor(0, 0);
 lcd.print("Temp: ");
 lcd.print(t);
 lcd.print(" ^C");
 Serial.println(t);
 lcd.setCursor(0, 1);
 lcd.print("Humi: ");
 lcd.print(h);
 lcd.print(" %");
 Serial.println(h);
 }
void gas()
{
 lcd.setCursor(0, 0);
 lcd.print("AIR QLY: ");
 lcd.print(mq135);
 lcd.print(" PPM");
 }
```