

Design and Implementation of IoT based Portable Outdoor Dust Density Monitoring System

Mahammad D.V.

Assistant Professor, Department of Electronics and Communication, Rayalaseema University- Kurnool-A.P. India.

Abstract: smart cities are gradually increasing in India. As a part of smart city Air pollution monitoring is one of the important work to alert the people. The air pollution is a mixture of solid particles like dust and many gases like vehicle and factories emissions. Due to air pollution it affects people's health like asthma, and lung disorders. And also a major concern is can cause global warning. Keeping all this in mind, it is necessary to have internet of thing (IoT) based a tool that can measure and alert the people from air quality. This project is done in our laboratory as a part of smart city concept. To design an air monitoring system a NodeMCU module and a Spark Fun Optical Dust Sensor is used as host controller and sensor respectively. For cloud platform blink app is used. By using this people can monitor the dust density in air using smart phone at any time and from anywhere. The system is successfully constructed and tested in our lab and found system is working satisfactorily.

Key words: Internet of Thing (IoT), Blynk app, Dust sensor.

1. Introduction:

Nowadays the Internet of Things (IoT) based air condition monitoring system is a part of smart cities and it is necessary. The best example for this situation is air pollution in Delhi city. In recent years, vehicles, factories' gas emissions are increased and apart from this a new dust particles are adding from formers waste burnt. So, due to these reasons now air condition is much polluted. Due to air pollution it Effect people's health like asthma and lung disorders[1]. It is difficult to determine by naked eye because air pollution may contain a lot of dangerous particles. It is essential to measure air quality by which we can alerts the people at right time[2-4]. Due to smart cities are getting popular in India, as a part of this, a low cost Internet of things (IoT) based dust monitoring systems is mandatory to promote this concept. Internet of Things based dust density monitoring system is used Optical Dust Sensor as sensing element and NodeMCU as host microcontroller and blink app is used as cloud platform. The system is successfully constructed and tested in our laboratory and found system is working satisfactorily.

2. Development of Hardware and Software of Design and Implementation of IoT based Portable Outdoor dust density Monitoring System.

2.1 System Design

The proposed system's block diagram is shown in figure-1. It mainly consist of a optical dust sensor, NodeMCU as a host microcontroller, Wi-Fi module to connect internet, Blynk server and Blynk APP for cloud services.

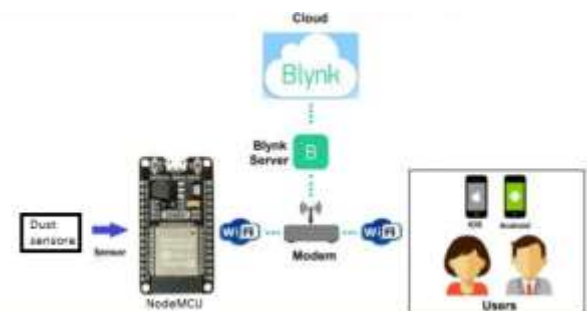


Figure-1: The block diagram of IoT based dust monitoring system

2.2 NodeMCU: The NodeMCU is an open source and very popular development board. And having ESP8266 Wi-Fi chip (Wi-Fi Protocols at 802.11 b/n/e/i and clocked at 2.4 GHz) and important pins like GPIO and AI.

It consists of:

1. 1 AI input
2. 16 GPIO pins

Power range +3.3v to 5v can be powered directly by USB cable. And this board is very suitable for IoT projects. The pin diagram of NodeMCU is shown in figure-2.

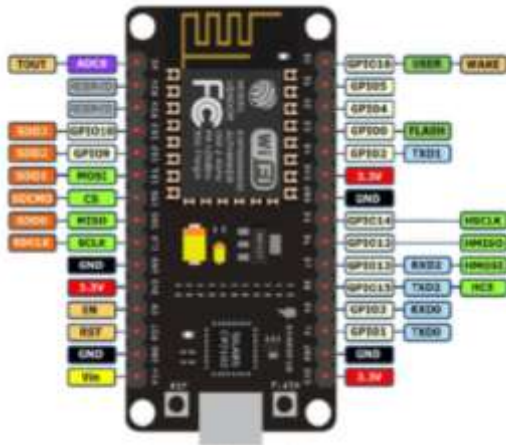


Figure-2: The Pin diagram of NodeMCU.

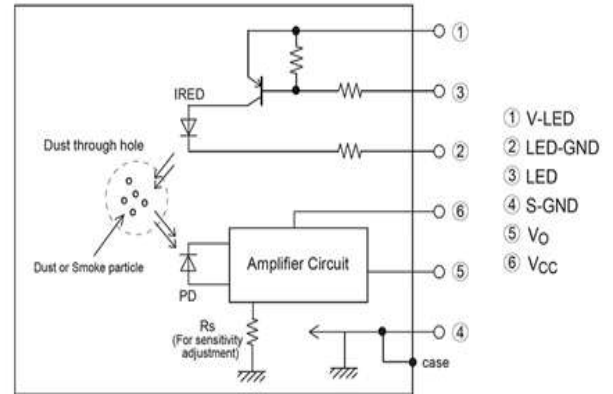


Figure-4: Internal schematic diagram of Optical dust sensor.

2.3 OPTICAL DUST SENSOR:

Optical air quality sensor is used in this system is Sharp's GP2Y1010AU0F and is designed to sense dust particles. The basic principle behind the sensor is an IR diode and a photo transistor is diagonally arranged into this device [5]. It allows it to detect the reflected light of dust in air. It is detecting very fine particles and is used in air purifier systems. It current consumption is (20mA max, 11mA typical), and can be powered with up to 7VDC. The output of the sensor is an analog voltage proportional to the measured dust density, with a sensitivity of 0.5V/0.1mg/m³. Sensor figure and internal schematic diagram shown in figure-3 and 4 respectively. Dust density mg/m³ characteristics of optical dust sensor is shown in figure-5

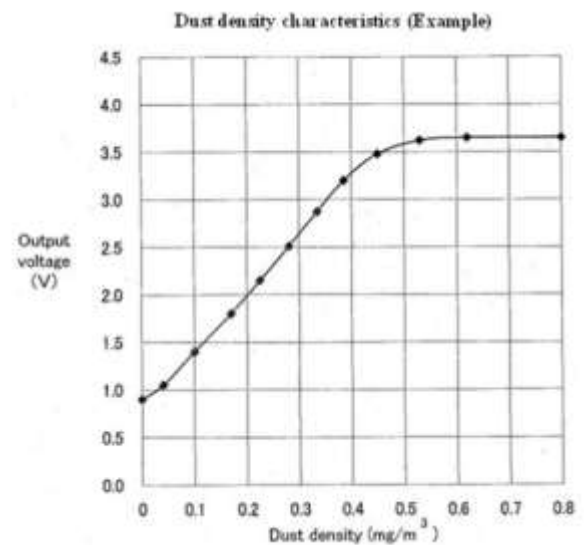


Figure-5: Dust density characteristics of optical dust sensor.



Figure-3: Optical dust sensor

2.3 Circuit Diagram:

Circuit diagram consist of NodeMCU with ESP8266, and to get the things done from host controller we need to connect NodeMCU 5v power supply and ground it properly. The sensor connector having SIX pins namely, V-LED, LED-GND, LED, S-GND, Vo and VCC. First S-GND and LED-GND connected to ground pin of NodeMCU. Vcc pin is connected to Vin pin of Node-MCU then it connected to 5V power supply. V-LED connected to power pin via 220hms and same pin connected to capacitor 0.022mF then it connected to ground. V0 pin is connected to analog channel of NodeMCU. LED pin is connected to D0 pin of NodeMCU. The proposed circuit diagram is shown in figure-6

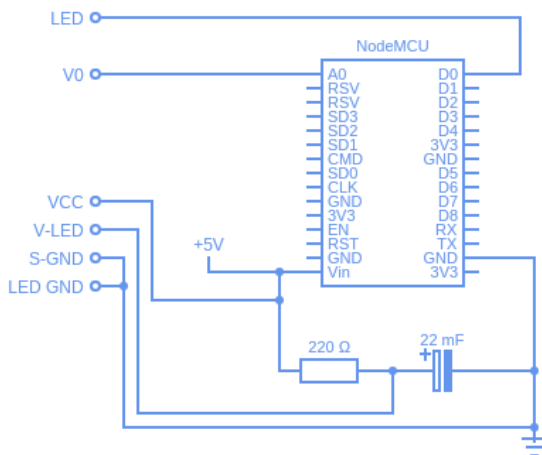


Figure-6: The proposed circuit diagram of IoT based dust monitoring system

3. SOFTWARE:

3.1 Arduino IDE: The proposed system's software is written in Arduino IDE. It is open software for many microcontrollers based on Arduino environment. Before writing the program for NodeMCU one need to install supporting libraries. In main program we need to give unique authentication token number which is provided by Blynk server, and provide SSID and password of Wi-Fi network. After developing the software then it compile and upload into NodeMCU. The detailed software is given below.

```
#include <ESP8266WiFi.h>

#include <BlynkSimpleEsp8266.h>

char          auth[]          =
"4rBSz4Z7wIANpWkSF0VMQvILyxZGBi65";

char ssid[] = "1234567";

char pass[] = "12312322";

const int inputchannel = A0;

const float Const = 0.5;

static float zerodust = 0.7;

int rightmotor1 =D0;

BlynkTimer timer;

void myTimerEvent()

{

digitalWrite(rightmotor1,LOW);

delay(280);
```

```
int sensorData = analogRead(inputchannel);

digitalWrite(rightmotor1,HIGH);

delayMicroseconds(9620);

float diffsen = sensorData - zerodust;

if (diffsen < 0 ) {

diffsen = 0;

zerodust = sensorData;

}

sensorData = sensorData / 1024.0 * 5.0;

float dustDensity = diffsen / Const * 100.0;

Blynk.virtualWrite(V5,dustDensity);

}

void setup()

{

pinMode(rightmotor1,OUTPUT);

Blynk.begin(auth, ssid, pass);

timer.setInterval(1000L, myTimerEvent);

}

void loop()

{

Blynk.run();

timer.run();

}

}
```

3.2 Blynk app:

Basically, Blynk is a Platform which support Android apps to control many IoT developed boards like Arduino, Raspberry Pi and the likes over the Internet. One needs to install Blynk APP from Google play store. Blynk is digital dashboard; here we can build a graphical interface for various projects by simply dragging and dropping widgets. The home screen of Blynk app is shown in figure-7.



Figure-7: Blynk app widgets configuring screen

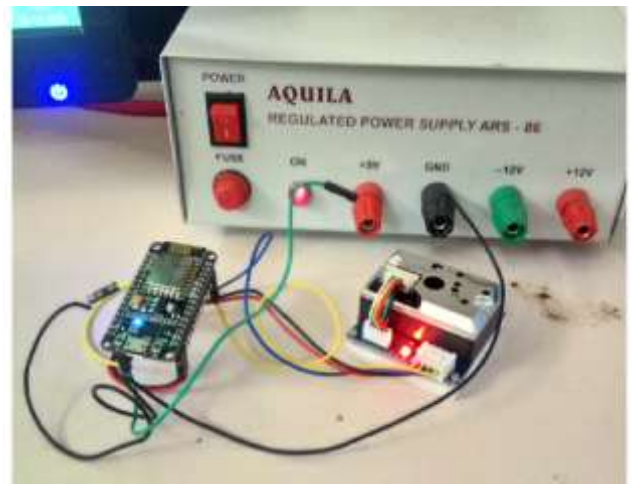


Figure-9: IoT based dust monitoring system

4. Results and Conclusion:

The system to monitor the dust density of air using IoT technology is proposed in present work. By using IoT technology it enhance the process of monitoring air quality issues. Here the using of optical dust sensors gives the sense of different type of particles present in air. The same measured values are presented in Blynk app, so that one can take precautions to avoid health issues[7]. The proposed system over comes many technical problems to connect cloud. And it provides the easy way like plug and play model. The proposed system “Design and Implementation of IoT based Portable Outdoor dust density Monitoring System” is successfully developed in our laboratory and tested. And found the system is working satisfactorily. The proposed system is shown in figure-8,9 and 10 respectively. As a future scope, it may add many more parameters for air quality monitoring.



Figure-10: Blynk app screen for dust monitoring system



Figure-8: IoT based dust monitoring system

5. References

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