IOT Based Air Pollution Monitoring System

A Project report submitted in partial fulfillment of the requirements for thedegree of B. Tech in Information Technology By,

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Under the supervision of

HOD &

PROFESSORS

Department of Information Technology

CERTIFICATE

To whom it may concern

This is to certify that the project work entitled IOT Based Air Pollution Monitoring System is the bonafide work carried out by kalesha M(513221205007), ruthra kotti (513221205017), roshini(513221205016), Mothilal(513221205306), Saravanan(513221205310) students of B.Tech in the Dept. of Information Technology, I affiliated to Anna University Chennai , India, during the academic year 2023-24, in partial fulfillment of the requirements for the degree of Bachelor of Information Technology and this project has not submitted previously for the award of any otherdegree, diploma and fellowship.

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List of Acronyms

DHT	Digital Humidity and Temperature
IoT	Internet of Things
PPM	Parts Per Molecule
PM	Particulate Matter
CO	Carbon Monoxide
CO_2	Carbon Dioxide
LED	Light Emitting Diode
LPG	Liquid Petroleum Gas
IDE	Integrated Development Environment

ABSTRACT

Air pollution is one of the biggest threats to the present-day environment. Everyone is being affected by air pollution day by day including humans, animals, crops, cities, forests and aquatic ecosystems. Besides that, it should be controlled at a certain level to prevent the increasing rate of global warming. This project aims to design an IOT-based air pollution monitoring system using the internet from anywhere using a computer or mobile to monitor the air quality of the surroundings and environment. There are various methods and instruments available for the measurement and monitoring quality of air. The IoT-based air pollution monitoring system would not only help us to monitor the air quality but also be able to send alert signals whenever the air quality deteriorates and goes down beyond a certain level.

In this system, NodeMCU plays the main controlling role. It has been programmed in a manner, such that, it senses the sensory signals from the sensors and shows the quality level via led indicators. Besides the harmful gases (such as CO_2, CO, smoke, etc) temperature and humidity can be monitored through the temperature and humidity sensor by this system. Sensor responses are fed to the NodeMCU which displays the monitored data in the ThingSpeak cloud which can be utilized for analyzing the air quality of that area.The following simple flow diagram (as shown in Fig. 1) indicates the working mechanism of the IoT-based Air Pollution Monitoring System.

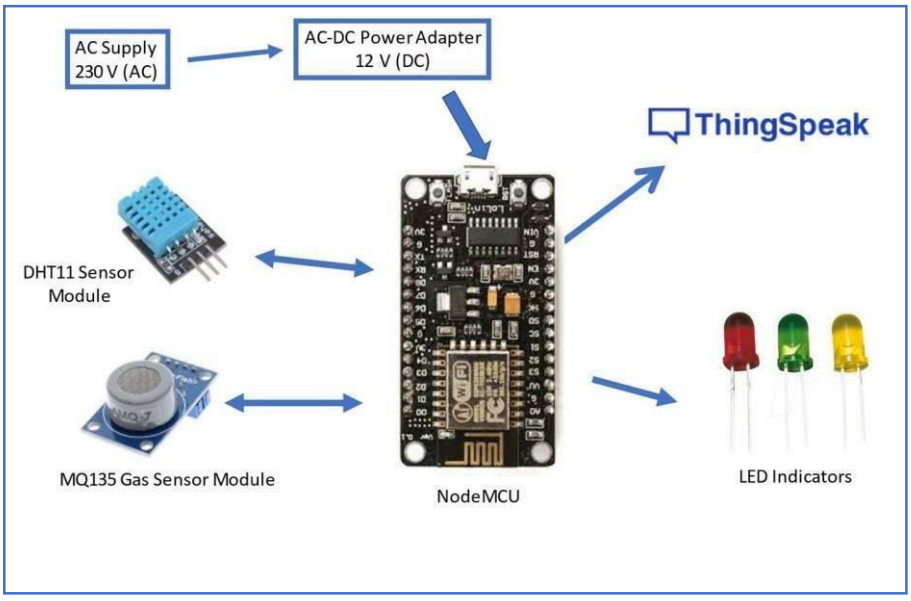

Fig.1. IoT based Air Pollution Monitoring System

1.1 Aim of the Project

Air is getting polluted because of the release of toxic gases by industries, vehicle emissions and increased concentration of harmful gases and particulate matter in the atmosphere.

The level of pollution is increasing rapidly due to factors like industries, urbanization, increase in population, vehicle use which can affect human health. Particulate matter is one of the most important parameters having a significant contribution to the increase in air pollution. This creates a need for measurement and analysis of real-time air quality monitoring so that appropriate decisions can be taken in a timely period.

1.2 Literature Survey

The explanation of the Air Quality Index (AQI) and its standard ranges are described in [1]. From 0-100 ppm the atmosphere is safe for living. If the ppm level increases above 100 then it moves out of the safety zone. If the ppm value rises above 200 then it becomes extremely dangerous for human life.

The DHT11 sensor module is used to measure the temperature and the humidity of the surroundings [2]. The MQ-135 gas sensor is used to measure the air quality of the surroundings [3]. It can be calibrated with respect to fresh air, alcohol, carbon dioxide hydrogen and methane. In this project, it has been calibrated with respect to fresh air [9], [10].

In [4] the controlling action of NodeMCU has been described. This research has shown the uses of C++ as the programming language for scripting the software code. It has an inbuilt Wi-Fi module which allows the project to implement IoT easily. Arduino IDE is used to implement the coding part of the project [5], [8]. ThingSpeak cloud is used for the cloud service. It has a free version which requires a delay of 15 seconds to upload an entry in the cloud [6], [7]. As this project uses two sensors, both of them have internal heater elements and withdraw more power(P=V*I), so though both sensors are turned ON, their output voltage levels vary and show unpredictable values due to insufficient power drive. So, we used a separate power supply for the sensors as NodeMCU alone is not sufficient to drive two sensors [9].

Chapter 2

THEORY & DESCRIPTION OF THE COMPONENTS

2.1 What is IOT?

The Internet of Things (IoT) describes the network of physical objects—"things"—that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet. These devices range from ordinary household objects to sophisticated industrial tools.

The field has evolved due to the convergence of multiple technologies, including ubiquitous computing, commodity sensors, increasingly powerful embedded systems, and machine learning.

2.2Components Used

- Hardware Components

1. NodeMCU V3
2. DHT11 Sensor Module
3. MQ-135 Gas Sensor Module
4. Veroboard(KS100)
5. Breadboard
6. Connecting Wires
7. AC-DC Adapters
8. LEDs emitting green, yellow and red colours
9. Resistors

- SOFTWARE COMPONENTS

1. ThinkSpeak Cloud
2. Arduino IDE

2.2 Brief Description of the Components

- NodeMCU V3

NodeMCU V3 is an open-source ESP8266 development kit, armed with the CH340G USBTTL Serial chip. It has firmware that runs on ESP8266 Wi-Fi SoC from Espressif Systems. Whilst cheaper, CH340 is super reliable even in industrial applications. It is tested to be stable on all supported platforms as well. It can be simply coded in Arduino IDE. It has a very low current consumption between 15 µA to 400 mA.

The pinout Diagram of NodeMC3 is shown in Fig. 2.1.

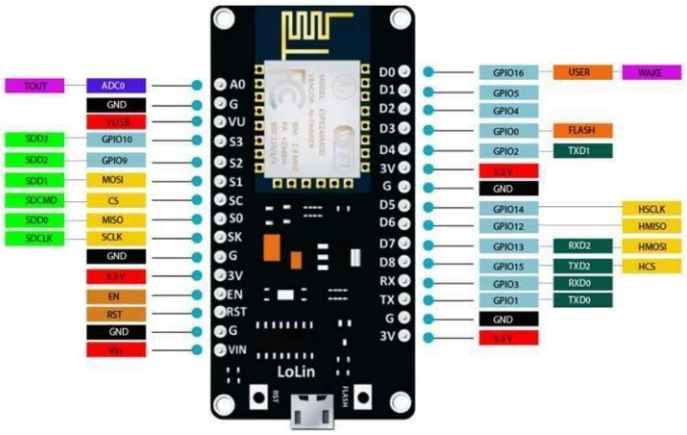

Fig. 2.1 (Pinout Diagram of NodeMCU V3)

- DHT11 Sensor Module

The DHT11 is a temperature and humidity sensor that gives digital output in terms of voltage. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air.

As shown in Fig. 2.2, we need to supply a voltage of 5V (DC) to the Vcc pin and ground it to the GND pin. The sensor output can be easily read from the Data pin in terms of voltage (in digital mode).

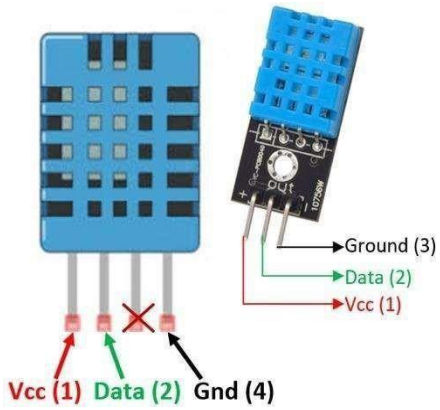

Fig 2.2 (Pinout Diagram of Humidity Measurement: The humidity sensing capacitor DHT11sensor)

has two electrodes with a moisture-holding substrate as a

dielectric between them as shown in Fig 2.3. Change in the capacitance value occurs with the change in humidity levels. The IC measure, process these changed resistance values andthen converts them into digital form.

Temperature Measurement: For measuring the temperature, the DHT11 sensor uses a negative temperature coefficient thermistor, which causes a decrease in its resistance value with an increase in temperature. To get a wide range of resistance values, the sensor is made up of semiconductor ceramics or polymers.

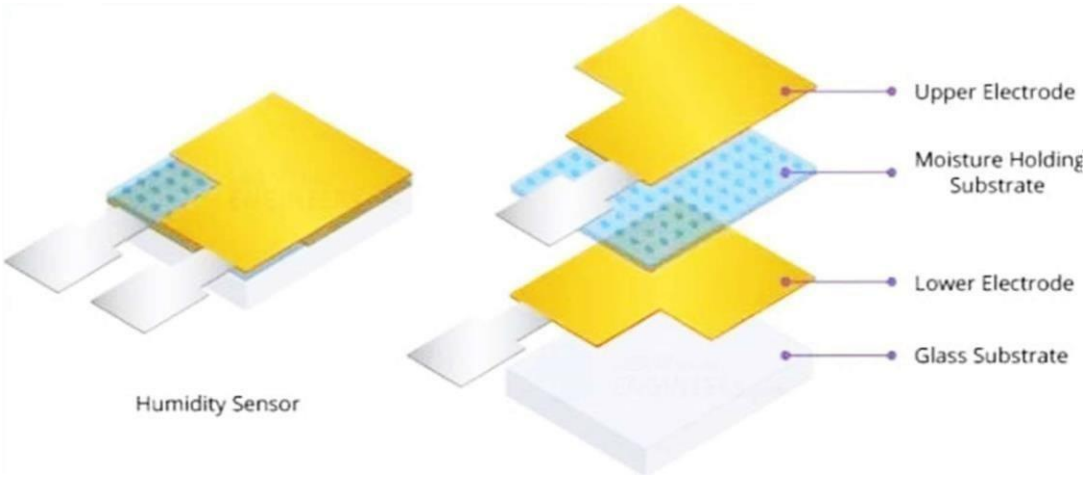

Fig 2.3(The structure of the humidity sensor)

MQ-135 Gas Sensor Module

The material of MQ135 is SnO2, it is a special material: when exposed to clean air, it is hardly being conducted, however, when put in an environment with combustible gas, it hasa pretty performance of conductivity. Just make a simple electronic circuit, and convert the change of conductivity to a corresponding output signal. MQ135 gas sensor is sensitive to Ammonia, Sulphide, Benzene steam, smoke and other harmful gases. Used for family, surrounding environment noxious gas detection device, apply to ammonia, aromatics, sulphur, benzene vapor, and other harmful gases/smoke, gas detection, tested concentration range: 10 to 1000ppm. In a normal environment, the environment which doesn't have detected gas set the sensor's output voltage as the reference voltage, the analog output voltage will be about 1V, when the sensor detects gas, harmful gas concentration increases by 20ppm per voltage increase by 0.1V

Veroboard is the original prototyping board. Sometimes referred to as ‘stripboard’ or ‘matrix board’ these offer total flexibility for hard wiring discrete components. Manufactured from a copper clad laminate board or Epoxy based substrate, it is offered in both single and doublesided formats. Vero boards are available in a wide range of board sizes and in both imperial and metric pitch – Veroboard is an ideal base for circuit construction and offers

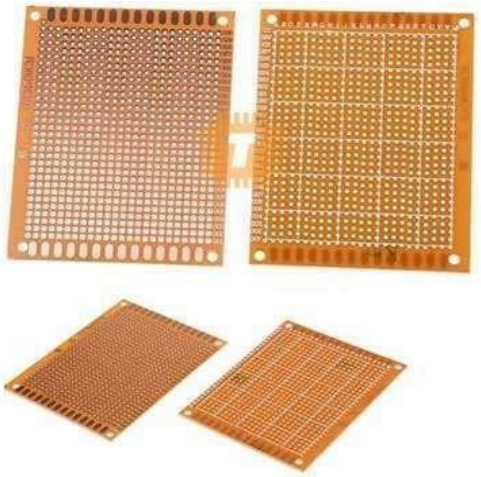

Fig 2.5 Veroboard

even greater adaptability using our range of terminal pins and assemblies. As with other stripboards, in using

Veroboard, components are suitably positioned and soldered to the conductors to form the required circuit. Breaks can be made in the tracks, usually around holes, to divide the strips into multiple electrical nodes enabling increased circuit complexity. This type of wiring board may be used for initial electronic circuit development, to construct prototypes for bench testing or in the production of complete electronic units in small quantities.

- AC-DC Power Adapter

An AC-DC power supply or adapter is an electrical device that obtains electricity from a grid-based power supply and converts it into a different current, frequency, and voltage. AC-DC power supplies are necessary to provide the right power that anelectrical component needs. The ACDC power

Fig 2.6 AC-DC Power Adapter

power source.

- LED (Red, Green & Yellow)

A light-emitting diode (LED) 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. The colour of the light (corresponding to the energy of the photons) is determined by the energy required for electrons to cross the band gap of the semiconductor. White light is obtained by using multiple semiconductors or a layer of lightemitting phosphor on the semiconductor device. LEDs have many advantages over incandescent light sources, including lower power consumption, longer lifetime, improved physical robustness, smaller size, and faster

switching. In exchange for these generally favourable attributes, disadvantages of LEDs include electrical limitations to low voltage and generally to DC (not AC) power, inability to provide steady illumination from a pulsing DC or an AC electrical supply source, and lesser maximum operating temperature and storage temperature. In contrast to LEDs, incandescent lamps can be made to intrinsically run at virtually any supply voltage, can utilize either AC or DC current interchangeably, and will provide steady illumination when powered by AC or pulsing DC even at a frequency as low as 50 Hz. LEDs usually need electronic support components to function, while an incandescent bulb can and usually does operate directly from an unregulated DC or AC power source.

Fig 2.7LEDs

Resistors

A resistor is a passivetwo-terminalelectrical component that implements electrical resistance as a circuit

element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses. High-power resistors that can dissipate many watts of electrical power as heat may be used as part of motor controls, in power distribution systems, or as test

Fig 2.8 Resistors

loads for generators. Fixed resistors have resistances that only change slightly with temperature, time or operating voltage.

Arduino IDE

The Arduino IDE is open-source software, which is used to write and upload code to the Arduino boards. The IDE application is suitable for different operating systems such as Windows, Mac OS X, and Linux. It supports the programming languages C and C++. Here, IDE stands for Integrated Development Environment. The program or code written in the Arduino IDE is often called sketching. We need to connect the Genuino and Arduino board with the IDE to upload the sketch written in the Arduino IDE software. The sketch is saved with the extension '.ino.'

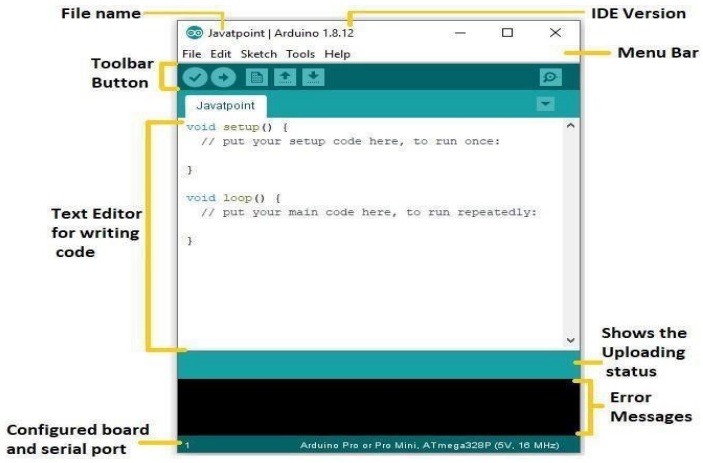

Fig 2.9Arduino IDE

ThingSpeak Cloud

ThingSpeak is open-source software written in Ruby which allows users to communicate with internet-enabled devices. It facilitates data access, retrieval and logging of data by providing an API to both the devices and social network websites. ThingSpeak was originally launched by ioBridge in 2010 as