IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Vol. 10, Issue 7, July 2021

DOI 10.17148/IJARCCE.2021.10741

Air Quality Detection using Embedded Systems

Thanushree D[1], Vaishnavi G[2]

Student, Department of Electronics and Communication Engineering, K S Institute of Technology, Bangalore, India[1,2]

Abstract - Air is essential for every living thing. Due to urbanization, there is growth in polluting industries, burning of wood, construction waste, substantial loss of forests and vehicles. Air pollution is a serious issue, the main objective of this system is to estimate the quality of air which all living things breathe. MQ9 and MQ135 gas sensors are used to detect the air quality of the environment. Node MCU ESP8266-12e microcontroller is used to convert analog values from these sensors to a digital value in ppm and display it on an LCD screen. The outputs from the sensor will be updated to the cloud through the Wi-Fi module and are stored and monitored using the IoT platform.

Keywords: Node MCU, Gas Sensors, Arduino IDE, Thinger.io

I. INTRODUCTION

Air pollution is the contamination of the atmosphere by gaseous, liquid, or solid waste or by-products. Air pollution is a mixture of solid particles, vehicle emissions, chemicals, smoke from factories, and dust in the air. Air pollution problems are faced both outdoors as well as indoors. Many industries and vehicles emit pollutants directly into the air, which is the main reason for the deterioration of the air quality on earth. Inhaling particulate matter in the air is at more risk of lung cancer, asthma, and other respiratory illness. Control of air pollution and air quality monitoring is necessary to create awareness in the community. Among all the health risks, air pollution is currently the 3rd important reason for the increased death rate in India. The system aims to detect and monitor the quality of air. The parameters of the environment to be monitored are the volume of CO and CO2, detection of flammable gases and smoke.

II. LITERATURE SURVEY

[1] ARDUINO UNO BASED AIR QUALITY MONITORING AND FILTERING SYSTEM

The model is for monitoring smoke levels in the atmosphere to make the environment intelligent. The developed system monitors CO2, CO, smoke, alcohol, LPG, temperature, and humidity with the help of the Arduino Uno Controller. The temperature and humidity of the environment are measured using the DHT11 sensor. The MQ135 gas sensor detects different types of dangerous gasses. Arduino controls the entire process and LCD for visual Output. Here it just displays the air quality percentage but designing and uploading data on a webpage with data and time to interface SD card and storing the data is taken as the future scope. [1]

[2] Analysis and control the air quality using Node MCU

Here, the system consists of MQ135 and Node MCU to monitor the air quality and calculate the number of toxic gases in the atmosphere and detoxify it. Later the system is connected to a cloud service called thinkspeak.com that enables the system to monitor the exact amount of pollutants at the given timeslot. The data sensed will be stored in the database for comparison with the value obtained in future executions. The final result depicts a line graph of the pollutants ranging from each time slot. The presence of various types of gases is detected using MQ135. This system is helpful to monitor the exact amount of air pollutants at the given timeslot, and installation is easier everywhere. But interfacing multiple sensors is not possible. [2]

[3] A SMART AIR POLLUTION MONITORING SYSTEM

The project uses an Arduino microcontroller, Wi-Fi module ESP 8266, MQ135 gas sensor to monitor air quality constantly and display the real-time values on an LCD screen. Wi-Fi module uploads data to a remote server with the help of the Thingspeak application. Accessible through a mobile device via the Cloud. The sensor detects air quality from 0-100 PPM range. But Thinkspeak requires a delay of 20 seconds to update data which can be a disadvantage in this project. [3]

[4] IOT based Air Quality Monitoring System Using MQ135 and MQ7 with Machine Learning Analysis

The pollution level is monitored from a computer or a mobile from a far distance also. WiFi which is to push the data onto the Cloud rather than using GSM or GPRS module, with the help of websites such as thinger.io or thingspeak, Cayenne and output can be seen and even be able to download the dataset. After connecting the ESP-01 to the hotspot,

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a connection will be established between the Thingspeak website when the account API Key entered in the Arduino Code is verified. Thingspeak needs a delay of 15 seconds of refresh interval to push to the data.[4]

[5] Urban Air Quality Analysis and Prediction Using Machine Learning

In this paper, the system uses a machine learning model to analyze and predict air quality. The Predictions are implemented in Unsupervised learning and supervised learning. The groups are formed based on their similarity using k- means clustering, then collected data sets are labeled. Then the data set labeling based on the centroid values obtained from K-Means clustered into three different classes low, moderate, and high. There is a conversion of data values from integer to factor and splitting of data sets. It includes Train data and Test data of 9:1 ratio. Then the analysis of air pollution is done using machine learning techniques such as Multinominal Regression and Decision Tree algorithm. In this work, the probabilistic model is used to reveal the values in cities in terms of different parameters. [5]

[6] A Review on Air Pollution Monitoring Techniques

The air pollution monitoring is done using an automated tomography strategy which creates a two-dimensional guide of contamination focus. It gives numerous favourable circumstances over the differential ingestion technique. A single laser source is placed in the zone's centroid in this framework. The laser bar is turned and coordinated towards the circuit of the circle. There is a round and hollow mirror with the goal that the occurrence laser pillar is reflected in a fan bar over the edge over the circle. The pillar from the mirrors is the roundabout district and strikes a lot of indicators lie in the same plane parallel to the ground. This strategy centres around lower transmitted laser vitality expanding the range and capacity to screen the territory that contains a few contamination sources. This framework unit is made up of a single microcontroller chip and a pollution server, which is a high-quality individual application server with web access, where the portable information gathering unit collects pollution levels and packs them into an edge with GPS location, date, and time. This information is sent to the pollution server over the open flexible system and sent to the GPRS modem. An information-based server which is joined to the pollution level which is utilized by the different customers. Pollution server for storing pollution levels that are used by a variety of customers. A pollution server with a Google map interface provides real-time toxins levels as well as the area in a large metropolitan region. The remote sensor system has its favourable position like in the case of IoT based implementations, for example, ease, simplicity to an arrangement and give continuous toxin information.[6]

[7] Air Quality Monitoring System

The system developed is for monitoring indoor air quality remotely. It is a cost and energy-efficient request and response protocol, along with a combination of address and data-centric protocols. Thingspeak IoT platform calibrates ppm value. The data is pushed directly to the cloud, so there is no need to display the value in the LCD. Data is pushed to the cloud via the Wi-Fi module rather than using GSM or GPRS modules. Here two sensors have internal heat elements, which draw more power, when both the sensors are turned On, their output voltage levels vary, and unpredictable values are shown due to insufficient power drive. Hence 9V battery, LM7805 Regulator is used for the MQ7 sensor, and the Arduino Uno Development kit with ATMega328P microcontroller and ESP-01 Wi-Fi module is used for connecting the ThingSpeak platform. After connecting the ESP-01, connection is established with the Thingspeak account with the help of the API key of the account provided. Using the cloud data, the website is hosted and data is displayed on the website.[7]

[8] IOT Based Air Pollution Monitoring System

The objective of this system is to monitor the air using IoT Based Air Pollution Monitoring System over a web server using the Internet. When the air quality goes down beyond a certain level an alarm is triggered. It shows the quality of air in terms of PPM on the LCD as well as on the webpage so that air pollution is monitored very easily. To detect harmful gases, the system uses MQ135 and MQ6 sensors which measures their amount accurately. When the circuit is connected to Arduino it starts sensing the gases and gives the Pollution level in PPM . The MQ135 gas sensor gives the output in the form of voltage levels hence to convert the output into PPM, libraries for the MQ135 sensor and MQ6 sensor are used. When the value increases from 1000 PPM, the buzzer starts beeping and the LCD and webpage will display alert messages. And when it increases to 2000, the buzzer keeps beeping and gives an alert message on the smartphone through GSM and displays it on the LCD and webpage. It also contains an LM35 sensor for temperature and SY-HS-220 for humidity so it shows the current temperature and humidity of the air. The buzzer is used when ppm crosses above a threshold limit and LCD shows the value of gases in ppm.[8]

[9] IOT Based Air Pollution Monitoring System Using Arduino

The system uses an Arduino microcontroller to monitor the air quality in the environment, and IoT Technology is recommended to improve air quality. A microcontroller, gas sensors, a mobile unit, a temporary memory buffer, and a web server with internet access are among the components required to gather data from various areas as well as coordinates information at specific times of the day. Average is taken for readings for a particular location are averaged

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in a closed time and space. The Global Positioning System (GPS) module is attached to a system to provide an accurate representation of pollution sources in an area. Using General Packet Radio Service (GPRS) connection the recorded data is periodically transferred and then the data will be displayed on the dedicated website with user acceptance. As a result, a large number of people are benefited. The Arduino is the heart behind such a project, and it controls everything. The Wi-Fi module is used to link the entire process to the internet, while the LCD is used to show the results. The Automatic Air & Sound Management System is a step forward in providing a solution to the most critical issue.[9]

III. PROPOSED METHODOLOGY

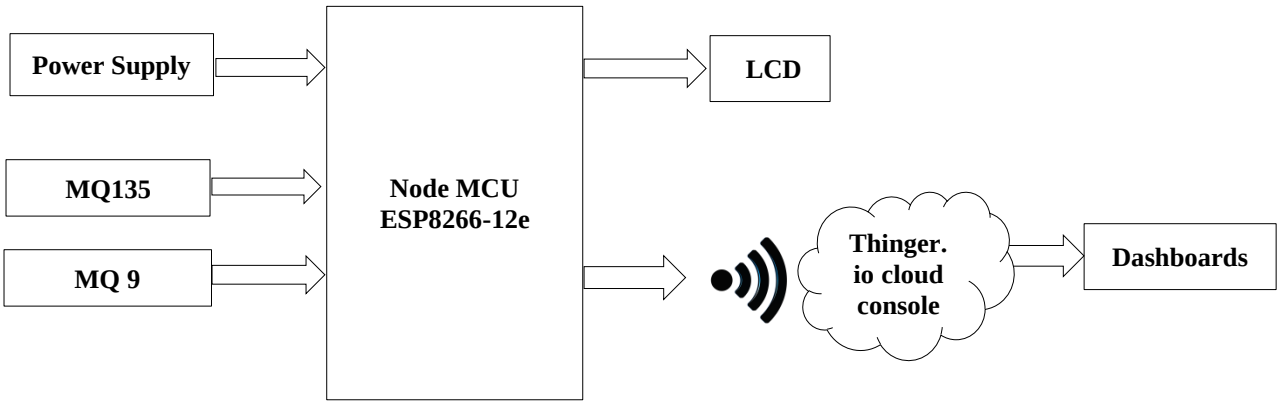

Fig 1: Block Diagram

The model is for monitoring the air quality by sensing the harmful gases present in the environment using Node MCU, MQ135, MQ9 gas sensors, and Thinger.io cloud console. The block diagram is as shown in Fig 1. The MQ135 and MQ9 gas sensors are used for detecting various gases like CO, CO2, flammable gases, and smoke. When the circuit is powered the sensors start to detect the gasses, the sensed data from the sensors is passed to Node MCU for Analog to digital conversion. The air quality index (API) is measured in parts per million. The sensed output is displayed on the LCD screen and a warning is displayed if the concentration of the toxic gases exceeds. Once the credential of the device and the cloud server match, the connection is established between the device and cloud, then the output from the sensor is updated to the cloud through the Wi-Fi module. The outputs are stored and monitored on the IoT platform, this data can be taken for further analysis.

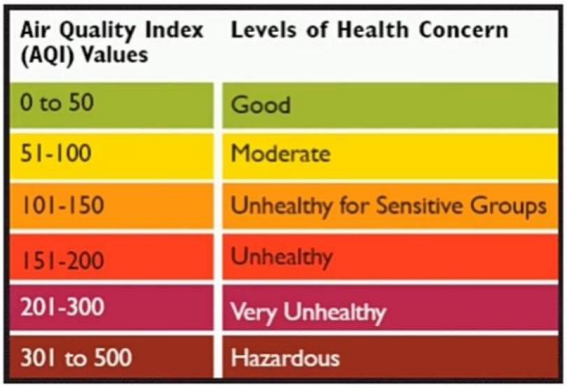

Fig 2: Air Quality Index

The above figure shows the Air Quality Index values range and its corresponding health concerns.

IJARCCE

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IV. CONCLUSION

The system keeps track of the air quality of a particular area and displays the measured value of the air quality on an LCD. MQ135 sensor detects toxic gases such as ammonia gas and benzene series steam, CO2, and smoke. MQ9 sensor detects CO at low temperature and flammable gases, methane, propane at high temperatures and displays all the parameters on the LCD screen in terms of ppm.

Monitoring the air quality will help us detect the amount of pollution in the environment. After knowing the air quality index at various locations, we can create awareness about the quality of air which living beings inhale. Node MCU controls the entire process of this project. It can be linked to an API using platforms like Webhooks and adafruit, such that users can request the air quality via the application and get the output on the screen.

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