

Design and Amplification of IoT Baised Air Pollution Monitoring System

Rohan Thapar¹ Mohit Lakha² Rajat Kumar³ Harpreet Kaur Channi⁴

^{1,2,3,4}Department of Electrical Engineering

^{1,2,3,4}Chandigarh University, Mohali, India

Abstract— Humans can be adversely affected by exposure to air pollutants in ambient air. Hence, health-based standards and objectives for a number of pollutants in the air are set by each country. Detection and measurement of contents of the atmosphere are becoming increasingly important. Careful planning of measurements is essential. One of the major factors that influence the representativeness of data collected is the location of monitoring stations. The planning and setting up of a monitoring station are complex and incurs a huge expenditure. An IoT-based real time air pollution monitoring system is proposed to monitor the pollution levels of various pollutants in Coimbatore city. The geographical area is classified as industrial, residential and traffic zones. This article proposes an IoT system that could be deployed at any location and store the measured value in a cloud database, perform pollution analysis, and display the pollution level at any given location.

Keywords: Ambient Air, Traffic Zones, Atmosphere, Pollutants

I. INTRODUCTION

Air pollution has become major problem for every nation, whether it is developed country or developing country. Health issue have been growing rapidly especially in urban areas of developing countries where industrialization and growing number of vehicles lead store lease of lot of air pollutants. Adverse effects of pollution can cause 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.

Air Pollution Monitoring System monitors the Air quality over a web server using Internet and will activate an alarm when the air quality goes down beyond a certain threshold level, means when there is sufficient amount of toxic gases present in the air like CO₂, smoke, alcohol, benzene, NH₃, LPG and NO_x. It will show the air quality in PPM (Parts Per Million) on the webpage so that it can monitor it very easily.

It is necessary to super vise air quality and keep it under control for a superior future and healthy living for all. Due to resilience and low cost Internet of things (IoT) is getting popular day by day. With the Industrialization and with the increase in the vehicles on road the atmospheric conditions have considerably affected. Adverse 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. Monitoring gives measurements of air pollutant and sound pollution concentrations, which can then be resolved interpreted and presented. This information

can then be applicable in many ways. Testing of monitoring data allows us to assess how bad air pollution and sound pollution is from day to day

II. REVIEW OF LITERATURE

Vijayakumar Sajjan and Pramod Sharma (2018)[1] purposed that Humankind, moving to a period centered upon improvement has overlooked the significance of supportability and has been the real guilty party behind the rising Pollution levels in the world's air among all other living life forms. The Pollution levels at certain spots have come to such high degrees that they have begun hurting our very own It will being. An IoT based Air Pollution observing framework incorporates a MQ Series sensor interfaced to a Node MCU outfitted with an ESP8266 WLAN connector to send the sensor perusing to a Thing Speak cloud. Further extent of this work incorporates an appropriate AI model to foresee the air Pollution level and an anticipating model, which is fundamentally a subset of prescient displaying. As age of poisonous gases from ventures, vehicles and different sources is immensely expanding step by step, it winds up hard to control the dangerous gases from dirtying the unadulterated air. In this paper a practical air Pollution observing framework is proposed. This framework can be utilized for observing Pollutions in demeanor of specific territory and to discover the air peculiarity or property examination. The obligated framework will concentrate on the checking of air poisons concentrate with the assistance of mix of Internet of things with wireless sensor systems. The investigation of air quality should be possible by figuring air quality index (AQI).

Pattar Sunil Mahesh et.al (2018) [2]purposed The level of pollution has increased with times by lot of factors like the increase in population, increased vehicle use, industrialization and urbanization which results in harmful effects on human wellbeing by directly affecting health of population exposed to it. In order to monitor in this project, we are going to make an IOT Based Air Pollution Monitoring System in which we will monitor the Air Quality over a web server using internet and will activate an alarm when the air quality goes down beyond a certain level, means when there is sufficient amount of harmful gases are present in the air like CO₂, smoke, alcohol, benzene and NH₃. It will show the air elements in PPM on the LCD and as well as on webpage so that we can monitor it very easily. In this IOT project, you can monitor the pollution level from anywhere using your computer or mobile.

Pradeep D. Landge et.al (2018) [3] proposed Air Quality Monitoring System for City: A Review. Objective of this paper is to design and implement a system for air quality monitoring using Internet of Things called as IoT. The model initiates from sensor devices that can sense, compute, and communicate data in a network. This study measures real-time PM_{2.5}, temperature, humidity, Air

Quality Index. Monitored data is wirelessly transmitted via WiFi module to a server. When the sensor node reads pollutant gases composition, temperature and humidity it will be displayed on the website. The monitored data with date and time can be retrieved as a tabular data for future analysis. With implementation of this work, precautionary alerts can be given to public on the designed website to wear anti-pollution mask, change paths while transporting where there is high air pollution ensuring high reliability. It will promote the public awareness about state of air pollution and how much important it is to reduce it. There will be news, surveys regarding pollution in different countries

Harsh Gupta et.al (2019) [4] An IoT Based Air Pollution Monitoring System for Smart Cities As the world's population is becoming increasingly urban, the cities are under pressure to remain livable. In recent years, the air quality of the cities has become one of the major cause of concern around the world. Thus, it is necessary to constantly monitor the air quality index of a city to make it smart and livable. In this paper, we propose and develop an IoT based Air Quality Monitoring System for Smart Cities. The real-time data of the air quality is accessed through the smart devices and analyzed to measure the impact on city dwellers. The smart devices are capable of measuring the Temperature, Humidity, Carbon Monoxide, LPG, Smoke and other hazardous particulate matters like PM2.5 and PM10 levels in the atmosphere. The gathered data is accessible globally through an Android Application.

Ramagiri Rushikesh et.al(2015) [5] purposed based vehicular pollution monitoring system for green revolution. The hardware architecture and software implementation are discussed in length. The performance of the system is also verified using IoT technology. The designed smart intelligent environmental system monitors the pollutants produced by the vehicles and also warn the vehicle owners to control the pollution. The system also sends the pollutant level data to the server for future analysis. The air pollution agencies can able to analyze the

data and also detect the vehicle registration numbers that causes more pollution in the atmosphere. The developed system is a low cost, simple to operate and is easily inserted in any locations. The developed system provides better accuracy with low cost than the existing system.

Harsh N. Shah, et.al (2018) [6] purposed 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 Pollution Monitoring System is used to monitor the Air Quality over a web server using Internet. It will trigger an alarm when the air quality goes down beyond a certain level, means when there are sufficient amount of harmful gases present in the air like CO₂, smoke, alcohol, benzene, NH₃ and NO_x. It will show the air quality in PPM on the LCD and as well as on webpage so that air pollution can be monitored very easily.

Arnab Kumar Saha et.al(2018) [7] purposed — In recent day scenario, the incessant increase in air and sound pollution prove to be an alarming problem. It has become mandatory to control and appropriately monitor the situation so that the required steps to curb the situation can be undertaken. In this project, an IOT-based method to monitor the Air Quality Index and the Noise Intensity of a region, have been proposed. The recommended technology comprises of four modules namely, the Air Quality Index Monitoring Module, the Sound Intensity Detection Module, the Cloud-based Monitoring Module and the Anomaly Notification Module. Firstly, the Air Quality Index is measured considering the presence of the five criteria air pollutants. Then the sound intensity is detected using respective sensor. After that, the Cloud-based Monitoring Module ensures the process of acquiring the data with the help of Wi-fi-module present in Raspberry Pi which fulfils the objective of analysis of information on a periodical basis. Finally, the Anomaly Notification Module alerts the user in case of an undesired condition.

S. No.	Author	Software /Equipmentused	Observation
1.	Vijayakumar Sajjan, Pramod Sharma(2019)	MCU, WLAN, AQI Etc	Air quality is a basic issue that clearly impacts human prosperity. Air quality data are accumulated remotely from checking bits that are furnished with an assortment of vaporous additionally, meteorological sensors. This data are researched and used as a piece of envisioning obsession estimations of pollutions using keen machine to machine organize.
2.	Pattar Sunil Mahesh et.al (2018)	Internet of things, air pollution, buzzer, sensors, monitoring system, Arduino, relay.	A low-cost, high-fidelity air quality monitoring device was designed, built and tested. The device can gather data at every second and transmit data via Wi-Fi and notify the organization depending on the threshold level. The device is low cost.
3.	Pradeep D. Landge et.al (2018)	Air Quality Index , Cloud ,Wi-Fi node , Sensor data ,	This paper presents the summary of various techniques of air quality monitoring. These techniques are elaborately discussed in the paper. In the proposed system, one of the most preferred technique is cloud based air quality monitoring system. Using the same cloud data, website is hosted and data is displayed on the website.
4.	Harsh Gupta et.al (2007)	Internet of Things; Air Quality; Smart Cities; Smart App DHT11: DHT11 sensor	The paper presented an IOT based Air Pollution Monitoring System for Smart Cities. A few sensors are deployed in the Jaypee Institute Campus to constantly monitor the

			Temperature, Humidity, Carbon Monoxide, Smoke, LPG, PM2.5 and PM10 levels in the atmosphere. In this work, a one-way communication between ThingSpeak, an open source cloud platform, and an Android Application has been developed. Raspberry Pi has been used as a gateway to interface the hardware system. The Graphs are plotted in ThingSpeak according to the sensors data received and the same can be visualized in an Android App in a tabular format. The Air Pollution Monitoring System is implemented and tested in real-life working condition and we are in the process of extending the nodes outside of the Jaypee Institute. In future, a large-scale node placement and data gathering have been planned for the purpose of forecasting of air pollution.
5	Ramagiri Rushikesh et.al(2018)	Internet of Things, Radio Frequency Identification, Vehicular pollution monitoring system, wireless technology	IoT based pollution monitoring system is developed and the performance of the developed system is verified successfully for various vehicles. The registration number of the vehicle inserted with RFID tag and passed through the monitoring system is identified using active RFID receiver and is displayed on the LCD. Fig 6 shows the display of the vehicle number that passes through the monitoring system with RFID tag. The monitoring system displays the pollutants levels of the vehicle and is shown in Fig 7. The controller sends the details of the vehicle and the pollutant values to server for monitoring the pollution levels of vehicle.
6	Harsh N. Shah, et.all (2018)	1) MQ135 Gas sensor 2) Arduino Uno 3) Wi-Fi module ESP8266 4) 16x2 LCD 5) Breadboard 6) 10K potentiometer 7) 1K ohm resistors 8) 220 ohm resistor 9) Buzzer 10) MQ 6 LPG gas sensor 11) Temperature sensor LM35 12) Humidity sensor SY-H5220	The system to monitor the air of environment using Arduino microcontroller, IOT Technology is proposed to improve quality of air. With the use of IOT technology enhances the process of monitoring various aspects of environment such as air quality monitoring issue proposed in this paper. Here, using the MQ135 and MQ6 gas sensor gives the sense of different type of dangerous gas and arduino is the heart of this project
7	Arnab Kumar Saha et.al (2018)	Pi 3B; MQ -135; LM 393; Air Quality Index;Sound Intensity	Humans are considered responsible for this polluted and dangerous environment. This is a major concern for the whole world. Thus, a smart way to monitor the various environmental parameters using a Raspberry Pi module has been discussed in this paper. The concept of IoT helps improve the quality of air, monitor the level of noise, temperature and humidity [12][13].It is a low-cost, precise and efficient method of monitoring. The monitoring of accumulated data in the cloud storage helps to analyze the various patterns in the environmental parameters and accordingly notifies the public

III. RESEARCH METHODOLOGY

This section presents and describes the methods of the IOT Based AIR Pollution Monitoring System that include system architecture defines in Section 3.1, Block Diagram 3.2 , circuit diagram in Section 3.3,working in section 3.4.

A. System Architecture:

The proposed IoT based real time pollution monitoring system has the DAQ that is connected to a remote think speak web server with a esp32 data base. The advantages of using Think speak web server are that it is less expensive,

always available and is independent of the location or nature of the DAQ.

The feature of think speak web server that provides the service of software, platform and infrastructure provide scope for scalability. The advantage of using thinks speak database is horizontal scalability, elasticity, reduced cost and ease of use. Think speak server and database is more suited for IoT application as any number of IoT device can easily connect, store and retrieve data. In this we are using c language and think speak web server which will help us to gain the live condition on air quality where the our project will be installed

B. Block Diagram:

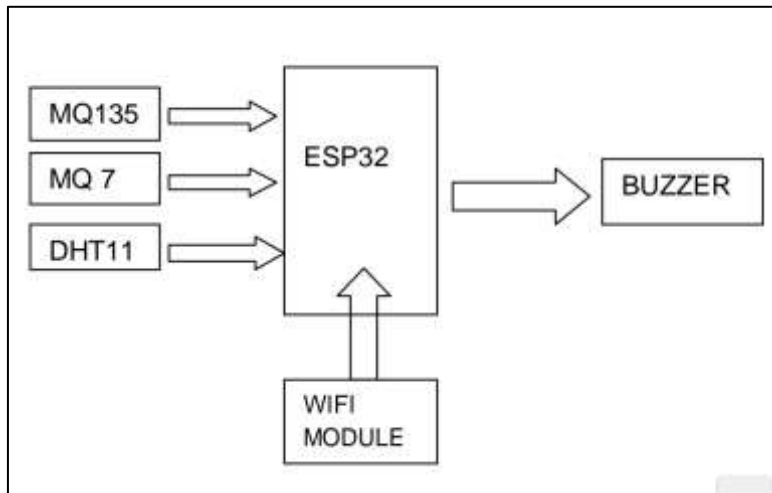


Fig. 1: Block diagram

C. Circuit Diagram:

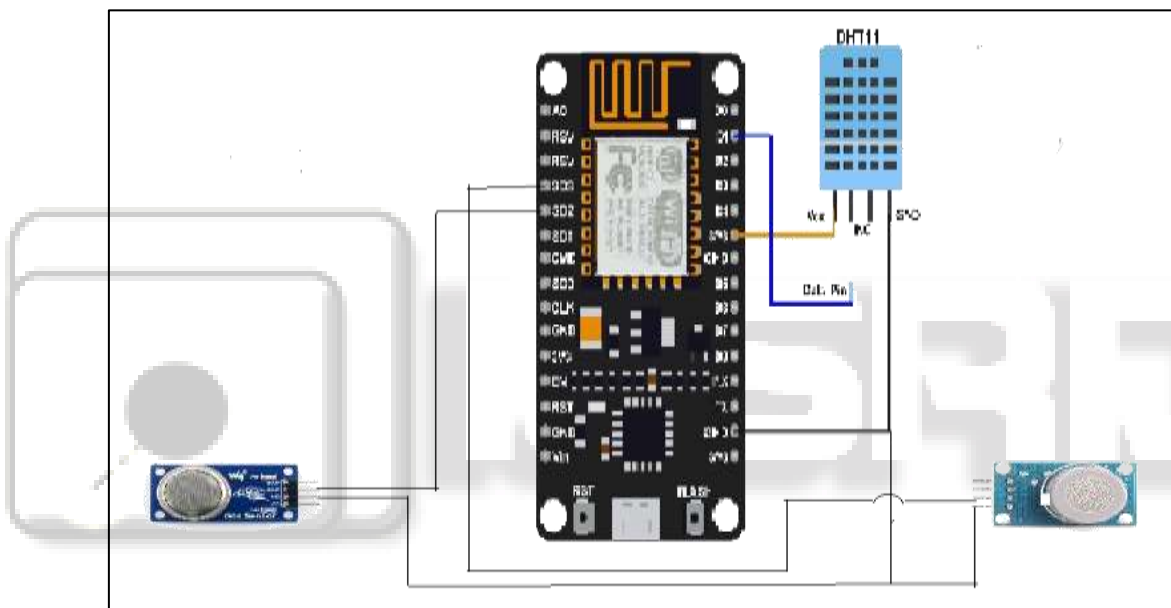


Fig. 2: Circuit Diagram

D. Working

In this we have installed 3 sensor MQ135, MQ7, DHT11 these sensor will tell us the quality of air as mq135 is air quality sensor for detecting a wide range of gases, including NH₃, NO_x, alcohol, benzene, smoke and CO₂. Ideal for use in office or factory. MQ135 gas sensor has high sensitivity to Ammonia, Sulfide and Benze steam,

The MQ-7 is a Carbon Monoxide (CO) sensor suitable for sensing CO concentrations in the air. It can detect CO-gas concentrations anywhere from 20 to 2000 ppm. It make detection by method of cycle high and low temperature, and detect CO at low temperature. It is widely used in domestic CO gas leakage alarm, industrial CO gas alarm and portable CO gas detector.

The sensor module is including resistive humidity sensing component and NTC temperature testing. The compatible digital temperature humidity sensor module is component and connected with 8-byte MCU. This is useful module is fast response, great anti-interference ability and durable.

These sensor will give the response to esp32 and that module will display the reading on think speak web server which and we will set buzzer which will alert when the air quality decrease from the given value

IV. FINDINGS AND ANALYSIS

Data measured from the individual zones (industrial, residential and traffic) are shown in the output. Three zones were selected in industry, residential and traffic areas. The IoT devices were deployed in a secured location at each of the zone. The measurement for each of the pollutant was taken according to the time interval specified by the pollution control board. In every location thereadings were recorded for five days continuously. The average reading at different timings is stored. The hourly average of stored measurements is retrieved for analysis. The measured data stored in the cloud database were used for the following analysis. Clearly visible that the NO_x pollution is high in all three zones due to the large number of textile mills present in the vicinity all the three zones.

V. CONCLUSION

The paper proposes a real time monitoring of air pollution at various locations and zones in Chandigarh city. The IoT system designed measures pollution in real time at any desirable location and hence is cost effective when compared to the existing system of stationary monitoring. It also avoids the problem of inconsistent pollution value. The user interface helps the people to know the pollution level at a certain area and the health hazard associated with it. People with specific allergies can refrain from visiting the place and hence be free from air prone health hazards. The system is scalable and supports any number of IoT devices that may be deployed since it's based on cloud platform. The interface supports all operating systems too. It is found that traffic pollution in Coimbatore city is relatively low. Due to the large number of foundries, brick kilns and textile mills the industrial pollution is found to be more. There is also considerable level of pollution in residential zones where textile mills were present. This system may be enhanced to measure more air pollutants. The data acquired may be used to predict pollution in similar zones depending on the location and vicinity of the type of industry in that location. This is expected to reduce the cost of pollution monitoring as well as it helps the people to choose their residential area depending on the associated health hazard. The system to monitor the air of environment using Arduino microcontroller, IOT Technology is proposed to improve quality of air. With the use of IOT technology enhances the process of monitoring various aspects of environment such as air quality monitoring issue proposed in this paper. Here, using the MQ135 and MQ7 gas sensor gives the sense of different type of dangerous gas and Arduino is the heart of this project. Which control the entire process. Wi-Fi module connects the whole process to internet.

REFERENCES:

- [1] Vijayakumar Sajjan, Pramod Sharma (2019)“Research on an Iot Based Air Pollution Monitoring System”.
- [2] Pattar Sunil Mahesh,Patil Bhushan Rajendra , Bodke Akshay Dnyaneshwar , Mr. Ulhās. V. Patil(2018) “A SURVEY PAPER ON AIR POLLUTION MONITORING USING IOT”
- [3] Pradeep D. Landge, R.R.Harne2(2018)“Air Quality Monitoring System for City: A Review”
- [4] Harsh Gupta, Dhananjay Bhardwaj, Himanshu Agrawal, Vinay Anand Tikkiwal, Arun Kumar (2019). “An IoT Based Air Pollution Monitoring System for Smart Cities”
- [5] Ramagiri Rushikesh, Chandra Mohan Reddy Sivappagari(2015)” Ramagiri Rushikesh, Chandra Mohan Reddy Sivappagari”
- [6] Harsh N. Shah , Zishan Khan , Abbas Ali Merchant , Moin Moghal , Aamir Shaikh , Priti Rane (2018)“IOT Based Air Pollution Monitoring System”
- [7] Arnab Kumar Saha , Sachet Sircar , Priyasha Chatterjee , Souvik Dutta , Anwesha Mitra , Aiswarya Chatterjee , Soumyo Priyo Chattopadhyay , Himadri Nath Saha(2018)” A Raspberry Pi Controlled Cloud Based Air and Sound Pollution Monitoring System with Temperature and Humidity Sensing”
- [8] Nurul Azma Zakaria , Zaheera Zainal Abidin , Norharyati Harum, Low Chen Hau,(2018)” Wireless Internet of Things-Based Air Quality Device for Smart Pollution Monitoring ”
- [9] Piyush Patil(2017) “Smart IoT Based System For Vehicle Noise And Pollution Monitoring”j. Dhole Shwetali Keken Priti , Pawbake Shivani , Pavan Upadhye (2020)” Real Time Air Pollution Monitoring System Using Cloud And IoT”