International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 04 | April - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

Air Pollution Monitoring System Using IOT

M SRINIVAS RAO, Assistant professor, Department of ECE, Satya Institute of technology and management, Vizianagaram, Andhra Pradesh, India.

Email:- maley.srinu@gmail.com.

BHOGAVARAPU BHAVANI, B.Tech Student, Department of ECE, Satya Institute of technology and management, Vizianagaram, Andhra Pradesh, India.

Email:- bhavanibhogavarapu@gmail.com

PYLA PARTHA SARATHI, B.Tech Student, Department of ECE, Satya Institute of technology and management, Vizianagaram, Andhra Pradesh, India.

Email:- pailapardhu123@gmail.com

SANGAPU TANOOJKUMAR, B.Tech Student, Department of ECE, Satya Institute of technology and management, Vizianagaram, Andhra Pradesh, India.

Email:- sangaputanoojkumar@gmail.com

VETCHA SAHITHI, B.Tech Student, Department of ECE, Satya Institute of technology and management, Vizianagaram, Andhra Pradesh, India.

Email:- sahithivetcha@gmail.com

MADDAMASETTY BHANU CHITRA, B.Tech Student, Department of ECE, Satya Institute of technology and management, Vizianagaram, Andhra Pradesh, India.

Email:- maddamasettybhanuchitra@gmail.com

VULLAKULA JAHANAVISAI, B.Tech Student, Department of ECE, Satya Institute of technology and management, Vizianagaram, Andhra Pradesh, India.

Email:- jahnavisai@gmail.com

ABSTRACT

This paper presents the development of a low-cost, real-time air pollution monitoring system using the Internet of Things (IoT). The system uses an ESP32 microcontroller integrated with air quality, temperature, and humidity sensors to collect environmental data. This data is then transmitted to a cloud platform via the MQTT protocol and visualized using the Blynk mobile application. The proposed system is ideal for monitoring harmful gases in industrial areas and alerting users when air quality deteriorates, contributing to better environmental awareness and occupational safety.

Keywords: IoT, ESP32, Air Quality Monitoring, Blynk, MQTT, Sensors, Embedded Systems

1. INTRODUCTION

With the growth of industrialization and urban development, air pollution has emerged as a critical environmental and public health issue. Pollutants such as carbon monoxide (CO), nitrogen oxides (NOx), sulphur dioxide (SO_2), and particulate matter pose serious health risks. IoT-based environmental monitoring has gained attention for its potential to deliver scalable, affordable, and real-time solutions.

This project focuses on building a real-time air quality monitoring system that leverages the IoT to sense, evaluate, and alert users of harmful gas concentrations in the air. It is designed to be deployed in industrial and urban settings to promote safer, healthier environments.

2. LITERATURE REVIEW

A review of prior works revealed a variety of approaches to air quality monitoring using both wired and wireless technologies.

- Marinov (2016) proposed a scalable sensor array with IR gas sensors.
- Marquez-Viloria (2016) developed a georeferenced particulate monitoring system using MQTT.
- Chen Xiaojun (2015) proposed a layered IoT-based structure focusing on accuracy.
- Vasim K. Ustad (2014) integrated GPS and ZigBee, though with low bandwidth limitations.
- Abdullah Kadri (2013) focused on solar-powered WSNs for real-time pollution tracking.
- Bhavika Bhatiya (2017) used XBee modules and hierarchical network architecture for air monitoring.

Although many of these systems provide accurate readings, they often involve high costs, complex installations, or limited data accessibility. Our system addresses these concerns with low-cost sensors, real-time mobile access, and cloud storage integration.

3. SYSTEM REQUIREMENTS

3.1 Hardware Components

- **ESP32 Microcontroller:** Central controller with integrated Wi-Fi and Bluetooth support
- **Sensors:**
  - MQ-135: Detects NH_3, NOx, CO_2, benzene, and smoke
  - MQ-5: Detects H_2, LPG, CO
  - MQ-3: Detects alcohol, benzene, and hexane
- DHT11: Measures temperature and humidity
- LCD Display: 16x2 I2C display for local output
- Jumper Wires, Breadboard: Circuit assembly
- Smartphone: For Blynk application interface

3.2 Software Requirements

- Arduino IDE: For programming ESP32 using Embedded C

- Blynk App: For real-time data visualization on mobile
- MQTT Protocol: For cloud data transmission

4. PROPOSED SYSTEM

The system continuously monitors air quality parameters and displays results in PPM on an LCD and through the Blynk mobile application. When pollutant levels exceed safe thresholds, the system alerts the user via notifications. The ESP32 acts as the main controller, collecting sensor data and uploading it to the Blynk cloud.

Key Features

- Real-time monitoring and alerting
- Mobile accessibility
- Cost-effective sensor integration
- Remote data logging

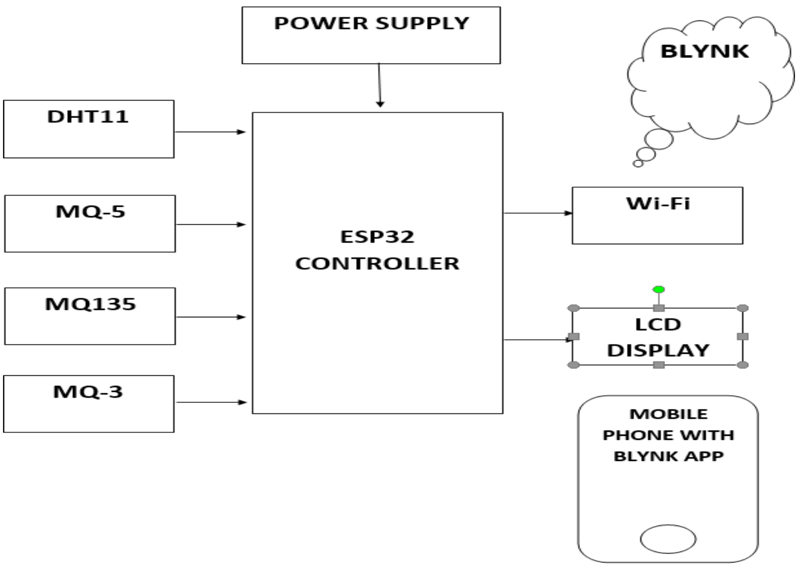

Figure 1: Block diagram for Air Pollution Monitoring System

5. SYSTEM ARCHITECTURE

Figure1:BlockDiagram
(Sensors → ESP32 → LCD + Blynk App via Wi-Fi)

Each gas sensor outputs analogy voltage proportional to gas concentration, which is converted to PPM using sensor libraries and formulas. ESP32 processes this data and displays it locally and remotely.

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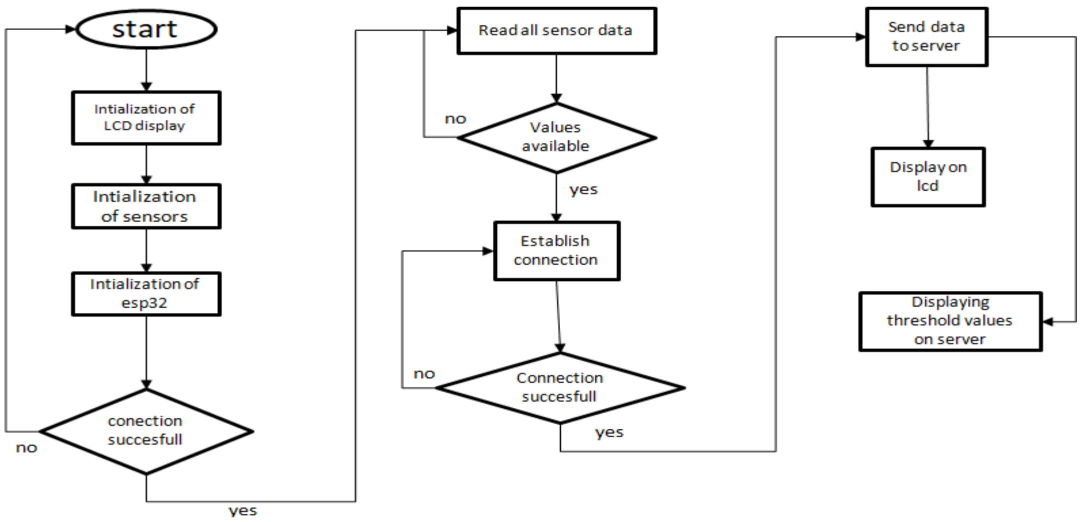

Figure 2: Flow Chart of proposed system

Figure 2: Flowchart Overview

- Power ON → Sensor Initialization → Data Collection → Display on LCD → Upload to Cloud → Notify via App

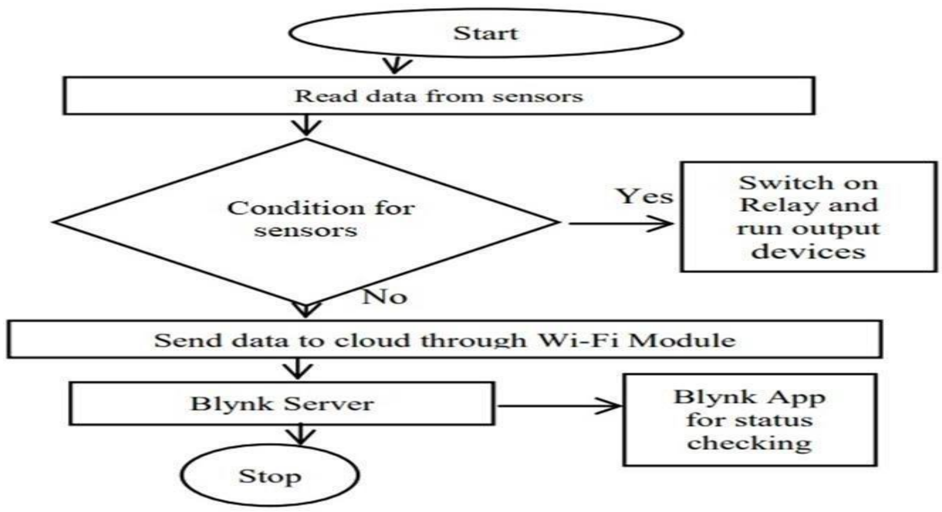

Figure 3: DFD for air pollution monitoring system

6. RESULTS AND DISCUSSION

The system was tested in various environments. The gas levels, temperature, and humidity were successfully recorded and transmitted. Accuracy of ±2–3% was observed compared to calibrated instruments.

Figure 3: Sample Readings in PPM

Figure 4: Blynk Application Output Interface

Figure 5: Hardware Setup

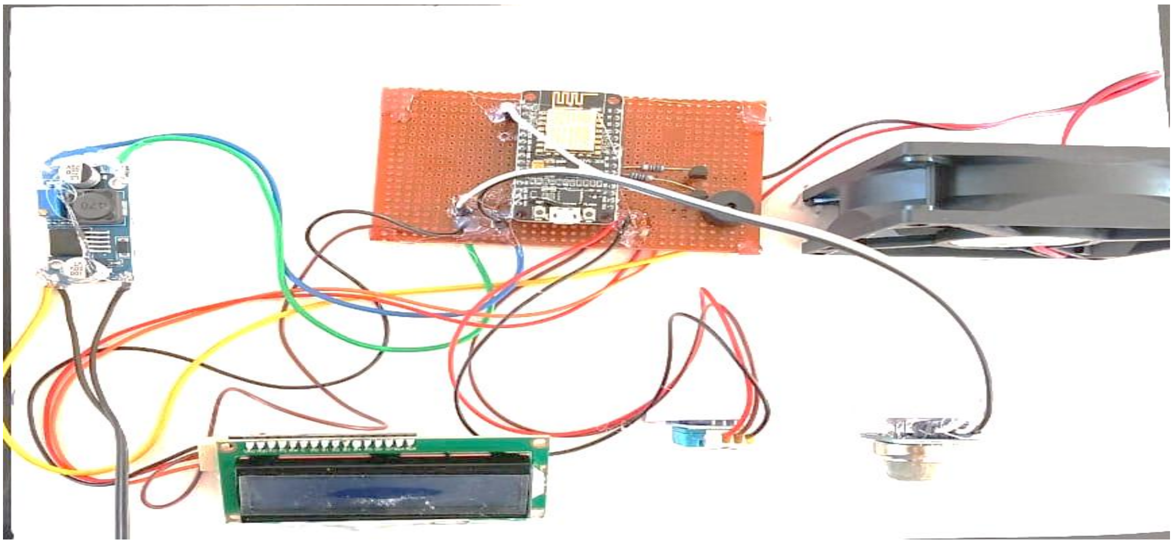

Figure 6: Hardware implementation

1. RESULTS

The below figure shows the overall prototype of Air Quality Monitoring Systems

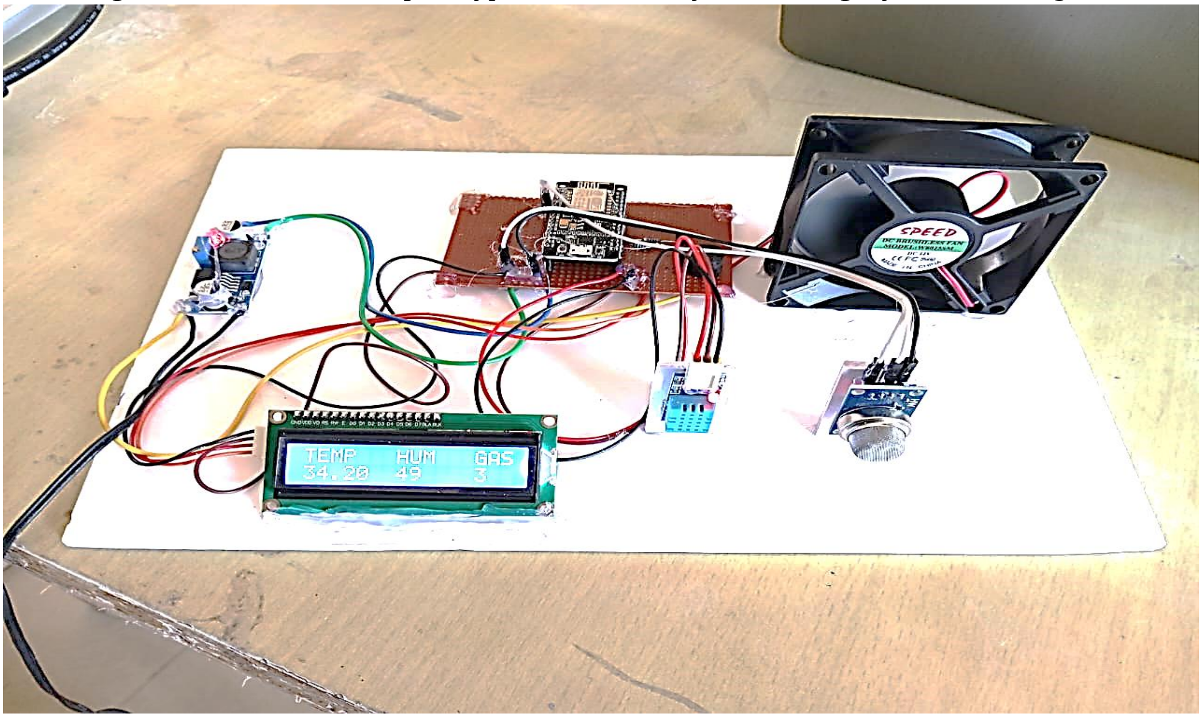

Fig 6.1 Air Quality Monitoring System Prototype

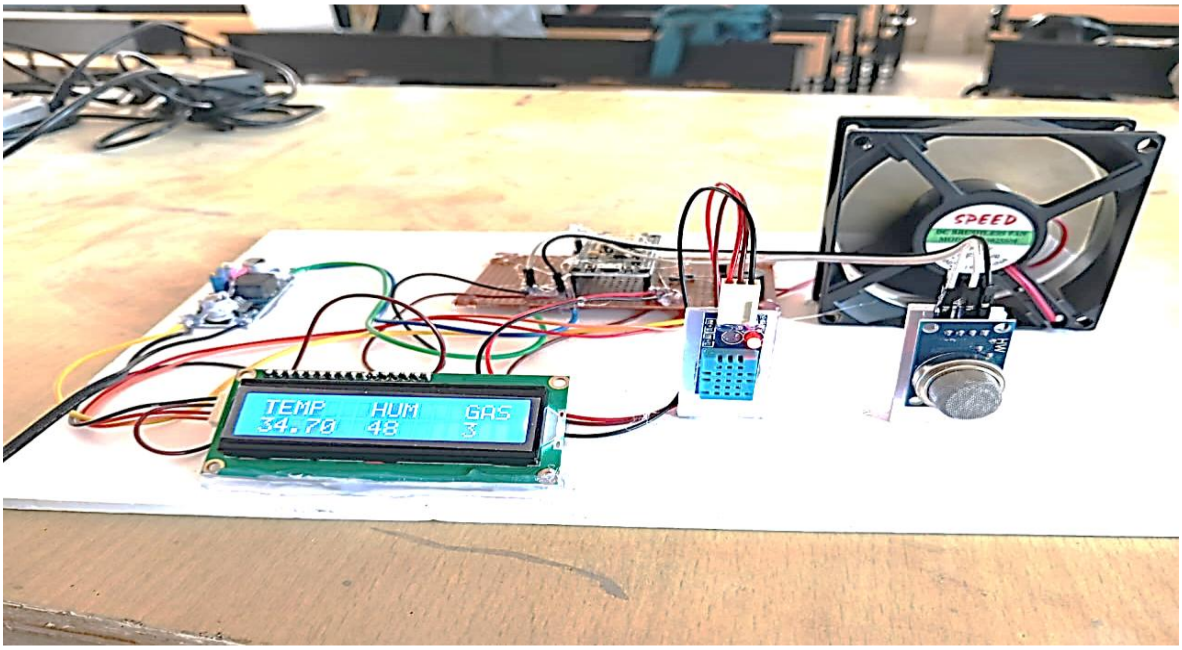

FIG 6.2 Temperature Is HIGH, Buzzer is ON

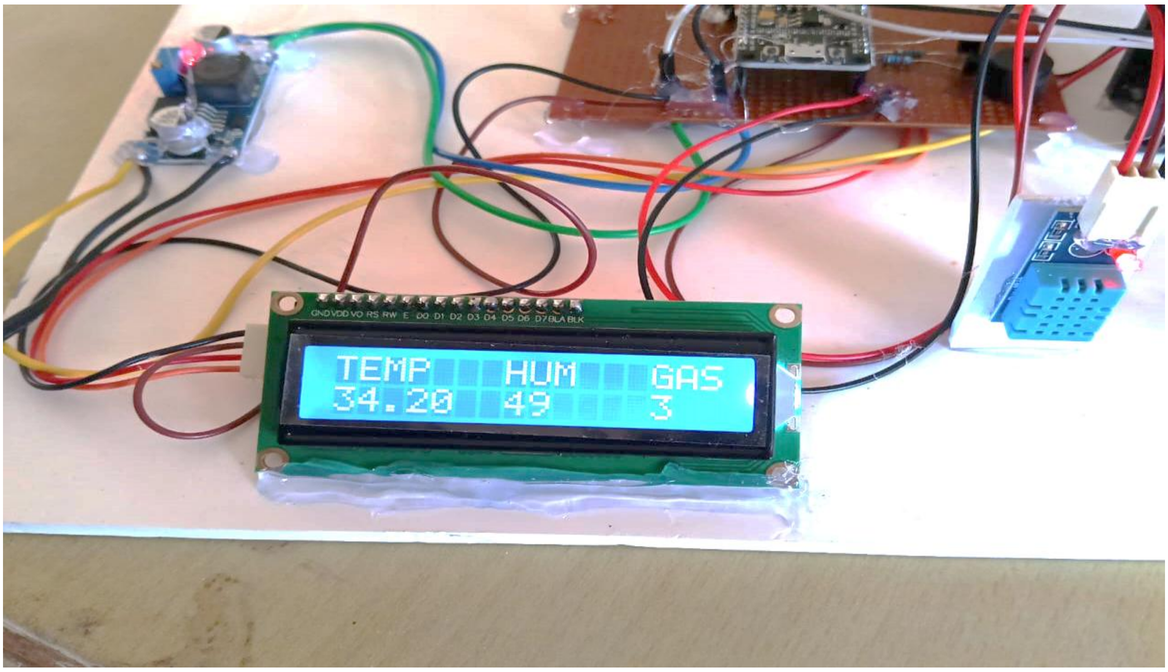

FIG 6.3 Gas Is Available, Buzzer Is ON

- When Temperature >=34 then Buzzer is ON.
- When Humidity >=45 then Buzzer is ON.
- When Gas is Available then Buzzer is ON

7. CONCLUSION

This IoT-based air pollution monitoring system demonstrates an effective, low-cost solution for real-time environmental tracking. It reliably detects harmful gases and provides alerts through a user-friendly mobile interface. With 97% accuracy, it supports proactive measures in industrial safety and public health. The design is scalable and can be extended by integrating more sensors for wider pollutant detection.

8. FUTURE WORK

- Integration of GPS for geo-tagged pollution mapping
- Solar-powered modules for remote deployment
- Machine learning-based air quality prediction
- Integration with smart city platforms

VIII. REFERENCES

[1] Marin B. Marinov, Ivan Topalov, ElitsaGieva, GeorgiNikolov, Air quality monitoring in urban environments, 2016 39th International Spring Seminar on Electronics Technology (ISSE),pp. 443-448

[2] David Marquez-Viloria, J. S. Botero-Valencia, Juan Villegas- Ceballos, A low cost georeferenced air-pollution measurement system used as early warning tool, 2016 XXI Symposium on Signal Processing,Images and Artificial Vision (STSIVA), pp. 1-6

[3] C, Air pollution monitoring using wireless sensor network, 2016 IEEE International WIE Conference on Electrical and Computer Engineering (WIECONECE), pp. 112-117

[4] Mr.Vasim K. Ustad , Prof.A.S.Mali , Mr.Suhas S.Kibile- “Zigbee Based Wireless Air Pollution Monitoring System Using Low Costand Energy Efficient Sensors”, 2014 International Journal of Engineering Trends and Technology (IJETT)

[5] Chen Xiaojun, Liu Xianpeng, XuPeng,“IoT- Based Air Pollution Monitoring and Forecasting System”, 2015 International Conference on Computer and Computational Sciences (ICCCS), pp. 257-260

[6] Abdullah Kadri, Elias Yaacoub, Mohammed Mushtaha, Adnan AbuDayya, “Wireless sensor network for real-time air pollution monitoring”,2013 1st International Conference on Communications, Signal Processing, and their Applications (ICCSPA), pp. 1-5

[7] Bhavika Bathiya, Sanjay Srivastava, Biswajit Mishra, “Air pollution monitoring using wireless sensor network”, 2017 IEEE International WIE Conference on Electrical and Computer Engineering , pp. 117-121

[8] Khaled Bashir Shaban, Abdullah Kadri, EmanRezk, “Urban Air Pollution Monitoring System With Forecasting Models”, IEEE Sensors Journal 2016, pp. 2598-2606

[9] Harsh N. Shah , Zishan Khan , Abbas Ali Merchant , Moin Moghal , Aamir Shaikh ‘IOT Based Air Pollution Monitoring System”, IJSER 2018

[10] Gagan parmar, sagar lakhani,manju k chattopadhyay, “An IOT based low-cost air pollution monitoring system”, IEEE 2017 International Conference on Recent innovations in signal processing and embedded systems (RISE)

[11] D. Verma, S. Dhul, R.saini, R.B. Dubey, “IoT Based Air Pollution Monitoring System”, International Journal of Innovative

Research in Engineering & Management (IJIREM), May 2018

[12] Frances Moore, "Climate Change and Air Pollution: Exploring the Synergies and Potential for Mitigation in Industrializing Countries", Sustainability, 2009. Vol. 1(1), pp. 43-54.

[13] H. Ali, J. K. Soe, and S.R. Weller, "A real-time ambient air quality monitoring wireless sensor network for schools in smart cities" In the ICSETS 2019 176 Proceedings of the IEEE First International Smart Cities Conference (ISC2’15). 25-28 Oct. 2015 Guadalajara, Mexico.

[14] B. Merikhi, F. Y. Nejad, and M. Abbaspour, “Sc-iaqm model for indoor air quality monitoring in a smart community,” in 2016 24th Iranian Conference on Electrical Engineering (ICEE), May 2016, pp. 1562– 1567.

[15] Al-Ali, A. R., Zualkernan, I., & Aloul, F. (2010). A mobile GPRS-sensors array for air pollution monitoring. AIEEE Sensors Journal, 10(10), 1666–1671.