

ADVANCED AIR QUALITY MONITORING SYSTEM (AAQM) USING ENSEMBLE ALGORITHMS

Ali A. Aboodee Alzaheiree

Imam Alkadhim University College

Article information:

Manuscript received: 05 Jun 2025; **Accepted:** 06 Jul 2025; **Published:** 31 Aug 2025

Abstract: Air pollution is very dangerous for human health. Nowadays many steps are taking by the government to overcome air pollution and improve air quality. Embedded is the updated technology that is used to improve the performance of air quality. The Enhanced system uses the integrated functions which are associated with it. The Ensemble system reduces manpower, saves time and operates efficiently without human interference. The proposed system detects the various dangerous gases and detects the air quality. Results show the processing of sensors and the working of the system.

Keywords: Ensemble system, aaqm, MQ5, gases.

Introduction

Observing air quality is one of the major worldwide reasons for untimely mortality and is the fundamental risk for people all over the world [1]. Almost all urban territories don't conform to air quality rules of the World Health Organization (WHO) [2, 3]. The hazard populaces that experience the ill effects of the adverse impacts of air pollution the most are kids, old, and individuals with respiratory and cardiovascular issues. These wellbeing intricacies can be stayed away from or decreased through raising the familiarity with air quality conditions in urban territories, which could enable residents to restrain their day-by-day exercises in the instances of raised contamination scenes, by utilizing models to figure or gauge air quality in areas lacking checking information.

Air pollution demonstrating depends on a thorough comprehension of connections between emanations, testimony, climatic fixations and qualities, meteorology, among others; and is a basic apparatus in administrative, look into, and measurable applications [4]. These models compute and foresee physical procedures and the vehicle inside the climate [5]. Hence, they are broadly utilized in evaluating and gauging the degrees of air pollution and surveying its effect on human and ecological wellbeing and economy [6–9]. Furthermore, air pollution demonstrating is utilized in science to help comprehend the important procedures among emanations and fixations, and comprehend the communication of air toxins with one another and with climate [10] and territory [11, 12] conditions. Displaying isn't just significant in identifying the reasons for air contamination yet additionally the outcomes of past and future relief situations and the assurance of their viability [4].

For example, air quality inputs:

- Since certain pollutants such as Nitrogen Dioxide and Ozone gases, are in an inter-relationship; values of these might be considered as inputs instead of outputs.

- All the Pollutants are affected by various weather conditions that affect these pollutants like the solar intensity, air temperature, wind speeds, wind directions and etc [6];
- The environment, on the other hand have a hysteresis effect where toxic substance get accumulated and spread over time.;

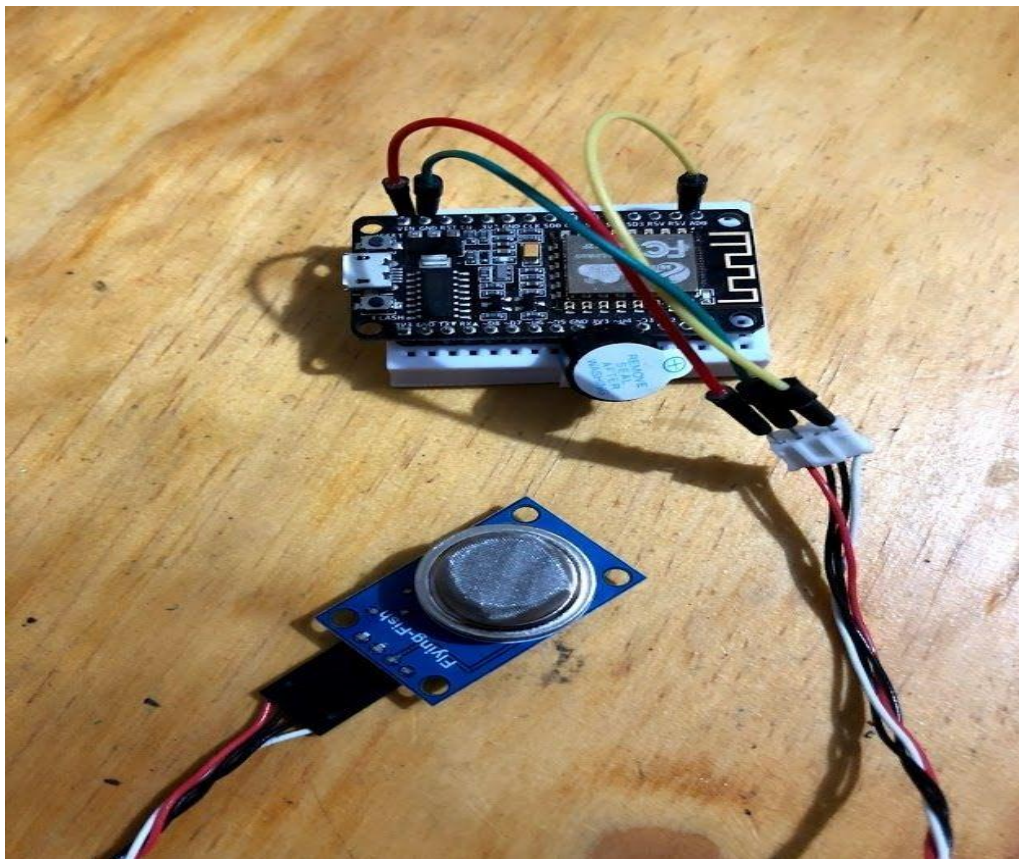


Figure: 1 Block Diagram for proposed system

Related Work

The air pollution checking framework is completely significant for identifying the wide scope of gases, likewise, sensors have a long lifetime, effectively accessible, less cost, simple to affect and are reduced. The nature of air is often checked indoor even as outside.

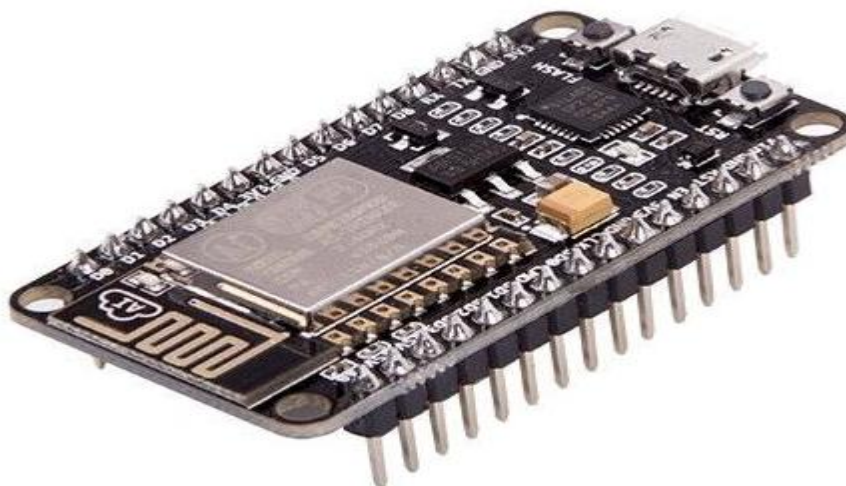


Figure: 2 Microcontroller

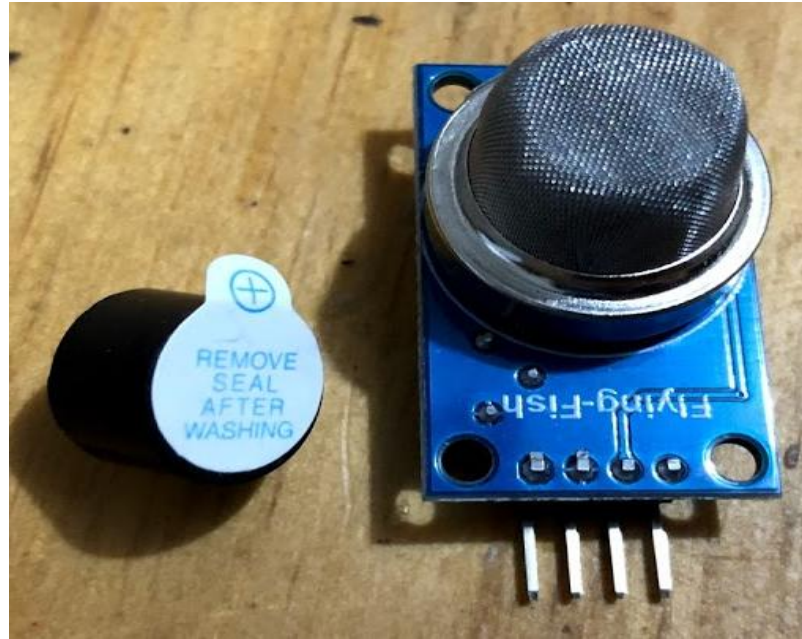


Figure: 3 Gas Sensor-1 (MQ-5)

The above IoT based air and commotion contamination observing gadget are an exceptional advance towards working cool. This gadget helps the urban specialists as well as even normal citizens to associate in controlling pollution and providing a sound environment. Once installed, these programmed gadgets are fit for continually tracking the contamination level and analyzing the determined information. The biggest feature of this gadget is that the output is digitized and analog format, with a very simple mobile application by any android device as smartphone, tablet computer, PDA 's etc. The device is very eco-friendly, and it does not harm the world in any way. Additionally It is one of the cutting edge innovation utilized and it additionally moderate when looked at different innovations grew up to date and perhaps introduced wherever. [3]



Figure: 4 Buzzers

This framework has highlights for the individuals to screen the measure of contamination on their cell phones utilizing the appliance. To execute this got to send the sensor gadgets in nature for gathering the knowledge and examination. By conveying sensor gadgets within the earth, the framework can bring the world into genuine for instance it can communicate with different items through the system. At that time the gathered information and examination results are going to be accessible to the top client through the Wi-Fi. the knowledge is often a big source while tending to the difficulty of the consequences of cruisers at sits (for example sitting tight for a green light) on air quality. additionally, to accomplish ongoing observing, the knowledge of CO fixation during a specific spot might be audited from versatile specialized gadgets, for instance, PDAs, advanced cells, and tablet PCs to help hold with airing quality in check. [5]

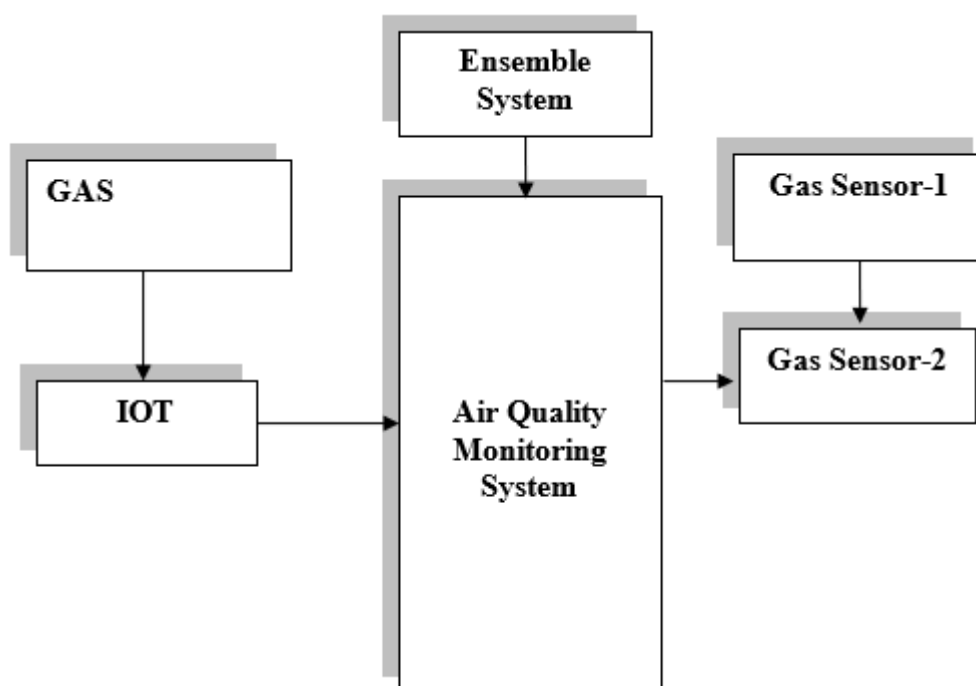


Figure: 5 System Architecture

AAQM

PROPOSED SYSTEM: The system used the air sensors to detect the presence of harmful and toxic gases/mixes [Methane, Propane, Butane, alcohol, noxious gases, carbon monoxide gas etc.] from pollution in air and also used sound sensor for capturing continuously noise level in environment. One module was a family air sensor device (MQ2) as our pollution concentrations, and the sound sensor module mic produced the ambient sound. The sensors work in tandem with Arduino(note :the expression is only a figure of speech, we use raspberry pi to be more precise) that compiles this data and then sends it through the mobile app. There is also provided to send the data over region wise WI-FI modem. Additionally, whenever the pollution is detected it immediately rings a bell and if its a sound pollution then a LED starts blinking regularly. The experts, as well as the chocked people, can verify their so-called data through their phone and that too free of cost add up by whatever means and can act against it on their end level only to try bringing to the desired pollution levels. This infrastructure would define as part and parcel of a community in the building of a healthy society

1) Node MCU Controller: This is an open source IoT platform, our target model which we are gonna use throughout this series contains esp8266 that holds FW version for now but you can have another versions of this controller as well. It combines the ESP8266 Wi-Fi

SoC from Espressif Systems with hardware to both parse and use the Esp-12 module called firmware. The term “NodeMCU” actually is a firmware, not the development kits itself. It should understand before using it. Lua scripting in the firmware. This is the one based on eLua project and compiled with Espressif Non-OS SDK for ESP 8266. Lua-cjson and Spiffs you might see in some other open-source projects being used in nodemcu.

2) Gas Sensor: This callback will sense the air.

3) Wi-Fi module: In this communication is done between the IoT components.

4) LCD Display:- LED blinks continuously whenever it detects the noise pollution and an Alarm is sounded immediately when air Pollution is detected.

Conclusion

The Air pollution system device are of very poor quality the ensemble system is used to resolve the problem identified in air. The Ensemble System integrates the hardware as well as other software components for indoor and outdoor urban air quality enhancement / pollution reduction. It is measured by various sensors like CO, CO₂, NO₂, temperature, humidity, radiation, ultraviolet means of Soil Moisture sensor and etc. send Redirected_command

References

1. Tapashetti, A., Vegiraju, D., Ogunfunmi, T.: IoT-enabled air quality monitoring device: a low-cost smart health solution. In: 2016 IEEE Global Humanitarian Technology Conference (GHTC), pp. 682–685. Seattle, WA (2016)
2. Khot, R., Chitre, V.: Survey on air pollution monitoring systems. In: 2017 International Conference on Innovations in Information, Embedded and Communication Systems (CICS), pp. 1–4. Coimbatore (2017)
3. Desai, N.S., Alex, J.S.R.: IoT based air pollution monitoring and predictor system on Beagle Bone Black. In: 2017 International Conference on Nextgen Electronic Technologies: Silicon to Software (ICNETS2), pp. 367–370. Chennai (2017)
4. Mukhopadhyay, A., et al.: Design of air quality meter and pollution detector. In: 2017 8th Annual Industrial Automation and Electromechanical Engineering Conference (SEMICON), pp. 381–384. Bangkok (2017)
5. Wang, D., Jiang, C., Dan, Y.: Design of air quality monitoring system based on internet of things. In: 2016 10th International Conference on Software, Knowledge, Information Management & Applications (SKIMA), pp. 418–423. Chengdu (2016)
6. Budiarto, A., Febriana, T.: IoT device used for air pollution campaign to encourage cycling habit in inverleith neighborhood. In: 2017 International Conference on Information Management and Technology (Imtech), pp. 356–360. Yogyakarta (2017)
7. Kumar, S., Jasuja, A.: Air quality monitoring system based on IoT using Raspberry Pi. In: 2017 International Conference on Computing, Communication and Automation (ICCCA), pp. 1341–1346. Greater Noida (2017)
8. Alshamsi, A., Anwar, Y., Almulla, M., Aldohoori, M., Hamad, N., Awad, M.: Monitoring pollution: applying IoT to create a smart environment. In: 2017 International Conference on Electrical and Computing Technologies and Applications (ICECTA), pp. 1–4. Ras Al Khaimah (2017)
9. Parmar, G., Lakhani, S., Chattopadhyay, M.K.: An IoT based low-cost air pollution monitoring system. In: 2017 International Conference on Recent Innovations in Signal Processing and Embedded Systems (RISE), pp. 524–528. Bhopal (2017)

10. Xiaojun, C., Xianpeng, L., Peng, X.: IoT-based air pollution monitoring and forecasting system. In: 2015 International Conference on Computer and Computational Sciences (ICCCS), pp. 257–260. Noida (2015)
11. Kim, S.H., Jeong, J.M., Hwang, M.T., Kang, C.S.: Development of an IoT-based atmospheric environment monitoring system. In: 2017 International Conference on Information and Communication Technology Convergence (ICTC), pp. 861–863. Jeju (2017)
12. Gokul, V., Tadepalli, S.: Implementation of a WiFi based plug and sense device for dedicated air pollution monitoring using IoT. In: 2016 Online International Conference on Green Engineering and Technologies (IC-GET), pp. 1–7. Coimbatore (2016)