

ARDUINO BASED AIR MONITORING AND FILTERING SYSTEM

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ABSTRACT:

The device designed here is intended to use in indoor applications and its purpose is to measure the air quality as per the AQI standards. If the air quality is poor, means the value is greater than 150 due to the smoke or any other toxic gasses present in the air. Air quality is measured with the air quality index (AQI) and it works like a thermometer. For filtering the air we are using the HEPA filter, Carbon filter and other filters. HEPA filter performs major operation in filtering the air. The overall performance of the Arduino-based air monitoring and filtration system provides an accessible and adaptable solution for improving indoor air quality, promoting healthier living environments, and addressing air pollution challenges in both residential and commercial settings.

Keywords – Sensors , LCD Display , Filtering System Monitoring System

I. INTRODUCTION

In generally people believes that outdoor air pollution is harmful and they are safe at home. Yet, the reality is quite different. Indoor air quality can be 10-15 times more polluted than outside. The air in the house is polluted by various pollutants, dust, and bacterias that cause disease Gases such as CO, CO₂, SO₂, and are extremely harmful for us. A growing concern about indoor air quality (IAQ) due to its significant impact on human health and well-being. Poor IAQ can lead to respiratory issues, allergies, and other health problems, particularly in indoor environments where people spend the majority of their time. Addressing this concern, our project introduces an innovative Arduino-based air monitoring and filtration system designed to actively enhance IAQ in various indoor settings. By integrating advanced sensors and smart filtration mechanisms, this system aims to provide real-time monitoring of key air quality parameters and to initiate targeted filtration processes when pollutant levels exceed safe thresholds.

We utilize high-efficiency particulate air (HEPA) filters to capture airborne particles effectively and activated carbon filters to adsorb volatile organic compounds (VOCs) and odors, thus ensuring comprehensive air purification.

Traditional air quality monitoring systems are often expensive, complex, and lack the capability for real-time adjustments based on sensor data. Our Arduino-based approach offers a cost-effective alternative with the flexibility to adapt to different indoor environments, ranging from residential homes to commercial buildings and educational institutions. By leveraging the power of Arduino microcontrollers and a suite of sensors, our system can detect particulate matter (PM_{2.5} and PM₁₀), carbon dioxide (CO₂) levels, temperature, humidity, and other IAQ parameters crucial for maintaining a healthy indoor environment.

II. LITERATURE REVIEW

The development of air monitoring and filtration systems has received significant attention in recent years due to the increasing awareness of indoor air quality (IAQ) issues and their impact on human health. Various research studies have explored different approaches and technologies to address these challenges, providing valuable insights and contributing to the advancement of IAQ management systems.

Abhishek kumar, Amit Saxena(2019) develop the Smart Air Quality Monitoring and Filtering System using IOT and filtering mechanism. In this work they emphasize Limited Coverage and cannot be used in different location. Jude Positos, Kris Divino(2017) Arduino based air quality testing, filtering and disinjection device using Machine Learning but in this work we get low accuracy rate and expensive. Alex Aligbe, Osichinaka Uthansakal(2020) Design of a Low-Cost Air Quality Monitoring System Using Arduino and Thing Speak but in this project Data transmission will not be reliable and data can be loss. Golwalkar, R.Shivgan, P.Sindhad(2020) Pollution Monitoring system by using Internet of Things and Lab View but in this system will not provide continuous monitoring and it is more cost. Sarath Chandra and Naveen (2022) Microcontroller based air quality monitoring using IOT and by using sensor configuration This system does not display the values accurately.

III. EXISTING METHODS

Arduino-based air monitoring and filtration systems have evolved through several key methods. First, they integrate an array of sensors such as PM_{2.5} and PM₁₀ sensors, CO₂ sensors, VOC sensors, and temperature/humidity sensors with Arduino microcontrollers. This sensor integration allows for comprehensive monitoring of air quality parameters in real time. Secondly, these systems often incorporate data logging and processing techniques, where Arduino boards collect sensor data at regular intervals and process it either locally or transmit it to external platforms for analysis and visualization. Wireless connectivity, using protocols like Wi-Fi or Bluetooth, enables seamless communication between Arduino devices and cloud-based platforms or local servers, facilitating remote monitoring and control capabilities. Cloud-based platforms like Thing Speak serve as central repositories for air quality data, offering features such as real-time dashboards, historical data analysis, and automated alerts based on preset thresholds. Moreover, advanced systems may employ intelligent filtration mechanisms, adjusting filtration processes based on sensor data to maintain optimal indoor air quality.

IV. METHODOLOGY

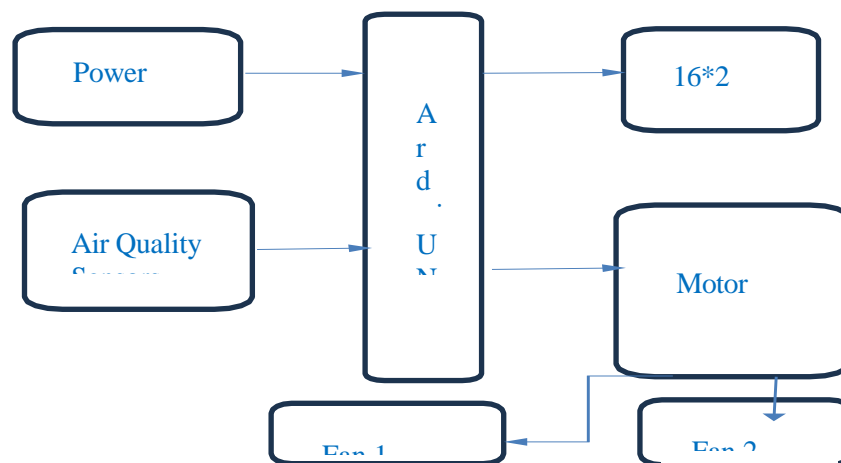
The implementation of Arduino-based air monitoring and filtration system involves several key steps to ensure accurate data collection, efficient filtration, and user-friendly operations. The selection and integration of

appropriate sensors play a crucial role. Once the sensor setup is established, the system focuses on data acquisition and processing. Arduino boards are programmed to collect sensor readings at predefined intervals, store the data locally, and transmit it wirelessly to a cloud-based platform or local server for further analysis. This data logging process ensures a continuous flow of air quality information, which forms the basis for real-time monitoring and historical data analysis.

In parallel, the system incorporates an intelligent filtration mechanism designed to improve air quality when pollutant levels exceed acceptable thresholds. This typically involves the use of high-efficiency particulate air (HEPA) filters, activated carbon filters, or other filtration technologies. Arduino microcontrollers are programmed to control the filtration process based on sensor data, activating or adjusting filter operations as needed to maintain optimal indoor air quality. Arduino-based air monitoring and filtration systems can deliver robust, cost-effective solutions for improving indoor air quality and promoting healthier environments.

BLOCK DIAGRAM

The block diagram represents several components used in Arduino based air monitoring and filtering system.



1. Power supply:

The power supply used in Arduino-based air monitoring and filtering systems is a critical component ensuring continuous and reliable operation. Typically, these systems are designed to be versatile in terms of power sources, allowing flexibility based on the deployment environment. For stationary installations, a stable AC power supply can be used, providing consistent voltage and current to power the Arduino board, sensors, actuators, and communication modules.

In this work project includes a display module (e.g., LCD or OLED), its power consumption can vary but is generally in the range of 20-100 mA depending on the size and type of display. basic Arduino-based air monitoring and filtering system without heavy-duty actuators or high-power communication modules might consume anywhere from 100 mA to 500 mA during normal operation.

2.16*2 LCD:

Using a 16x2 LCD display in an Arduino-based air monitoring and filtering system can provide valuable real-time information to users. The power consumption of a typical 16x2 LCD display module depends on several factors such as backlight brightness, display refresh rate, and whether the display is actively showing information or in standby mode.

Based on these factors, a 16x2 LCD display with a LED backlight and moderate brightness settings might consume around 20-40 mA when actively displaying information. In standby mode, the power consumption can drop to a few milliamps or even less, depending on the display module's efficiency.

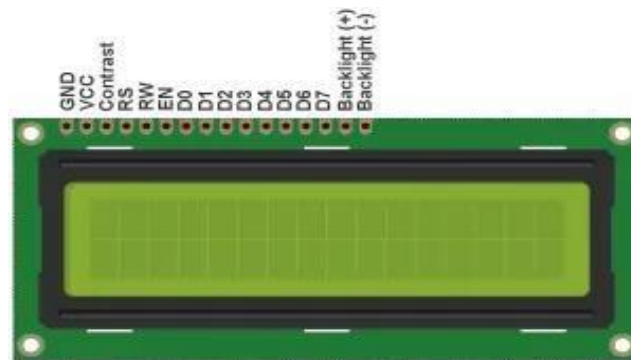


Fig.16*2 LCD display

3. Air Quality sensor:

The MQ135 air sensor is a widely used component in air quality monitoring due to its versatility and affordability. It detects a range of gases including ammonia, benzene, alcohol, smoke, and carbon dioxide (CO₂), making it suitable for assessing indoor air quality and detecting pollutants that can affect human health. Operating on the chemiresistance principle, the MQ135's sensing element's conductivity changes in the presence of specific gases, producing an analog output voltage proportional to gas concentrations. However, accurate readings require periodic calibration in clean air and consideration of operating conditions like temperature and humidity. While the MQ135 is cost-effective and integrates well with Arduino and other microcontrollers for data processing, it has limitations in terms of sensitivity and specificity compared to more specialized sensors



Fig . MQ135 Sensor

4. Motor Driver:

In an air monitoring and filtering system, the motor driver can be used to control the speed of fans or the operation of actuators based on sensor readings or user-defined parameters. For example, if the system detects an increase in particulate matter (PM) concentration, the motor driver can be programmed to increase the speed of a fan or activate an air purifier to improve air quality. Similarly, the motor driver can be integrated into HVAC (heating, ventilation, and air conditioning) systems to regulate airflow based on real-time air quality data.

5. Fans:

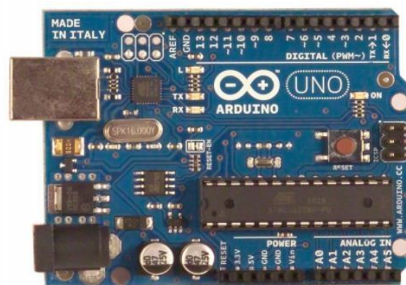
In Arduino-based air monitoring and filtering systems, fans are essential components used for air circulation, ventilation, and filtration purposes. Fans are typically employed to improve airflow within an enclosure or a designated area, ensuring proper distribution of filtered or conditioned air. Various types of fans can be integrated into these systems, including axial fans, centrifugal fans, and exhaust fans, depending on the specific application requirements.



Fig . Air purifier

6. Arduino UNO:

The Arduino Uno is a popular microcontroller board extensively used in air monitoring and filtering systems due to its versatility, ease of use, and wide range of compatible sensors and peripherals. In such systems, the Arduino Uno serves as the central processing unit, responsible for collecting data from various sensors, controlling actuators like fans or pumps, and executing algorithms for real-time monitoring and control. Responses like



activating air purifiers or adjusting ventilation systems to maintain optimal air quality levels. This proactive approach helps improve overall health and well-being, especially in indoor spaces where air pollutants can accumulate.



Fig . After Purifying



Fig . When threshold value is greater than 450

Fig .Arduino UNO

Advantages

1. Cost-Effective: Arduino boards and sensors are relatively inexpensive compared to proprietary monitoring systems, making them accessible for DIY projects and small-scale implementations.
2. Low Power Consumption: Many Arduino boards are designed to operate on low power, making them suitable for battery-powered or energy-efficient applications. This is advantageous for portable or off-grid air monitoring systems.

Applications

These applications demonstrate the wide-ranging impact and utility of Arduino-based air monitoring and filtering systems across environmental, industrial, healthcare, educational, and community-focused domains.

1. Indoor Air Quality Monitoring
2. Industrial Emissions Monitoring
3. Healthcare Facilities

V . RESULTS

An Arduino-based air monitoring and filtering system can yield several significant results. Firstly, it provides real-time insights into air quality parameters such as particulate matter levels, gas concentrations, temperature, and humidity, enabling users to make informed decisions about indoor or outdoor environments. By continuously monitoring air quality, the system can detect pollution spikes or hazardous conditions, triggering automatic

VI. CONCLUSION

In the realm of air quality monitoring and filtration, Arduino-based systems stand out as versatile, cost-effective solutions with wide-ranging applications. Their accessibility and affordability democratize environmental monitoring, allowing hobbyists, researchers, educators, and industry professionals to create tailored solutions. The modularity of Arduino facilitates customization, scalability, and

integration with various sensors, enabling precise monitoring of indoor and outdoor air quality, emissions control in industrial settings, smart HVAC management, and educational initiatives. These systems not only drive technological advancements in sensor technology and data analytics but also empower communities through citizen science, education, and collaborative efforts to address air quality challenges. With their impact on public health, safety, and environmental sustainability, Arduino-based air monitoring and filtering systems play a pivotal role in shaping a cleaner, healthier future by providing actionable insights and promoting proactive measures against air pollution.

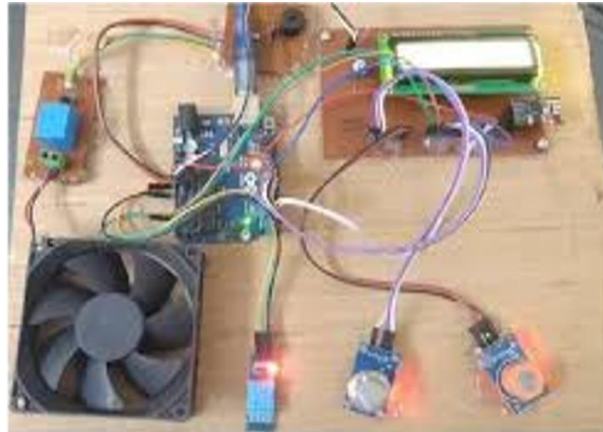


Fig. Air monitoring system

VII . REFERENCE

- [1] Kelechi, A. Hilary, et al. "Design of a low-cost air quality monitoring system using arduino and thing speak." *Comput. Mater. Contin* 70 (2022): 151-169.
- [2] Cruz, Louis Anton A., et al. "Development of a low-cost air quality data acquisition IoT-based system using Arduino Leonardo." *International Journal of Engineering and Manufacturing* 9.3 (2019): 1.
- [3] Perumal, B., et al. "Air Pollution Monitoring System by using Arduino IDE." *2021 Second International Conference on Electronics and Sustainable Communication Systems (ICESC)*. IEEE, 2021.
- [4] Chaudhry, Vikhyat. "Arduair: air quality monitoring." *International Journal of Environmental Engineering and Management* 4.6 (2013): 639-646.