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IOT BASED FUME EXTRACTION SYSTEM.

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ABSTRACT:

Industrial and domestic settings experience dangerous health risks due to harmful gases together with dust and smoke particles in the air. The proposed system utilizes IoT technology to build a Fume Extraction and Purification System which efficiently detects then filters and cleans airborne pollutants. An air quality monitoring system operates through a NodeMCU microcontroller which employs MQ135 gas sensor detection of harmful gases and combining it with the GP2Y1010AU0F sensor for dust and smoke particles and the DHT22 sensor for temperature and humidity readings. The 24V DC fume extraction system uses a 120mm x 120mm fan that pulls polluted air through combined filters containing activated carbon and HEPA materials to achieve clean air products. Together these components comprise a 24V 2.5A SMPS that regulates power using an LM2596 buck converter and a single-channel 5V relay module to control fan operation. The system features a 16x2 I2C LCD that shows air quality readings in real time and remote monitoring occurs via ThingSpeak server. The automatic fume extraction installation sets a dependable and economical solution for boosting air quality performance in workshop environments together with laboratories and industries. Real-time monitoring is possible because of IoT technology integration which provides critical alerts for pollution control and health protection purposes.

Keywords: IoT (Internet of Things), Fume Extraction, Air Quality Monitoring, NodeMCU, Gas and Dust Sensors, Filtration System (HEPA & Activated Carbon), ThingSpeak (Remote Monitoring)

Introduction:

The growing air pollution outbreak affects both industrial sites and domestic areas through dangerous fumes that present severe health threats to humans. Our solution based on IoT includes an Fume Extraction and Purification System which detects harmful airborne contaminants while effectively filtering them.

The main controller implements NodeMCU along with three sensors including the MQ135 gas sensor and the GP2Y1010AU0F sensor and the DHT22 sensor which perform monitoring functions of harmful gases and dust and smoke particles and temperature and humidity respectively. The fume absorption process depends on a 120mm x 120mm 24V DC fan that guides the air through sequential filtering using activated carbon then HEPA filters to remove toxic substances from the air.

The I2C LCD 16x2 panel shows live air quality readings and the device operates through a 24V 2.5A SMPS that utilizes an LM2596 buck converter to regulate voltage. The ThingSpeak server functions as a remote platform where acquired data gets transmitted for monitoring and analysis purposes.

The solution delivers high efficiency while maintaining affordability and provides smart air quality cleaning functions that are suitable for laboratories and workshops and other spaces requiring fume extraction.

Literature Survey:

The table below provides a comparative analysis of research papers focused on IOT Based Fume Extraction System. It highlights the authors, titles, publication years, along with the advantages (pros) and limitations (cons) of the proposed methods and technologies in each study. This comparison aims to offer insights into the advancements and challenges in the domain of automated answer grading systems using artificial intelligence, natural language processing (NLP).

Table 1 – Comparative Analysis of Research

Sr. No.	AUTHOR	TITLE	YEAR	PROS	CONS
[1]	A. Sharma et al.	IoT Based Air Pollution Monitoring System	2020	Real-time data monitoring; Mobile alerts	No active fume extraction mechanism
[2]	R. Kaur & M. Singh	Smart Exhaust	2021	Uses gas sensors with	Limited to predefined

		System Using IoT for Industries		automated fan control	threshold settings
[3]	S. Patel et al.	Design of Air Quality Monitoring System Using ESP8266	2019	Low-cost and compact design using NodeMCU	Lacks data logging and storage features
[4]	P. Verma & R. Dubey	Smart Air Purifier with IoT	2022	Includes air filtration and cloud connectivity	No real-time control over fan speed or direction
[5]	T. Yadav et al.	IoT Based Gas Leakage Detection System Using MQ Sensors	2020	Effective use of MQ-135 & MQ-2 sensors; emergency alerts	No integration with fume extractor or purifier
[6]	M. Iqbal et al.	Industrial IoT for Hazardous Gas Detection and Notification System	2021	Multi-sensor integration; Industrial focus	No actuator control for extraction or mitigation
[7]	V. Kumar & D. Singh	Air Quality Index Prediction and Monitoring Using IoT and NodeMCU	2023	Uses machine learning for AQI prediction; cloud dashboard	Predictive only; doesn't act on pollution in real-time

3. Problem statement:

The accumulation of dangerous gases together with dust particles and smoke sparks serious health risks within enclosed spaces of laboratories workshops and industrial facilities. Long-term inhalation of these contaminants results in respiratory diseases as well as chronic allergies that affect one's health. Current fume extraction systems perform poorly because they operate through manual controls while they present neither real-time monitoring nor any method to access the system remotely which creates intricate challenges to track and manage indoor air quality.

This proposed project seeks to develop an IoT-based Fume Extraction and Purification System equipped with intelligent detection capabilities together with automated purification mechanisms and remote monitoring features. Multiple sensors which include gas, dust and environmental ones work together with a NodeMCU microcontroller to control a high-efficiency fume extraction unit. The system implements activated carbon together with HEPA filtration to successfully remove pollutants from the environment. The system shows real-time data on an LCD display screen while simultaneously sending it to the ThingSpeak IoT platform for access and analysis outside the local area.

4. Proposed methodology:

1. Problem Identification: Realized the necessity for an intelligent and efficient system to detect and purify dangerous fumes along with gases and dust found inside laboratory spaces and workshops.

2. A thorough examination of fume extraction and air purification systems and IoT-based monitoring solutions took place through a literature review and research effort to analyze existing technologies and their gaps.

3. The system design included selecting appropriate components that included NodeMCU (ESP8266) as the microcontroller with MQ135 gas sensor and GP2Y1010AU0F dust sensor using DHT22 for temperature and humidity measurements and enabled the use of a DC fan with activated carbon and HEPA filters combined with a 5V relay controller and a 16x2 I2C LCD and a 24V SMPS and a buck converter.

4. A system design phase created an efficient cost-effective circuit which unites all components for real-time collection and filtration control and display transmission functions.

5. An SMPS authorized the operation of hardware through a buck converter while serving as the source for connecting sensors for air quality observation, extraction fan management and air purification assembly and control relay operation.

6. The creation of code functioned for sensor data processing and threshold checking and fan control and LCD display with integrated capabilities for Wi-Fi-based ThingSpeak real-time monitoring and data logging.

7. The testing phase involved evaluating system performance by subjecting it to varied environmental situations to confirm sensor precision along with fan reaction along with display output and Internet of Things connectivity for dependable automatic air purification.

5. Modules and Their Functionalities:

1. Gas Sensors (MQ-135, MQ-7, CO2 Sensors):
Functionality: Detect harmful gases such as carbon monoxide (CO), nitrogen dioxide (NO2), and volatile organic compounds (VOCs). An air quality monitoring system that operates based on these sensors will trigger an alert when pollution levels reach unsafe thresholds.
2. Particulate Matter (PM) Sensors:
The measuring ability of air dust and smoke particles ensures proper functioning in industrial zones as well as laboratory workspaces. Particulate Matter sensors tell the filtration system when to activate through their monitored data.
3. Temperature and Humidity Sensors:
The system uses sensors for environmental data monitoring of both temperature and humidity since these elements affect air quality. The sensors enhance system functioning while providing reliable fume extraction data through accurate measurements.
4. Microcontroller (e.g., Arduino, ESP8266, Raspberry Pi):
The central control unit which functions as the control processor collects sensor information and runs threshold tests before activating the fume extraction system. The system runs as intended through operational decisions made from actual data acquired in real-time.
5. Fume Extraction Fan/Motor:
The system starts its operation automatically if measurements detect gas or particulate counts above set thresholds. The system retrieves polluted air for filtration processing before it releases cleaned air back to the environment.
6. IoT Integration (Blynk, AWS IoT, ThingsBoard):
Functionality: Connects the system to an IoT platform, enabling remote monitoring via a mobile app or web dashboard. The system provides accurate real-time air quality data to users through remote tracking features which include automatic notification services and distant system control.
7. Therapy System Laundry (HEPA & Activated Carbon Filters) conducts filtration of polluted air before generating clean air for the environment.
The device removes hazardous pollutants from air streams through its filtration process. Both HEPA filtration and activated carbon filtration remove different elements from the air so the environment gets cleaned air.

6. Software requirement specifications:

The Arduino IDE controls the development of software that enables IoT-based Fume Extraction and Purification System with MQ135 sensor and GP2Y1010AU0F sensor coupled to DHT22 sensor along with relay control and LCD display. The NodeMCU (ESP8266) functions as a sensor data collector and processor which distributes real-time air quality information through the Wi-Fi connection to ThingSpeak IoT platform. The system offers programmed features for enabling fans automatically while it shows measurements on a 16x2 I2C LCD when pollution levels reach beyond secure thresholds. The system allows real-time observation along with automatic management and distant data accessibility via a web-based control panel.

7. Conclusion:

Property owners seeking an effective smart solution at affordable prices have found their answer in the IoT-Based Fume Extraction and Purification System. The system executes real-time monitoring alongside automated fan control with activated carbon and HEPA filtration which works for efficient removal of dangerous dust particles and harmful gases and smoke. Air quality monitoring becomes more comprehensive when users access NodeMCU through ThingSpeak to check environmental conditions from any location. This system offers practical benefits through its efficient power usage together with expandable features and AI capabilities and solar power integration for numerous facilities such as laboratories laboratories plus workshops and residential properties. The project plays an important role in developing cleaner sanitary and intelligent indoor environments.

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