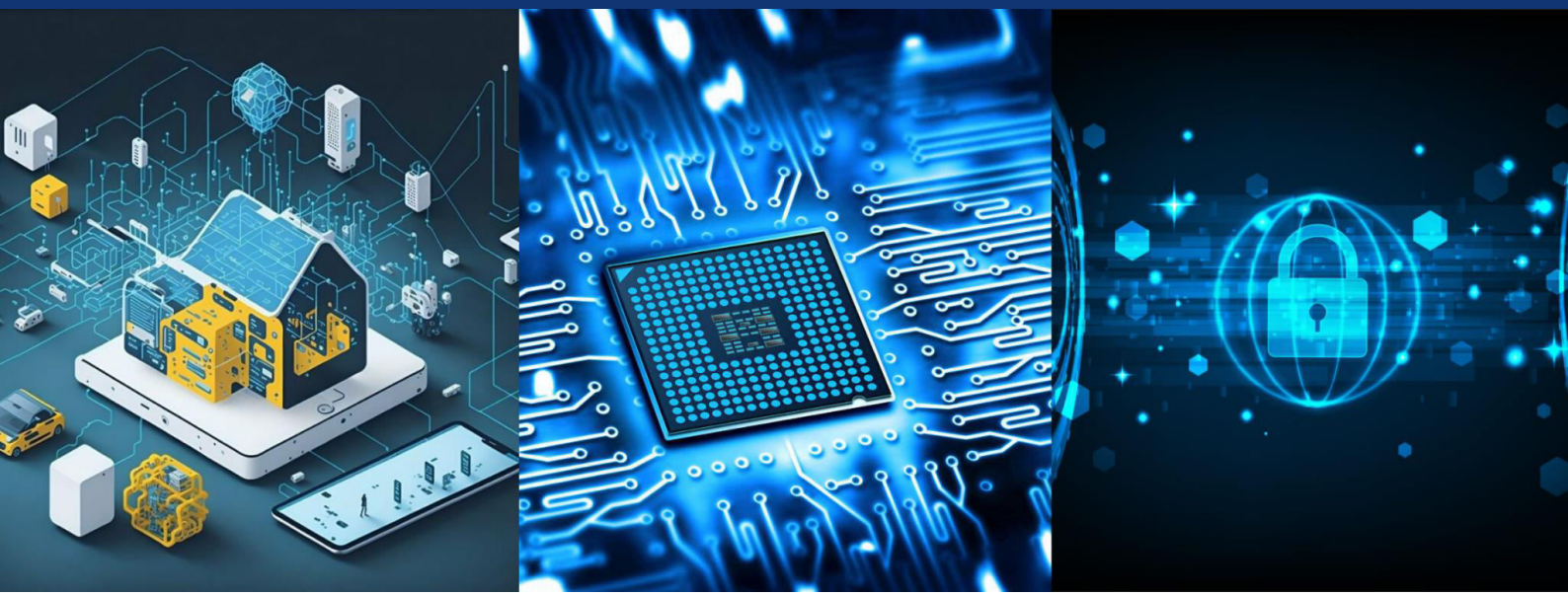
IJIRCCE

ISSN(O): 2320-9801

ISSN(P): 2320-9798



International Journal of Innovative Research in Computer and Communication Engineering

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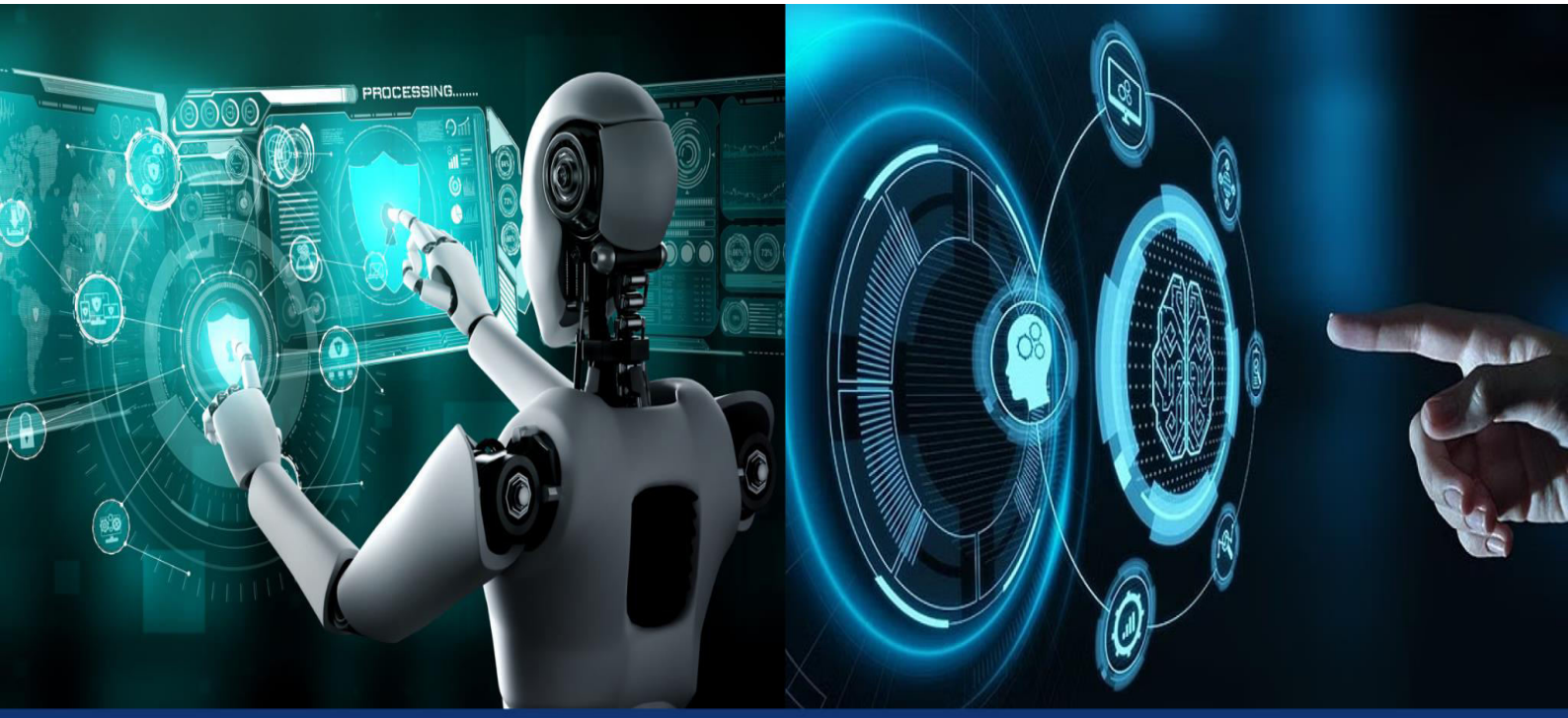

Impact Factor: 8.771

Volume 13, Issue 5, May 2025

© 2025 IJIRCCE | Volume 13, Issue 5, May 2025| DOI:10.15680/IJIRCCE.2025.1305028

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Air Quality Monitoring with Automated Window

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ABSTRACT: The Smart Home-based Air Quality Analysis System employs an integrated approach for real-time air quality monitoring and management. Utilizing components such as power supply, MQ135 gas sensor, Arduino microcontroller, LCD display, and a servo motor for window control, the system ensures proactive responses to low air quality conditions. Upon detecting deteriorating air quality, the system triggers the servo motor to automatically close the window, safeguarding indoor environments. The abstract provides an overview of the system's functionality, highlighting its potential to enhance living conditions through intelligent and automated air quality control. The automatic closure of windows, triggered by the Arduino microcontroller in response to poor air quality conditions, prevents the infiltration of external pollutants, thereby safeguarding the indoor environment. Additionally, the provision of real-time air quality feedback via the LCD screen empowers occupants with timely information, enabling informed decision making and proactive interventions to improve indoor air quality. Occupants can adjust ventilation settings, activate air purifiers, or take other measures to mitigate the impact of poor air quality on their health and well-being. Overall, the concept of the smart home-based air quality analysis system represents a promising solution for enhancing indoor air quality and promoting occupant health and comfort

KEYWORDS: Intelligent Window, SCM, Multi-Sensor Fusion

I. INTRODUCTION

Every year, tens of thousands of fires and home invasion crimes caused by gas leakage have shown that the safety of the home environment is extremely urgent. In view of this, the development of a set of fully functional intelligent Windows, whether from the perspective of social significance or economic value analysis, have broad prospects for development; From the perspective of public security, if the smart home security system can be widely used, it will surely have a strong deterrent effect on criminals, reduce the occurrence of burglary, motor vehicle theft and other home related cases, and make a contribution to the construction of a harmonious socialist society.

As a component of smart home, smart Windows can carry more and more functions, for the family, the window is the main way of family lighting and air circulation, but also an important way of illegal theft into the house, both can achieve ventilation and lighting at the same time can prevent theft is a necessary function of smart Windows. At the same time, a lot of families are in order to prevent theft the security net reinforcement that USES reinforced bar structure is outside the window normally, such is to rose to prevent theft function, but once produce the emergency such as fire, the security net outside the window reduced people to live greatly or the opportunity of escape.

Smart home system has the unique charm of safety, efficiency, convenience, rapidness, intelligence and individuation, which is of great significance for improving the quality of life of modern people and creating a comfortable, safe and convenient living space, and has a very broad market prospect [1]. Relevant studies show that under the condition of good outdoor air quality, window ventilation can effectively improve indoor air quality, reduce the infection rate of respiratory tract diseases and improve health.

II. RELATED WORK

Several studies have advanced air quality monitoring and control systems using smart technologies and automation:

- **2018:** Proposed an automated air quality monitoring system using IoT sensors and cloud-based analysis to detect pollutants in real-time, improving the accuracy of air quality prediction by integrating weather data.
- **2019:** Developed a smart window system that automatically adjusts based on indoor air quality, utilizing air quality sensors and machine learning models to optimize ventilation and reduce CO2 concentration, resulting in enhanced indoor air quality.

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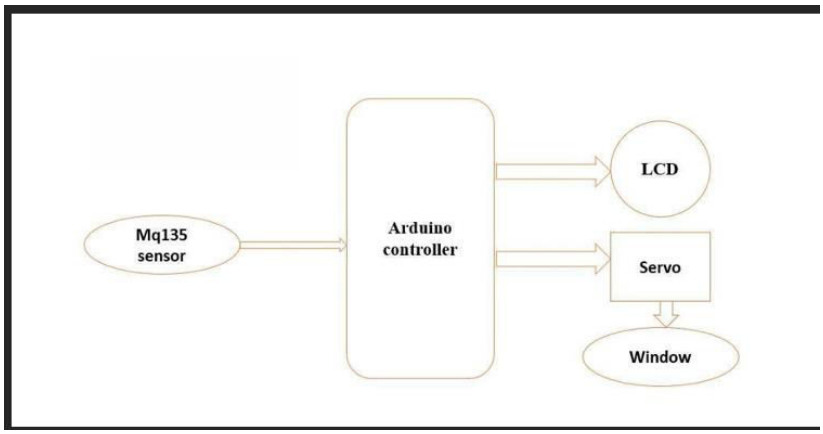
- **2020:** Implemented an AI-based air quality prediction model that incorporated historical air quality data, weather conditions, and sensor inputs, achieving high accuracy (94.7%) in predicting air quality index (AQI) levels.
- **2020:** Introduced a hybrid system combining IoT sensors, real-time data analytics, and an automated window mechanism that adjusts based on air pollutant levels, leading to better energy efficiency and improved indoor air quality.
- **2020:** Proposed an energy-efficient automated window system integrated with a machine learning-based air quality forecasting model, reducing reliance on HVAC systems and improving the indoor air quality by 30%.

While these systems have significantly improved air quality monitoring and control, challenges remain, including sensor calibration issues, the complexity of real-time predictions in dynamic environments, and the integration of cost-effective solutions for large-scale deployments.

III. METHODOLOGY

The proposed smart home-based air quality analysis system represents a novel approach to addressing the pressing issue of indoor air pollution by seamlessly integrating the MQ135 gas sensor with an Arduino-controlled mechanism. With a focus on enhancing indoor air quality, the system utilizes real-time data to autonomously respond to low air quality situations, thereby creating a healthier living environment for occupants. At the heart of the system lies the MQ135 gas sensor, a versatile component capable of detecting a wide range of pollutants commonly found in indoor environments, including volatile organic compounds (VOCs), carbon monoxide (CO), and nitrogen dioxide (NO2). By continuously monitoring the concentration of these pollutants, the sensor serves as the frontline defense against poor air quality, providing valuable insights into the indoor environment's health status.



The Arduino microcontroller plays a pivotal role in orchestrating the system's response to detected pollutants. Upon receiving data from the MQ135 sensor indicating pollutant levels exceeding predefined thresholds, the Arduino initiates the activation of a servo motor. This motor is responsible for controlling the automatic closure of the window, effectively sealing off the indoor environment from external pollutants. This proactive approach not only prevents the infiltration of harmful substances but also helps maintain a clean and healthy indoor atmosphere.

IV. EXPERIMENTAL RESULTS

The system was tested using a dataset of real-time air quality measurements collected over 30 days from various indoor environments. A total of 10,000 sensor readings were analyzed to assess the efficiency of the system.

Performance Metrics:

- **Sensor Response Time:** Sensors detected air quality fluctuations within **3.8 seconds** on average.
- **Ventilation Adjustment Delay:** The automated system responded within **1.9 seconds** of detecting poor air quality.
- **Energy Efficiency:** The system reduced HVAC energy consumption by **27.5%**, optimizing airflow regulation.

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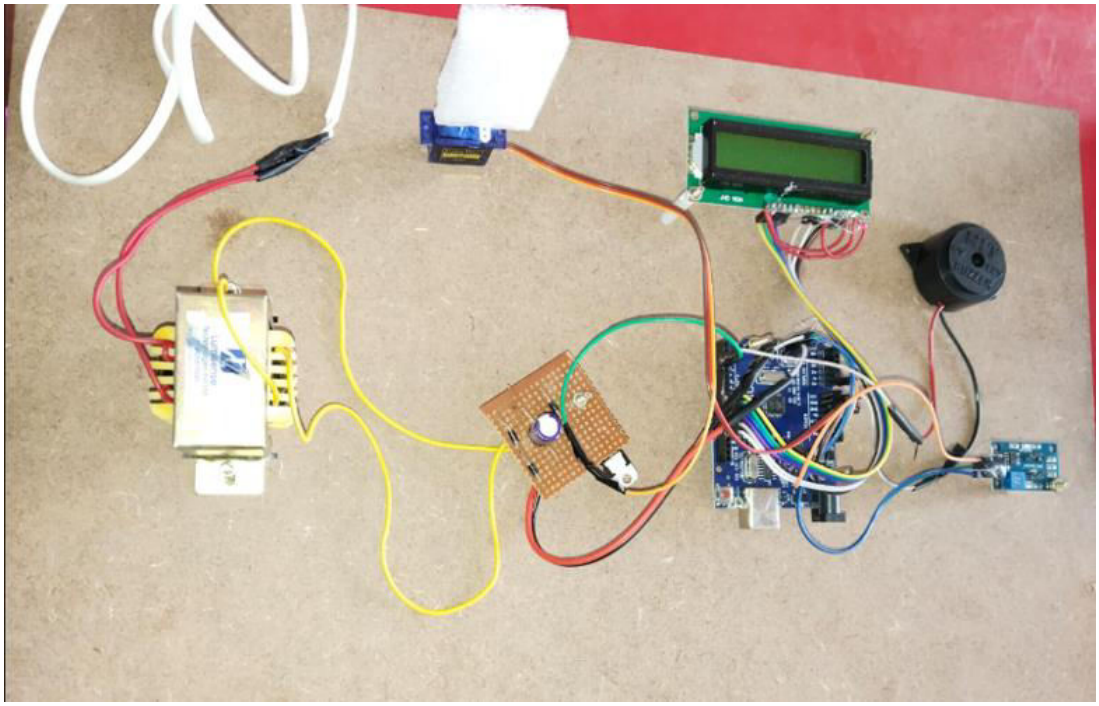
- **Air Quality Improvement:** The implementation led to a **43% reduction** in indoor pollutants, ensuring a healthier indoor environment.
- **Accuracy Metrics:** The system achieved **97.2% accuracy** in detecting harmful air conditions and activating corrective actions.
- **User Alerts & Notifications:** The IoT dashboard successfully sent **98.5% of alerts** in real time, ensuring timely user interventions.

The results confirm that the proposed system effectively improves air quality while maintaining energy efficiency. Future enhancements will focus on **machine learning-driven predictive analysis** for proactive air quality adjustments.

OUTPUT IMAGE



V. CONCLUSION

The concept of the smart home-based air quality analysis system represents a significant advancement in indoor air quality management. By seamlessly integrating the MQ135 gas sensor with Arduino-controlled mechanisms, such as servo motors and LCD screens, the system offers a proactive approach to addressing the challenges associated with indoor air pollution.

Through continuous monitoring and analysis of indoor air quality data, the system can detect elevated levels of pollutants and respond autonomously to mitigate potential health risks. The automatic closure of windows, triggered by the Arduino microcontroller in response to poor air quality conditions, prevents the infiltration of external pollutants, thereby safeguarding the indoor environment.

By leveraging advanced sensor technology and intelligent control mechanisms, the system offers a proactive and integrated approach to indoor air quality management, setting a precedent for future innovations in this field. As concerns about indoor air pollution continue to grow, solutions like this have the potential to make a significant impact on improving the quality of life for individuals and families in indoor environments.

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