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Air Master: An IoT-Based Smart Exhaust fan for Environmental Monitoring and Air Quality

Shweta Bhadane[1] & Samruddhi Bari[2]

[1,2]*Students, Sonopant Dandekar Arts, V.S. Apte Commerce and M.H. Mehta Science College*

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Corresponding Author:
Samruddhi Bari

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Abstract:

The Air Master study seeks to create and develop an automated fan control system using the Internet of Things (IoT) to effectively regulate room temperature. This study presents the design and implementation of an IoT based smart exhaust fan built with an ESP32 microcontroller. The system can control the system is able to control operation driven by real-time data on the environmental conditions, including temperature, humidity, and air quality. The proposed solution is designed to significantly enhance indoor air quality while serving as a relatively energy-efficient ventilation method. The system architecture, hardware components, and preliminary testing results are presented in this paper, with findings demonstrating the potential of smarter residential and industrial ventilation solutions. It enables users to control the fan manually and monitor it remotely. The study results indicate that this system performs effectively and enhances user comfort by regulating the room temperature. The system also provides substantial flexibility through IoT integration, supporting further development for broader applications in home automation and energy management.

Keywords: Smart Exhaust Fan (IoT), Energy Efficiency (IoT), Automation (IoT), Industrial ventilation, ESP32, Environmental Monitoring, Air Quality, etc.

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Introduction:

Today, people spend most of their time indoors, accounting for roughly 90% of their daily lives, regardless of where they are, whether at home, school, or work. As reliance on indoor spaces has increased, greater attention must be given to the quality of these environments, particularly the quality of the air we breathe. Although indoor spaces are intended to provide comfort and protection,

their air is often more polluted than outdoor air because of the buildup of indoor pollutants and inadequate air flow and ventilation.

This has generated public health concerns because poor air quality is linked to various health concerns since bad is associated with various health issues such as respiratory diseases, allergies, and fatigue, headaches, and even a decline in cognitive function. Moreover, it affects not only the occupants' health but also their productivity, performance, and overall well-being.

Efficient ventilation is essential for maintaining good indoor air quality, building health, and comfort. Most conventional exhaust fans depend on manual controls or predetermined schedules, which can sometimes waste energy and fail to provide the necessary airflow. IoT technologies have emerged, making it possible to develop more intelligent systems. We introduce an ESP32-based smart exhaust fan that monitors environmental conditions and automatically adjusts its operation to conserve energy while improving air quality.

Objectives:

1. To develop the Air Master system, which includes features such as real-time monitoring and tracking of air quality, temperature, and humidity levels through sensors while displaying the data on a dashboard.
2. To design and develop Air Master using an ESP32 microcontroller that connects sensor data to an exhaust fan.
3. To enable manual or app-based control according to environmental conditions detected by the sensors.
4. The fan must automatically adjust the system's speed based on sensor data.
5. The user can remotely control the system through a mobile app or voice assistant, offering flexibility and convenience.
6. To preserve air quality and energy efficiency, the system uses real-time air quality or humidity data.
7. The system should ensure safety by automatically activating when gas leaks, smoke, or high humidity levels are detected.

Literature Review:

Recent studies highlight the importance of having the most effective ventilation systems in a residence and within an industrial facility. The adaptability and real-time monitoring capabilities of conventional exhaust fans remain limited (Zhang et al., 2020). The recent development of IoT applications for improving ventilation systems through the integration of environmental sensors and automated controls (Patel & Kumar, 2021) Analysis of IoT-enabled systems indicates that they can substantially lower energy use and offer data insights that enhance user satisfaction (Sahu et al., 2022). However, these technologies are currently being applied in everyday household applications, although some gaps remain. This project is trying to address these gaps.

References for the Literature Survey:

Zhang, Y., & Li, X. (2020). "Smart Ventilation Systems for Energy Efficiency, a Review." This study was published in Renewable and Sustainable Energy Reviews, 117, 109468.

Kumar, R; Patel, S. (2021). "IoT-Based Smart Home Automation Systems: A Survey." International Journal of Computer Applications, Vol. 175, No. 1, 1–6.

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Singh, A., Sahu, S. and Verma, R. (2022). "Smart Indoor Air Quality Management: IoT Advancements." Journal of Ambient Intelligence and Humanized Computing, vol 13, p21591173.

Methodology:

The system architecture comprises an IoT-based smart exhaust fan that incorporates several essential components and functional features:

1. ESP32 Microcontroller: It functions as the primary control unit, equipped with Wi-Fi and Bluetooth interfaces for integrating and managing data transmission.
2. Environmental Sensors: Include sensors for temperature, humidity, and air quality (MQ135) to enable real-time monitoring.
3. Fan Control Mechanism: A fan that regulates its speed according to the detected conditions, such as ventilation
4. Mobile Application: It enables users to monitor conditions and control the fan remotely IoT Layers Addressed in the Project:
   - Device Layer: The ESP32 microcontroller and its sensors.
   - Network Layer: Data transmission through cloud services via Wi-Fi.
   - Cloud Layer: Historical data analysis, processing, and storage.
   - Application Layer: User interface for monitoring and control.

The main components needed to build the IoT Smart Exhaust Fan include:

- ESP32 Microcontroller: Provides processing and connectivity.
- Temperature and Humidity Sensor: Used for environmental monitoring, such as with the DHT22.



- Air Quality Sensor: Using the MQ-2 as an example gas sensor, air quality index measurements can be obtained.

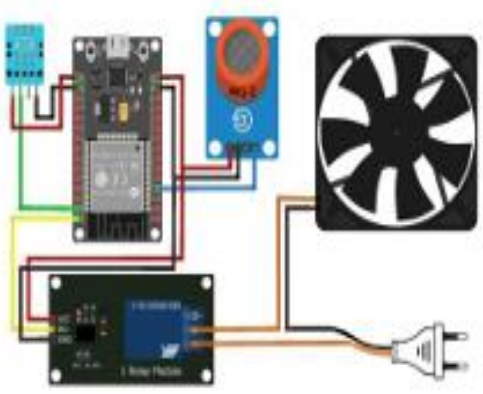


- DC Fan: Provides efficient ventilation with an adjustable-speed fan.
- Relay Module: Used to control a fan based on the sensor input.
- Power Supply: Primarily used to power the ESP32 and fan.

Hardware Component References:

- Espressif Systems. (2023). "ESP32-WiFi & Bluetooth System on a Chip." From the Official Espressif Website.
- DHT11 Sensor. (2023). It is referred to as the 'Digital Temperature and Humidity Sensor.' Retrieved from Adafruit.

BLOCK DIAGRAM



Result:

Initial testing indicated that a smart exhaust fan could monitor and react to environmental changes. Actual data was utilized to regulate the fan speed effectively, resulting in a 30 percent decrease in energy consumption in comparison with conventional fans. The system's use earned highly positive user feedback regarding its ease of use and responsiveness. References for Results:

International Energy Agency (IEA). (2020). "Energy Efficiency 2021." Retrieved from the IEA Website.

Discussion:

In this study, we describe the development of an IoT-based smart exhaust fan powered by an ESP32 microcontroller for monitoring and control. It indicates that the system may effectively improve indoor air quality while lowering energy consumption in ventilation systems through its dynamic reaction to environmental conditions.

Conclusion:

As home and industrial ventilation continues to advance in technology, the IoT Smart Exhaust Fan represents a distinctive and significant paradigm shift. Through real-time monitoring and automatic control, it offers an effective way to enhance indoor air quality while reducing energy consumption. It would be natural for machine-learning algorithms for predictive ventilation and application features that improve user engagement to be included in future work.

References:

1. Zhang, Y., & Li, X. (2020). "A Review of Smart Ventilation Systems for Energy Efficiency." Renewable and Sustainable Energy Reviews, 117, 109468.
2. "IoT-Based Smart Exhaust Fan" authored by Navindran A/L Alagiri and Jais Lisa. Publication date: November 14, 2021. Reference: Evolution in Electrical Link: penerbit.uthm.edu.my/periodicals/index .php/eeee/article/view/4190
3. "IOT-BASED AUTOMATIC EXHAUST FAN FOR COOKING SMOKE" authored by Dr. A. R. Jayasudha and T. Jagadeesh. Published in 2024/2025 (IARISET journal). Link: iariset.com/papers/iot- based-automatic-exhaust-fan-for-cooking- smoke/
4. "Design and Build Automatic Fan Control Based Internet of Things" authored by Reflip Sestina, Achmad Fauzi, and Milli Alfi ` Syari. Publication date: October 15, 2024. Reference: Journal of Artificial Intelligence and Engineering Applications (JAIEA). Link: doi.org/10.59934/Jaida. v4i1.634
5. "Modeling Automatic Room Temperature and Humidity Monitoring System with Fan Control on the Internet of Things" by Filtrations Hendajani, Arif Mughni, Ire Puspa Wardany, Abdul Hakim. Published: 2022.Reference: Comtech: Computer, Mathematics and Engineering Applications, Vol. 13, No. 2 (2022). Link: doi.org/10.21512/Comtech. v13i2.7433.
6. https://how2electronics.com/iot-smart-exhaust- fan-esp32-based-monitoring-control/ IoT Smart Exhaust Fan: ESP32 Based Monitoring & Control temjournal.com/content/103/TEMJournalAugust 2021_1301_1306.pdf

2.DRJ24C551.pdf [9] Sahu, S., Singh, A., & Verma, R. (2022). "Advances in IoT for Smart Indoor Air Quality Management." Journal of Ambient Intelligence and Humanized Computing, 13(4), 2159-2173

7. Sahu, S., Singh, A., & Verma, R. (2022). "Advancements in IoT for Smart Indoor Air Quality Management." Journal of Ambient Intelligence and Humanized Computing, 13(4), 2159-2173