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IoT System for Indoor Air Quality Monitoring using ThingSpeak: Promoting Healthy Work Environments

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Article: Prototype of a Livestock Monitoring System Using a Wireless Surveillance Network for Cattle Rustling Prevention.

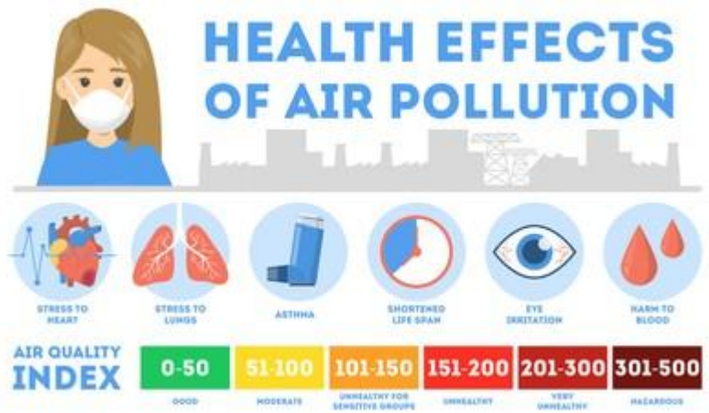
Conference: 22nd LACCEI International Multi-Conference for Engineering, Education and Technology (LACCEI 2024), San Jose, Costa Rica.

Presentation Outline

Introduction	❑Motivation
Materials & Methods	❑Architecture & Components
Results & Discussion	❑Results Analysis
Conclusions	❑And Future Works
References	❑Information Sources

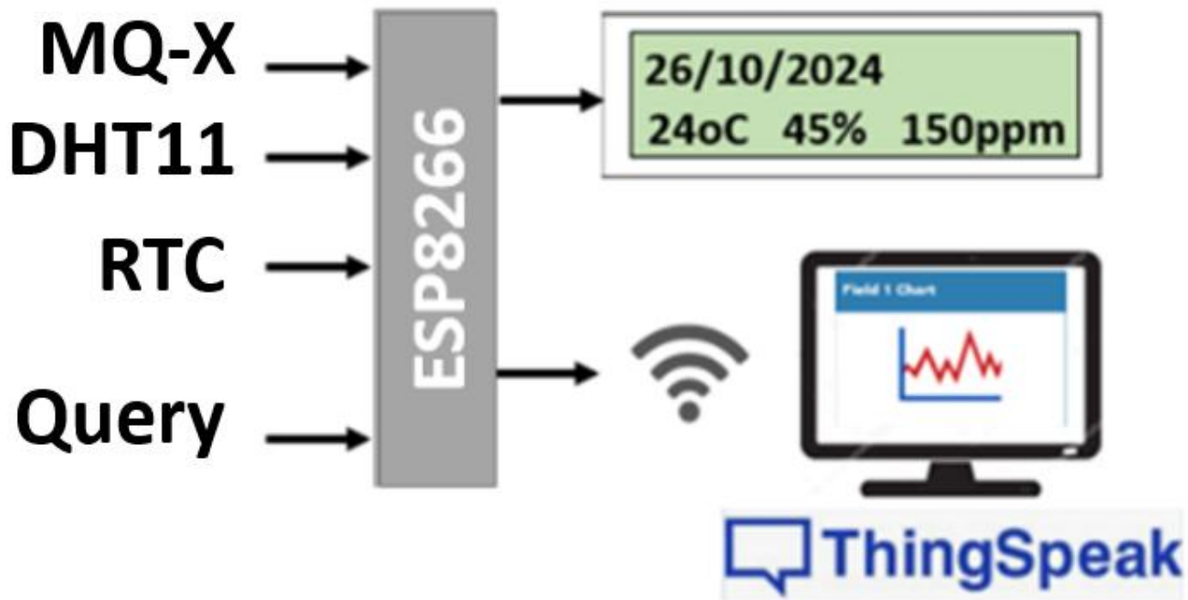
Introduction

Monitoring indoor air quality is essential for protecting health and well-being, as prolonged exposure to high carbon dioxide levels (CO_2) and other pollutants can cause headaches, fatigue, and cognitive impairment.



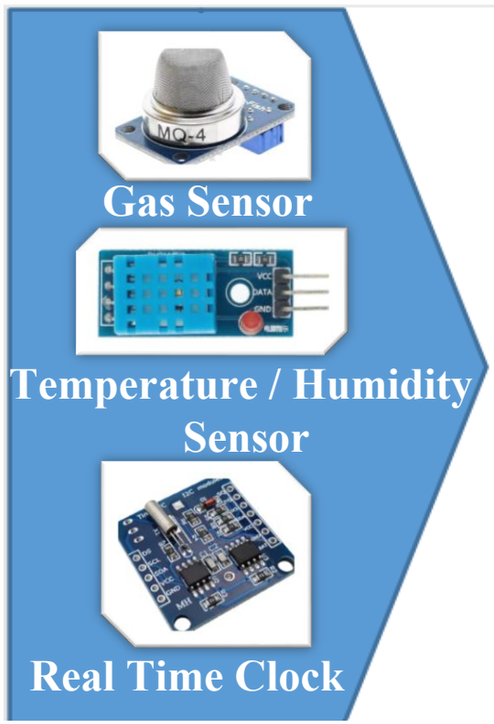
Materials & Methods

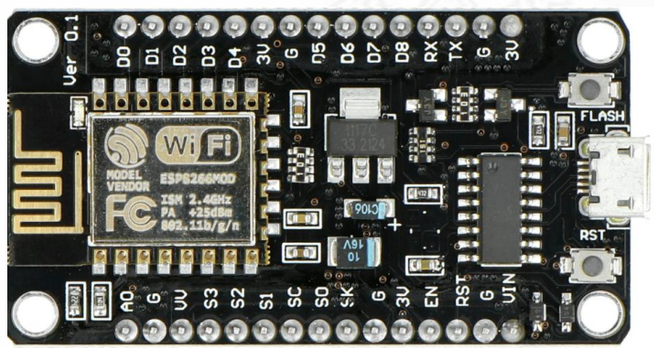
The embedded system consists of an ESP8266 microcontroller module for Wi-Fi communication, a sensor unit integrating an MQ-4 sensor for CO_2 measurement and a DHT11 sensor for temperature and humidity monitoring, a DS3231 RTC module for precise timestamping of data, and a 4GB microSD module for local data storage.

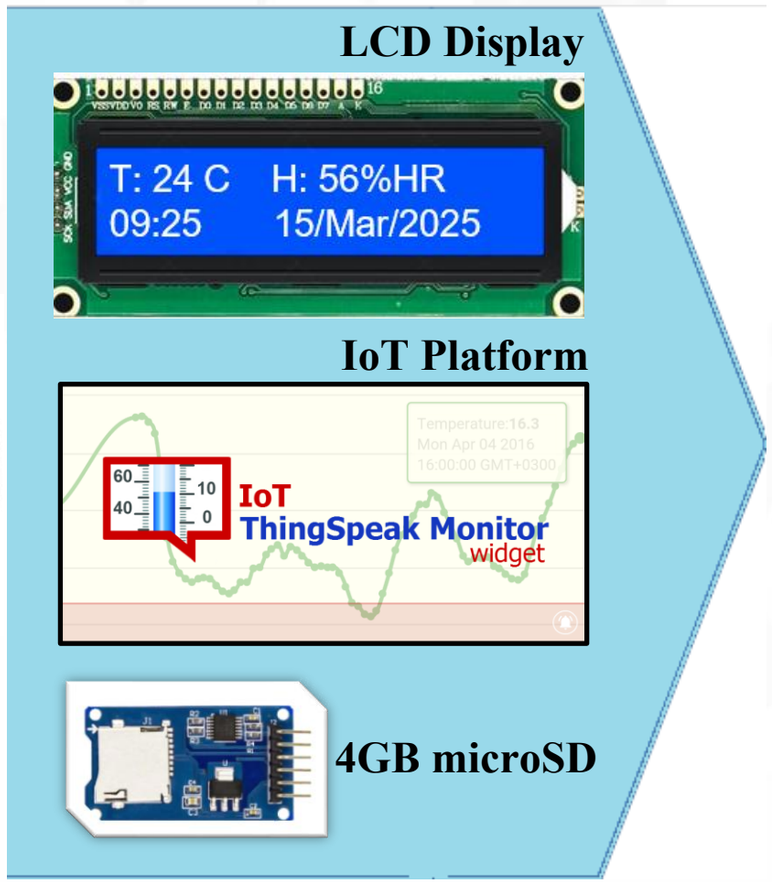


Materials & Methods

The system can be expanded by integrating additional MQ-series sensors to enhance its monitoring capabilities.



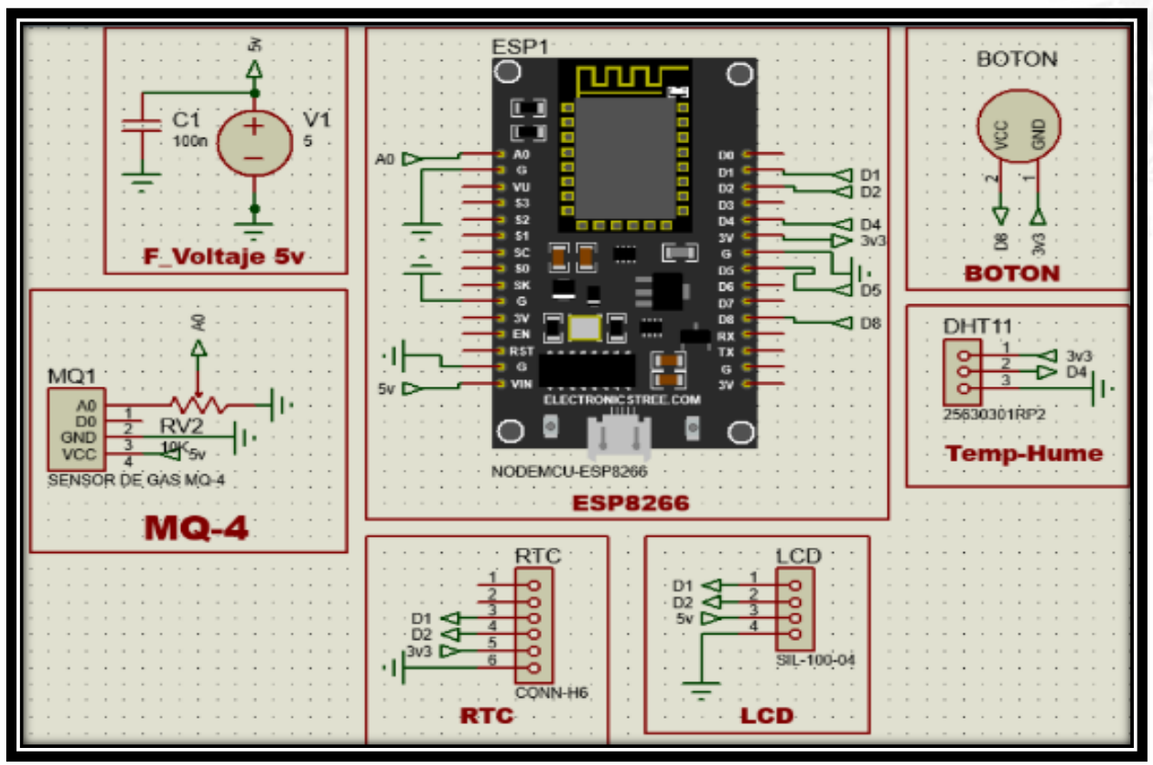


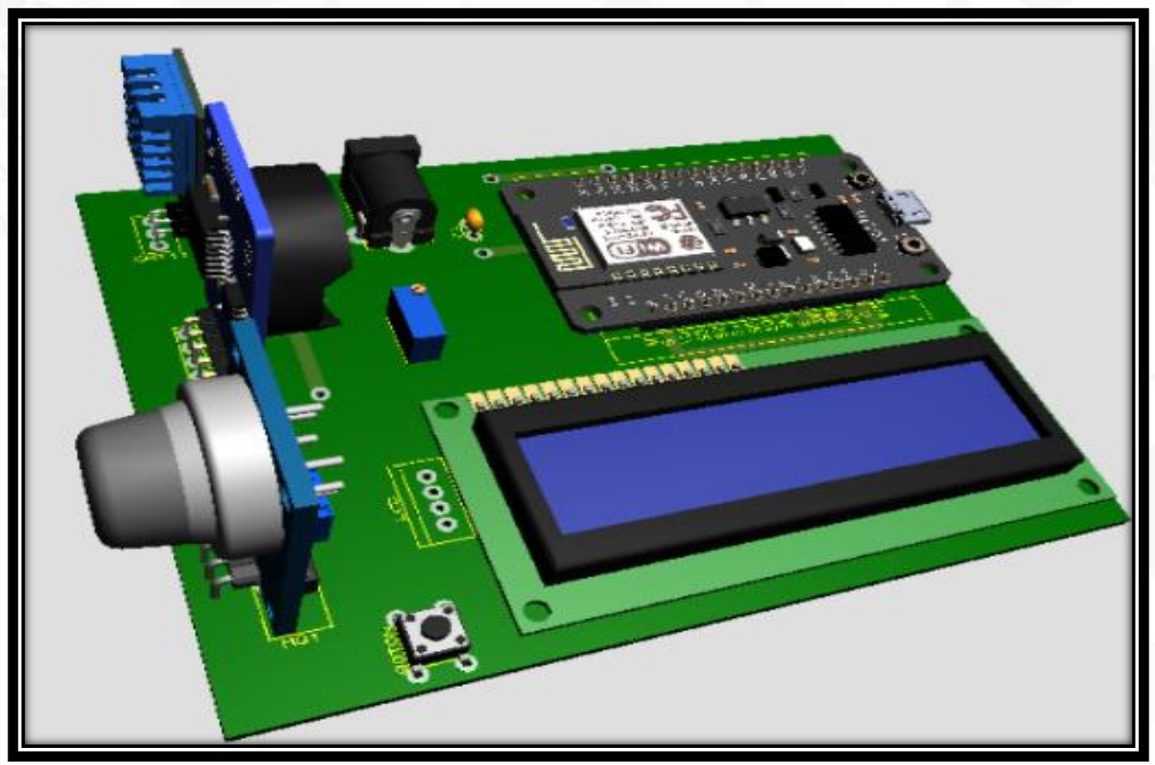


Materials & Methods

The simulation included the Tensilica L106 microcontroller integrated into the ESP8266 module, which provides Wi-Fi connectivity for transmitting data to the ThingSpeak platform.

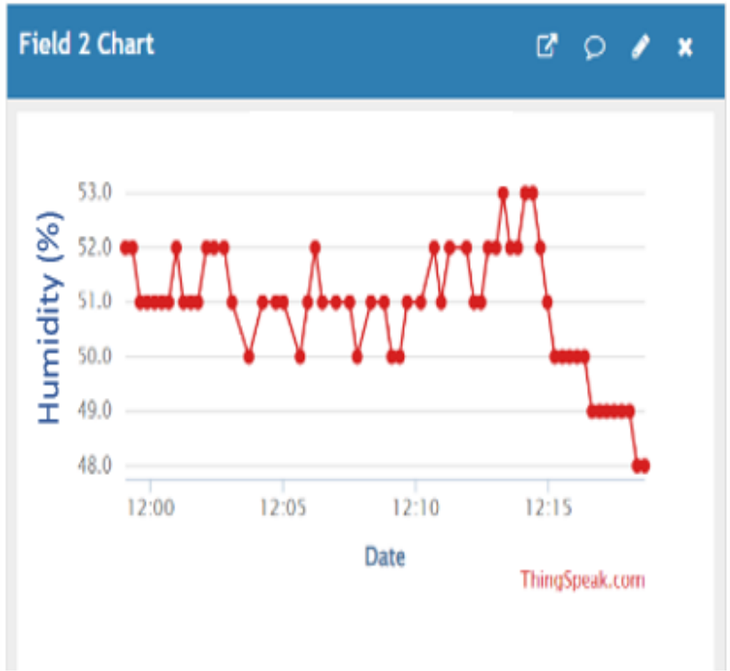
The Schematic Capture and PCB Layout functionalities of the ISIS Proteus software were used to design and generate the system's printed circuit board (PCB).

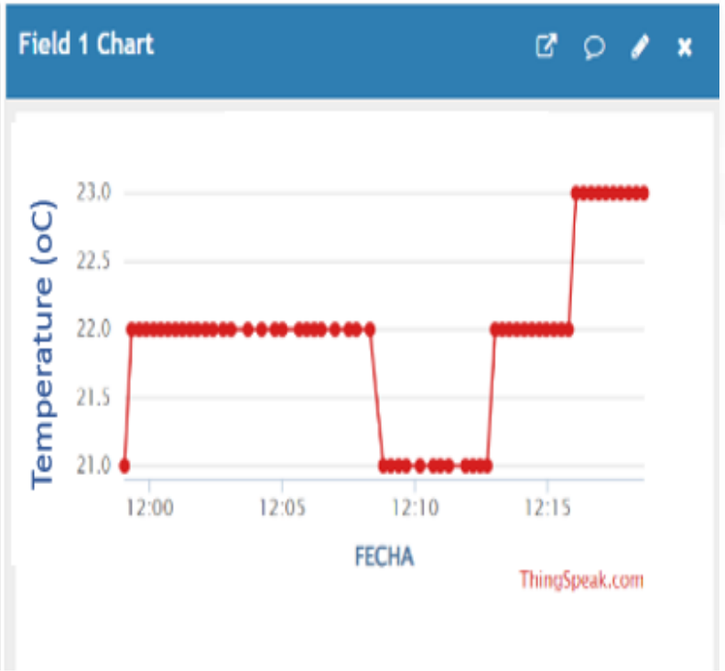


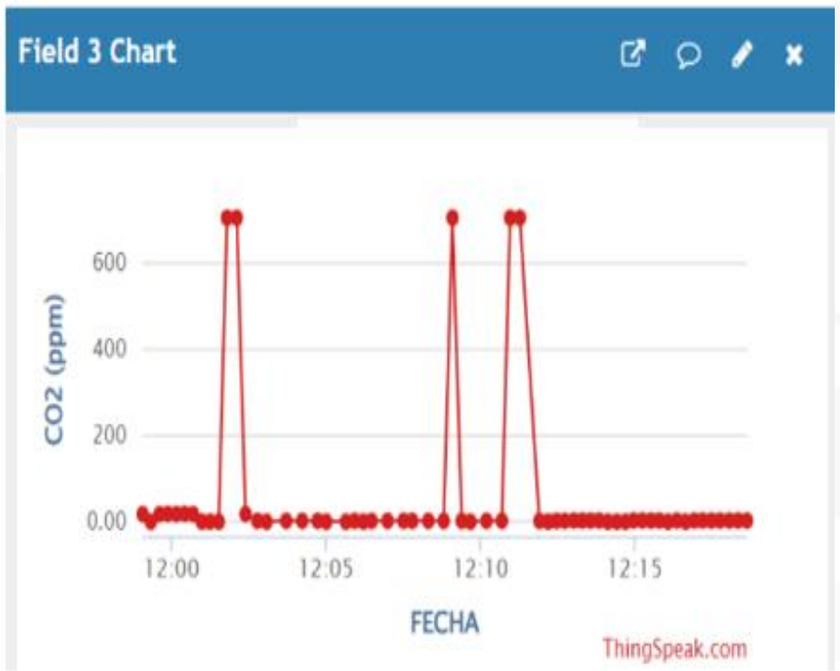


Results & Discussion

The tests were conducted in the Digital Electronics Laboratory at UPTC, Tunja, monitoring environmental conditions. To modify CO_2 levels, the device was exposed to a lighter or briquette, whose gases, when burned, generate CO_2 and volatile organic compounds (VOCs).







Results & Discussion

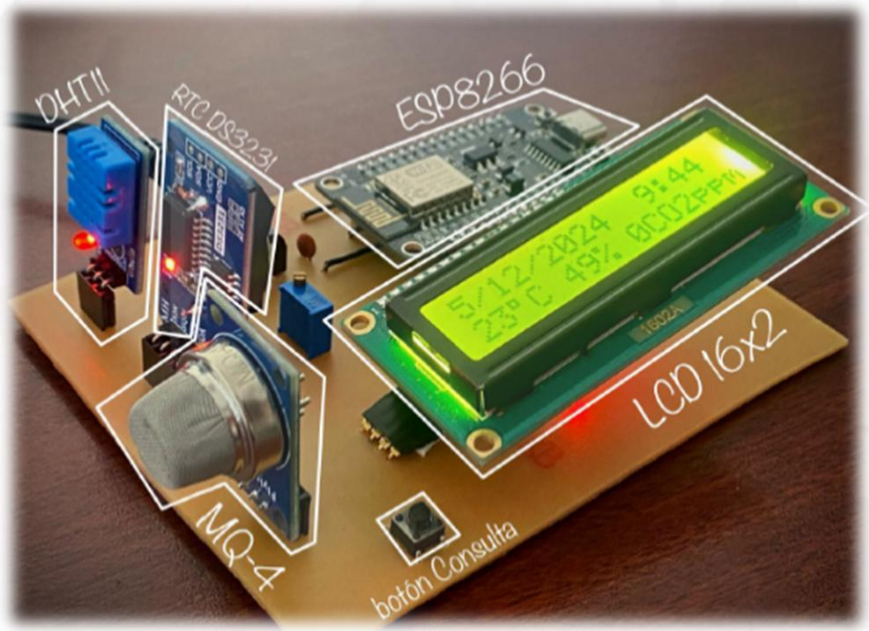
Alarm events are logged on a 4GB microSD card in **.txt* format, structured for compatibility with CSV files to facilitate further analysis.

.txt

- Alarma
- Air_Quality
- Air_Quality
- alarm

.csv

Date	Temperature (oC)	Humidity (%)	CO2 (ppm)
28/11/2024 9:12	20,6	62	693,3
28/11/2024 9:12	20,6	62	686,2
28/11/2024 9:12	20,6	62	650,9
28/11/2024 9:12	20,6	62	533,1



The IoT-based air quality monitoring system is a cost-effective solution, with a total development cost of 26.64 USD.

Component	Cost
ESP32	8.0 USD
MQ-4	2.17 USD
DHT11	1.83 USD
DS3231	4.35 USD
MicroSD Module 4GB	4.57 USD
Cables and box	5.72 USD
Total	**26.64 USD**

Conclusions & Future Work

Monitoring systems for environmental variables like temperature, humidity, and gases are crucial in laboratories and offices to prevent health and safety risks. They enable early warnings, improve workplace safety, and ensure compliance with regulations, maintaining a healthy indoor environment.

The ESP8266 is ideal for IoT applications due to its Wi-Fi™ module, serial communication support, and Arduino IDE compatibility. For more demanding tasks, the ESP32 offers superior performance with more RAM, higher processing speed, and improved ADC resolution, among other upgrades.

The proposed system costs USD 27, significantly cheaper than commercial alternatives. It focuses on CO_2 monitoring but supports additional MQ-X sensors for multi-gas detection. However, ThingSpeak's free tier introduces a 30-second latency, and real-time alerts are absent. Future improvements include lower-latency IoT platforms, edge computing, and AI-driven air quality analysis for enhanced reliability and responsiveness.

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THANKS!

Questions?

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