PROJECT ABSTRACT

IoT Warehouse Environment Monitor

A multi-zone ESP32 sensor network for warehouses: temperature, humidity, air quality and light per zone, with threshold alerts and a zone-map dashboard.

Project type: Hardware + Software (Hybrid)

Availability: Built to order

Suitable branches: IoT & Embedded, Electronics / E&TC

Technologies: ESP32, DHT22, MQ-135, LDR, buzzer, 16x2 LCD, web dashboard

Price: Request a quotation

1. Introduction / Background

Warehouses store goods worth lakhs under environmental limits: pharma cartons degrade above set humidity, food stocks spoil in heat, and poor ventilation lets fumes accumulate near docks. Problems are usually found during audits - weeks after the damage.

This project builds a zone-wise monitoring network: an ESP32 node per warehouse zone carries a DHT22 (temperature/humidity), an MQ-135 gas sensor, an LDR for light/door state and a buzzer for local alarms, with an LCD for on-site readings. The StoreGuard dashboard shows a clickable zone map, 24-hour climate history per zone, air-quality status and a threshold-alert log, so the warehouse manager sees excursions as they happen.

2. Problem Statement

Small and mid-size warehouses rely on occasional manual checks or a single wall thermometer. Zone-level excursions - a hot dock, a humid pharma corner, fumes near dispatch - go unnoticed until stock is damaged or an audit fails.

This project provides continuous per-zone monitoring with configurable thresholds: temperature and humidity from the DHT22, indicative air-quality from the MQ-135, light state from the LDR, local buzzer alarms, and a dashboard that highlights the offending zone and logs every alert with its duration.

3. Objectives

- Sense temperature and humidity per zone with DHT22 sensors.
- Monitor indicative air quality per zone with MQ-135 gas sensors.
- Detect light/door state per zone with LDR sensors.
- Raise local buzzer alarms and dashboard alerts when thresholds are breached.
- Present a zone map, per-zone 24-hour history, air-quality panel and alert log on a web dashboard.

4. Proposed Methodology

- Build one ESP32 node per zone with DHT22, MQ-135, LDR, buzzer and LCD; assign zone names (inward, racking, dock, cold corner, dispatch, pharma).
- Set goods limits per zone type (e.g. 30 C for general goods, tighter humidity for pharma) during commissioning; note that MQ-135 readings are indicative, not calibrated ppm.
- Sample every 30 s; evaluate thresholds on the node for instant buzzer response and publish to the dashboard.
- Render the zone map with per-zone status dots, the selected zone's 24-hour chart with limit lines, the air-quality panel and the alert log.
- Validate with controlled tests: warm a zone past its limit and confirm the alert, buzzer and log entry fire.

5. System Architecture / Working

The edge layer is a set of ESP32 zone nodes, each self-contained with its sensors, buzzer and LCD, evaluating thresholds locally so alarms work without the network. Nodes report to the dashboard over Wi-Fi.

The application layer is the StoreGuard dashboard: a clickable zone map with live temperature/humidity and status dots, the selected zone's 24-hour temperature/humidity chart against goods-limit lines, an air-quality panel (smoke/fire state, worst CO2 and VOC zones, dock light state) and a timestamped alert log.

6. Hardware / Software Requirements

- Hardware: ESP32 development board per zone, DHT22 sensor, MQ-135 gas sensor module, LDR module, active buzzer, 16x2 LCD with I2C backpack, 5 V power supplies, breadboard and jumper wires.
- Software: Arduino IDE with DHT library, Wi-Fi network, web dashboard (single-file HTML/JS app included).

7. Expected Outcomes

- Per-zone temperature, humidity, air-quality and light monitoring with live status.
- Threshold alerts with local buzzer and dashboard log entries.
- 24-hour climate history per zone against configurable goods limits.
- Zone map giving the whole warehouse state at a glance.
- A documented build: wiring diagram, firmware, dashboard and commissioning checklist.

8. Applications

- Pharma and food-godown storage monitoring.
- Cold-corner and dispatch dock supervision.
- Small e-commerce fulfilment warehouses.
- Museum and archive storage climate control.
- Teaching multi-node IoT networks in embedded courses.

9. Future Scope

- Calibrated CO2 (NDIR) sensing for ASHRAE-grade air-quality data.
- Automated exhaust-fan and dehumidifier control from alerts.
- LoRa mesh for large warehouses beyond Wi-Fi range.
- Cloud history with compliance-ready audit reports.
- Predictive alerts from trend analysis before limits are breached.