PROJECT ABSTRACT

IoT Grain Silo Monitoring System with Pest and Moisture Alerts

An ESP32-based grain silo monitor that tracks temperature, humidity and CO2 inside a model storage bin, raising pest and moisture alerts on an OLED display and a cloud dashboard. Delivered built-to-order with working prototype, firmware, dashboard guide, report, PPT and viva kit.

Project type: Hardware

Availability: Built to order

Suitable branches: IoT & Embedded

Technologies: ESP32, DHT22, CO2 sensor, ultrasonic level sensor, IoT cloud dashboard, OLED display, solar power, alert rules

Price: Request a quotation

Prepared by Projectech · projectech.in — for academic project reference.

01. Title

IoT Grain Silo Monitoring System with Pest and Moisture Alerts

02. Introduction / Background

Stored grain spoils silently: moisture migration condenses on cool silo walls, and infestation by grain weevils raises CO2 as the insects respire. By the time a farmer sees the damage, a large part of the stock is lost. Manual inspection — climbing the silo and sampling — is slow and hazardous. Continuous in-silo sensing solves this: temperature and humidity reveal condensation risk, CO2 reveals respiration from pests or germinating grain, and a level sensor reports remaining stock. This project builds that monitoring loop on an ESP32: sensors inside a model galvanized silo bin, local alerts on an OLED, and cloud telemetry with threshold-based pest and moisture alerts.

03. Problem Statement

Smallholder farmers and grain-storage operators lose stored grain to moisture and pest damage that is detected only after it becomes visible. The project addresses this with a student-built IoT monitor for a model silo: temperature, humidity and CO2 sensors watch the storage environment continuously, a level sensor tracks stock, and alerts fire locally and on a cloud dashboard when pest-respiration signatures or moisture thresholds are crossed — demonstrating the full sensing-to-alert IoT pipeline.

04. Objectives

- Monitor temperature and humidity inside a model grain silo with a DHT22 sensor.
- Detect pest and spoilage signatures with a CO2 concentration sensor.
- Track remaining grain stock with an ultrasonic level sensor.
- Show live readings and alert states on an OLED display.
- Publish telemetry to a cloud dashboard with configurable pest and moisture alert rules.
- Power the node from a solar-charged Li-ion supply for field-like operation.
- Deliver the complete student kit: prototype, firmware, calibration guide, report, PPT and viva Q&A.;

05. Proposed Methodology

The system is built in three stages. (1) Sensing: a DHT22, a CO2 sensor and an ultrasonic level sensor are mounted in a model galvanized silo bin and read by an ESP32 on a timed schedule, with a deep-sleep duty cycle to extend battery life. (2) Local intelligence: firmware compares readings against configurable thresholds; a rising CO2 baseline flags pest respiration, sustained high humidity flags condensation risk, and the OLED shows live values plus alert state. (3) IoT telemetry: readings and alert flags are published over Wi-Fi (MQTT/HTTP) to a cloud dashboard that stores history, plots trends and sends pest/moisture alerts. A solar panel with a charge controller tops up the Li-ion battery.

06. System Architecture / Working

The ESP32 wakes on its sampling schedule and reads temperature, humidity, CO2 and grain level. Each reading is compared against the configured pest and moisture thresholds; the OLED immediately reflects the current values and any active alert. The node then publishes the dataset over Wi-Fi to the cloud dashboard, which logs the history, renders trend charts and raises pest and moisture alerts when thresholds are crossed. Between samples the ESP32 deep-sleeps, and the solar-charged battery keeps the node running without mains power.

07. Hardware / Software Requirements

- ESP32 development board (Wi-Fi)
- DHT22 temperature/humidity sensor

- CO2 concentration sensor (NDIR/MQ-class)
- Ultrasonic level sensor
- 0.96-inch OLED display
- Model galvanized silo bin
- Solar panel with charge controller and Li-ion battery
- Cloud dashboard (Blynk/ThingSpeak class)
- Arduino IDE (C/C++ firmware)

08. Expected Outcomes

- A working silo monitor reporting temperature, humidity, CO2 and grain level.
- Pest alerts from CO2-respiration signatures and moisture alerts from humidity thresholds.
- Trend history on the cloud dashboard supporting storage-decision discussion.
- A documented sensor-calibration procedure performed on the student's own build.
- A complete report, PPT and viva Q&A; covering storage science and IoT telemetry.

09. Applications

- Demonstrating IoT for agricultural post-harvest storage.
- Teaching threshold-based alerting and duty-cycled sensor nodes.
- Classroom demos of environmental monitoring from device to cloud.

10. Future Scope

- LoRa backhaul for silos beyond Wi-Fi range.
- Automated aeration-fan control driven by the moisture alerts.
- Multi-silo gateway deployments with per-silo alert rules.
- Grain-temperature-cable probes for depth-profile monitoring.