



# Automated Food Grain Monitoring System Using IoT

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**ABSTRACT:** This paper presents an IoT-based automated food grain monitoring system designed to improve storage conditions and reduce post-harvest losses. The system utilizes an ESP32 microcontroller integrated with sensors such as DHT11 for temperature and humidity, MQ135 for air quality detection, LDR for light intensity, IR sensor for intrusion detection, and a flame sensor for fire detection. The collected data is processed and transmitted to a cloud platform for real-time monitoring. Alerts are generated when environmental parameters exceed predefined thresholds. The system ensures safe storage conditions, enhances warehouse security, and provides a cost-effective solution for smart grain management.

**KEYWORDS:** IoT, ESP32, Food Grain Monitoring, Warehouse Automation, Sensors, Smart Agriculture.

## I. INTRODUCTION

Food grain storage is a critical component of the agricultural value chain, directly influencing food quality, availability, and economic stability. In developing economies, a significant fraction of post-harvest loss occurs during storage due to uncontrolled environmental conditions such as elevated temperature, excessive humidity, and the presence of harmful gases. These conditions accelerate biochemical degradation, promote fungal growth, and increase the risk of pest infestation, ultimately reducing the shelf life and market value of grains.

Conventional storage practices rely on periodic manual inspection, which is labor-intensive and fails to provide continuous monitoring. Such approaches are inherently reactive rather than proactive, often detecting anomalies only after irreversible damage has occurred. Moreover, the absence of real-time alerts and remote visibility further limits timely intervention.

The emergence of the Internet of Things (IoT) provides a scalable solution for continuous, real-time monitoring through interconnected sensing and communication layers. By integrating low-cost sensors with wireless microcontrollers and cloud platforms, IoT systems enable data acquisition, transmission, and analytics for informed decision-making.

This work proposes an **Automated Food Grain Monitoring System** based on the ESP32 microcontroller. The system integrates multi-modal sensing (temperature, humidity, gas concentration, light, intrusion, and fire), local visualization (LCD), and cloud connectivity for remote monitoring. Threshold-based alerting mechanisms (buzzer/SMS) enable rapid response to abnormal conditions. The proposed solution aims to reduce storage losses, enhance safety, and provide a cost-effective pathway toward smart warehouse management.

## II. LITERATURE SURVEY

Recent studies emphasize IoT's role in agriculture and cold-chain logistics. Rashid and Vasan (2018) developed an IoT-enabled cold chain monitoring system focusing on temperature and humidity, demonstrating reduced spoilage through real-time alerts. Zhang and Chen (2020) proposed a smart logistics framework that integrates multiple sensors with cloud platforms, enabling remote supervision and improved supply chain reliability.

Bhattacharya and Roy (2019) introduced a cloud-based monitoring architecture for perishable goods, highlighting the importance of data analytics for performance evaluation. Other works explore GSM-based alerting, wireless sensor networks, and low-power microcontrollers for distributed monitoring.

Despite these advances, many solutions are **parameter-limited** (often only temperature/humidity) and lack **comprehensive safety features** such as fire detection, intrusion sensing, and gas monitoring. Additionally, some systems do not provide **edge-level feedback** (local display/actuation) or **multi-channel alerts**.

The proposed system addresses these gaps by combining **multi-sensor integration**, **edge visualization (LCD)**, **cloud logging**, and **multi-modal alerts (buzzer + SMS)**, thereby delivering a more robust and practical warehouse monitoring solution.

### III. EXISTING SYSTEM

Traditional grain storage monitoring is predominantly manual, involving periodic checks of environmental conditions. This approach is time-consuming, susceptible to human error, and incapable of capturing transient anomalies. The absence of continuous monitoring leads to delayed detection of adverse conditions such as spikes in temperature or humidity.

Furthermore, existing systems typically lack **remote access**, **data logging**, and **automated alerts**. As a result, stakeholders cannot track conditions in real time or respond promptly to emerging risks. These

### IV. PROPOSED SYSTEM

The proposed system employs the ESP32 microcontroller as the central processing and communication unit. It interfaces with a suite of sensors to capture environmental and safety-related parameters:

- DHT11: Measures temperature and relative humidity
- MQ135: Detects air quality and harmful gases (e.g., CO<sub>2</sub>, NH<sub>3</sub>)
- LDR: Monitors light intensity inside the storage area
- IR Sensor: Detects intrusion or unauthorized access
- Flame Sensor: Identifies fire hazards
- Vibration Sensor: Detects abnormal movement
- LCD (16×2): Displays real-time values locally

The ESP32 aggregates sensor data, displays key metrics on the LCD, and transmits readings to a cloud platform via Wi-Fi. A threshold-based decision layer evaluates each parameter against safe limits. When thresholds are exceeded, the system triggers alerts (buzzer and SMS), enabling immediate corrective action. The design is modular, low-cost, and scalable

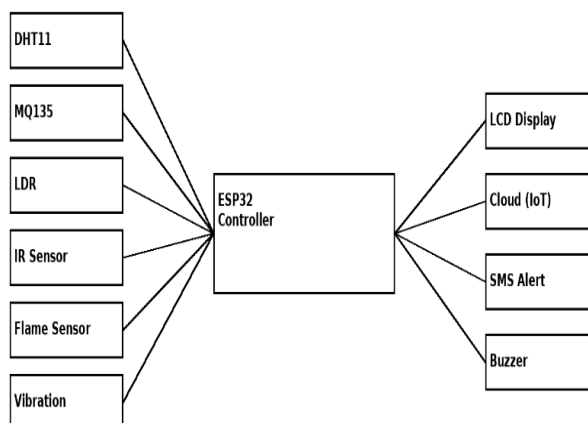


Fig. 1. Proposed System Block Diagram

The proposed system consists of multiple sensors such as DHT11, MQ135, LDR, IR, flame, and vibration sensors connected to the ESP32 microcontroller. The ESP32 processes the sensor data and transmits it to a cloud platform via Wi-Fi. The system also displays real-time data on an LCD and generates alerts through a buzzer and SMS notifications when abnormal conditions are detected.

### V. SYSTEM ARCHITECTURE AND METHODOLOGY

#### A. Architecture Overview

The architecture comprises three layers:

1. **Sensing Layer:** Sensors capture environmental and safety data.
2. **Processing Layer:** ESP32 performs data acquisition, filtering, threshold comparison, and communication.
3. **Cloud Layer:** Stores and visualizes data for remote monitoring and historical analysis.

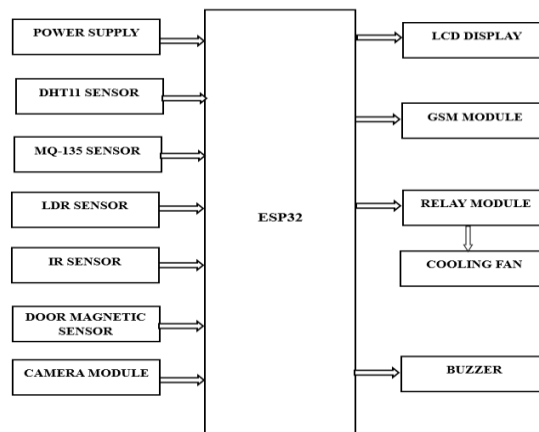


Fig. 2. Block Diagram of the Proposed System

#### B. Working Principle

1. Initialize ESP32 and sensor interfaces
2. Establish Wi-Fi connection
3. Acquire sensor readings (T, H, gas, light, intrusion, fire, vibration)
4. Display values on LCD
5. Transmit data to cloud platform
6. Compare values with predefined thresholds
7. If exceeded → trigger buzzer/SMS alert
8. Repeat in continuous loop

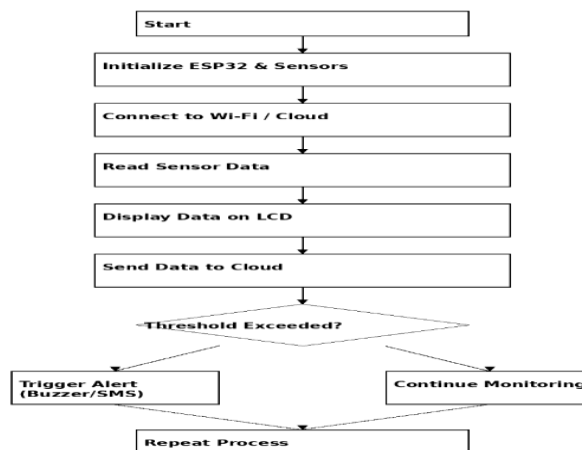


Fig. 3. Flowchart of the Working Principle

The system starts by initializing the ESP32 and sensors, followed by establishing a connection with the cloud platform. Sensor data such as temperature, humidity, and gas levels are continuously collected and displayed on the LCD. The data is then transmitted to the cloud for monitoring. The system checks whether the sensor values exceed predefined thresholds. If any abnormal condition is detected, alerts are triggered using a buzzer or SMS. Otherwise, the system continues monitoring in a loop.

### C. Threshold Logic (example)

- Temperature > 35 °C → Activate fan/alert
- Gas level > threshold → Trigger buzzer + SMS
- Fire detected → Immediate alert
- Intrusion detected → Security alert

### 5.1 Hardware components:

1. ESP32
2. DHT11 Sensor
3. MQ135 Gas Sensor
4. IR Sensor
5. LDR Sensor
6. Flame Sensor
7. Vibration Sensor
8. LCD Display
9. Buzzer
10. Camera Module
11. Power Supply

## 5.2 SOFTWARE REQUIREMENTS

### 5.2.1 Arduino IDE

Arduino Integrated Development Environment (IDE) is used for writing, compiling, and uploading the program code to the ESP32 microcontroller. It provides an easy-to-use interface and supports embedded C programming.

### 5.2.2 Embedded C

Embedded C programming language is used for developing the control program of the system. It is used to interface sensors, process data, and control system operations.

### 5.2.3 ThingSpeak Cloud Platform

ThingSpeak is an IoT cloud platform used for storing, analyzing, and visualizing sensor data in real time. It enables remote monitoring of warehouse conditions through graphical representation.

### 5.2.4 ESP32 Board Package

ESP32 board support package is installed in Arduino IDE to enable programming and communication with the ESP32 microcontroller

### 5.2.5 Wi-Fi Communication Protocol

Wi-Fi protocol is used for transmitting sensor data from the ESP32 to the cloud platform for remote monitoring and alert generation

## VI. HARDWARE REQUIREMENTS

### 1.ESP32 Microcontroller

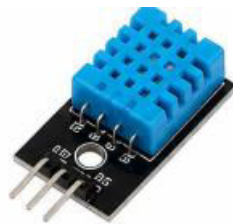
Quantity: 1 Used as the main processing and control unit with built-in Wi-Fi capability.



**Figure 5.1 Esp32**

## **2.DHT11 Sensor**

Quantity: 1 Measures temperature and humidity inside the warehouse.



**Figure 5.2. DHT11 Sensor**

## **3. MQ135 Gas Sensor**

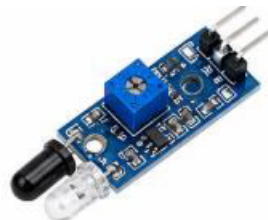
Quantity: 1 Detects harmful gases and monitors air quality.



**Figure 5.3. MQ135 Gas Sensor**

## **4.IR Sensor**

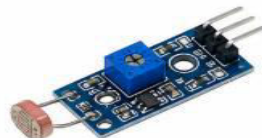
Quantity: Used for intrusion detection and identifying unauthorized movement..



**Figure 5.4. IR Sensor**

## **5.LDR Sensor**

Quantity: 1 Monitors light intensity inside the warehouse.



**Figure 5.5. LDR Sensor**

#### **6. Flame Sensor**

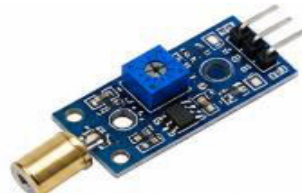
Quantity: 1 Detects fire hazards and provides early warning alerts..



**Figure 5.6. Flame Sensor**

#### **7. Vibration Sensor**

Quantity: 1 Detects abnormal vibrations or movement in the warehouse.



**Figure 5.7. Vibration Sensor**

#### **8. LCD Display**

Quantity: 1 Displays real-time sensor values and system status.



**Figure 5.8. LCD Display**

#### **9. Buzzer**

Quantity: 1 Generates alarm sound when abnormal conditions are detected.



**Figure 5.9. Buzzer**

#### **10. Power Supply**

Quantity: 1 Provides required electrical power to the entire system.



**Figure 5.10. Power Supply**

### VII. RESULTS & DISCUSSION:

The proposed IoT-based Food Grain Monitoring System was successfully designed and implemented using the ESP32 microcontroller and multiple environmental sensors. The system continuously monitored important parameters such as temperature, humidity, gas concentration, light intensity, vibration, and intrusion in the warehouse environment.

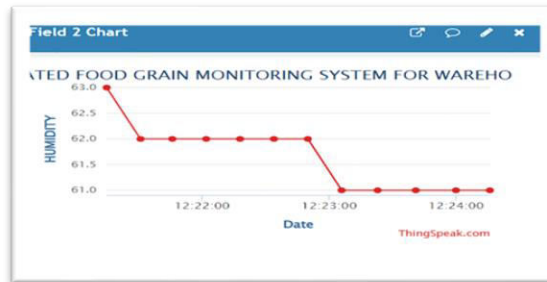


Figure 6.1 Humidity

The humidity monitoring output shown in **Fig.1** demonstrates the real-time tracking of humidity levels inside the warehouse. Maintaining proper humidity is important to prevent fungal growth and spoilage of food grains.

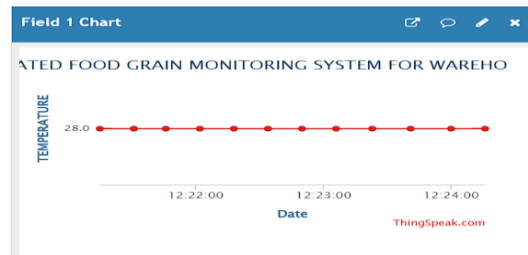


Figure 6.2 Temperature

The system continuously monitored important parameters such as temperature, humidity, gas concentration, light intensity, vibration, and intrusion in the warehouse

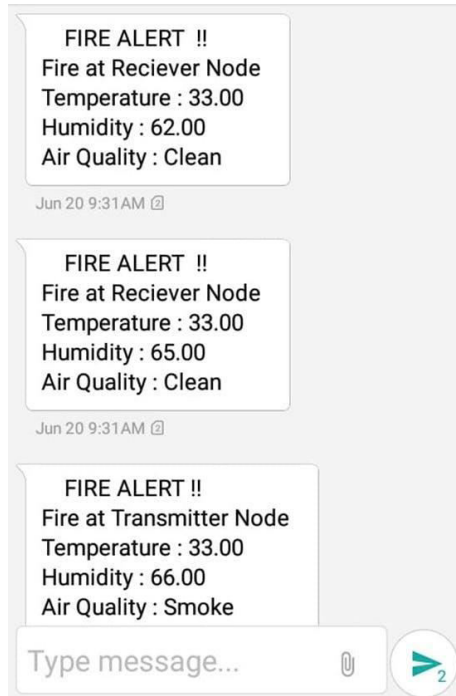


Figure 6.3 Mobile SMS.

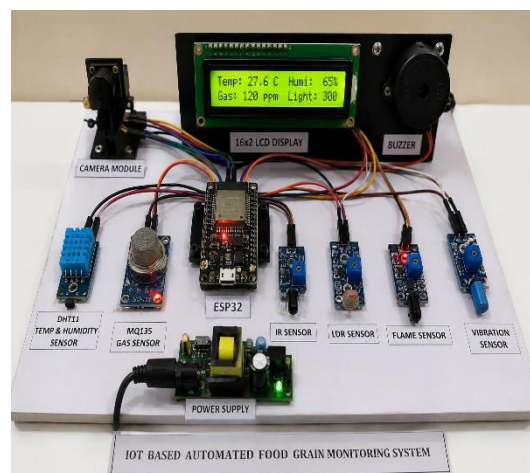


Figure 6.4 Prototype

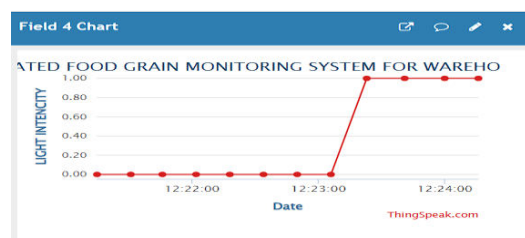


Figure 6.5 Light Intensity



9. Zhang, Y., & Chen, W. (2020). *Smart Logistics and Cold Chain Monitoring Using IoT Technology*. Journal of Supply Chain Management Research, 12(1), 23–30.
10. Arduino Official Documentation <https://www.arduino.cc/en/Guide/HomePage>
11. Patil, S., & Kulkarni, P. (2017). *IoT Based Fruit Storage and Transportation Monitoring System*. International Journal of Computer Applications, 168(9), 10–14.
12. Chen, L., Zhang, Z., & Li, Y. (2018). *IoT Sensors and Real-Time Monitoring for Perishable Goods*. International Journal of Sensors and Applications, 8(3), 55–63.
13. Li, X., & Wang, J. (2019). *Implementation of GSM-Based Alert System for Cold Chain Logistics*. International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, 8(6), 2345–2352.
14. Patil, R., & Suryawanshi, A. (2020). *Real-Time Environmental Monitoring System for Perishable Goods Using IoT*. International Journal of Innovative Technology and Exploring Engineering, 9(2), 112–118.
15. Cold Chain Management: Challenges and Opportunities. FAO Technical Paper, Food and Agriculture Organization of the United Nations, 2016. <http://www.fao.org/3/i6192e/I6192E.pdf>



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