

# Smart Grain Storage System Using IOT

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**Abstract**—*The Smart Grain Management System is a comprehensive, mobile technological solution designed to minimize post-harvest losses and ensure the quality of stored grains, allowing produce to be safely preserved for six months to one year. The system continuously monitors critical grain health parameters, specifically addressing spoilage factors such as improper moisture content, temperature fluctuations, and the hidden presence of insect pests. It integrates low-power wireless probes for collecting real-time data on internal grain temperature, moisture content, and ambient conditions, which is then processed by a microcontroller and transmitted via Internet of Things (IoT) technology to a user interface.*

**Index Terms**—*Arduino Uno, Grain Storage, IoT, Pest Control, Sensors, Automation.*

## I. INTRODUCTION

The history of grain storage spans thousands of years, and various climatic conditions, cultural traditions, and technological developments have shaped the way grains are preserved and managed. The grain management system therefore should be improved to reduce the farmers' effort and prevent unnecessary losses. A model is created to intelligently monitor stored grains by checking temperature, humidity, pest activity, and moisture levels inside the storage unit. The prototype is an example of modern technology for enhancing post-harvest processes, including maintaining grain quality, preventing spoilage, and alerting farmers through automated sensing support. Grain management technology plays a vital role in food preservation and is an important step in supporting a stable and civilized lifestyle. The basic trend for improvement in grain storage is the use of well-equipped and efficient monitoring tools. In traditional methods also we had tools, but they were not automated and required manual checking.

## II. LITERATURE SURVEY

Intelligent Grain Storage Management System based on IoT — Ajay Doltade, Ankita Kadam, Sayali Honmore, Sanjeev Wagh (IJSR, 2019) ResearchBib+1• The authors designed a real-time monitoring system for grain storage using IoT. They used DHT11 sensors for temperature and humidity, MQ2 and MQ135 gas sensors to measure environmental gases, and a PIR sensor to detect movement. IOT based Smart Food Grain Storage Monitoring System for Silos using Google Apps Script — Vallisree Sivathanu, Mudumby Kalyan R Swami, A.R.L. Padmaja, Samhitha V (Primeras Scientific, 2023) primerascientific.com.Design and Experimental Analysis of a Low-Cost Smart Grain Storage Monitoring System for Rural Applications — Dhanshri Pradip More, Dr. D. L. Bhuyar hbrppublication.com. This work designs a low-cost system using commonly available sensors (temperature, humidity, gas) integrated with a microcontroller. Alerts are sent using GSM (mobile network) when conditions cross thresholds.

## III.EXISTING SYSTEM

Existing smart grain storage systems have increasingly leveraged Internet of Things (IoT) technology to automate monitoring and reduce the manual labor associated with traditional inspection methods. For instance, Doltade et al. (2019) developed a real-time monitoring system that utilizes DHT11 sensors for temperature and humidity, alongside MQ2 and MQ135 sensors for detecting environmental gases and PIR sensors for movement. Similarly, Pratama et al. introduced a prototype based on the ESP32 microcontroller, integrating DHT22,

LDR, and soil-moisture sensors to track grain conditions

#### IV. PROPOSED SYSTEM

The proposed Smart Grain Management System is a portable, automated technological solution designed to minimize post-harvest losses by continuously monitoring the health of stored grains. Controlled by an Arduino Uno microcontroller, the system integrates environmental sensors such as the DHT22 and MQ135 to track critical parameters like temperature, humidity, moisture content, and gas levels in real-time. A key innovation of this design is the inclusion of a magnetron that emits controlled electromagnetic (EM) waves to effectively disinfect pests without using chemicals. This comprehensive setup reduces the reliance on manual inspection and chemical preservatives, offering a cost-effective method for farmers to maintain grain quality for up to a year.

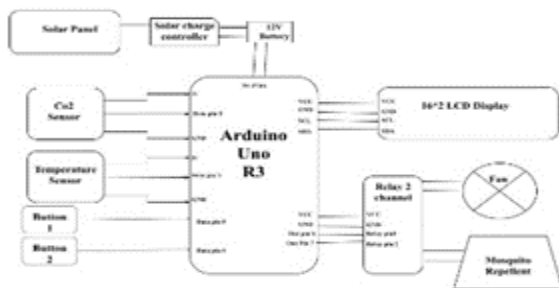
#### V. ADVANTAGES

- Minimizes Grain Spoilage
- Automation Improves Storage Conditions
- Enhances Grain Quality
- Cost Saving
- Supports Large-Scale Storage

#### VI. METHODOLOGY

Initially, we need to make sure all the components are connected and give power through an external device. This smart storage project aims to create a system that can automatically adjust its ventilation during high-heat or high-moisture events using sensors to detect spoilage-like conditions.

#### VII. BLOCK DIAGRAM



System We have designed a smart grain management unit for continuous monitoring and control of storage conditions. The system operates automatically based on sensor inputs and has greater advantages compared to traditional manual inspection methods, which are time consuming and often inaccurate. Systems depending on frequent human observation may not work properly during long-term storage or in large warehouses. In this design, the electronic sensing modules and the mechanical control mechanisms function together in an efficient manner to maintain grain quality. It reduces the running cost associated with grain spoilage, pest infestation, and repeated manual checking. A set of environmental sensors such as temperature, humidity, and moisture sensors are connected to the microcontroller. These sensors continuously collect data and help in detecting spoilage conditions.

#### VIII. WORKING PRINCIPLE

A Smart Food Grain Storage and Handling System is designed to ensure safe, efficient, and automated movement and monitoring of food grains using IoT-based technology. In this system, a horizontal conveyor belt is used to transport grains from the input section to the lifting area, while a vertical conveyor belt elevates the grains to different storage levels or bins, enabling space-efficient handling. An Arduino Uno acts as the central controller, continuously receiving data from a temperature sensor and a CO2 sensor placed inside the storage environment to monitor conditions that may cause spoilage, insect infestation, or fungal growth. When temperature or CO2 levels exceed safe limits, the system immediately alerts the user through LED indicators and displays real-time values and warning messages on a 16x2 LCD display. All components are interconnected using a breadboard, allowing easy prototyping and maintenance. This smart system reduces manual intervention, minimizes post-harvest losses, and improves food grain quality by ensuring continuous monitoring and controlled handling of stored grains.

#### IX. HARDWARE IMPLEMENTATION

This smart grain storage system consists of several types of sensors and the vital part of this smart gain

storage system is Arduino which controls all other components. Fig shows that Arduino is used as microcontroller connected with other components. It also consists of DHT22 temperature sensor, which help for temperature detection in the silo tank. Also, we use MQ135 CO<sub>2</sub> sensor, which help to detect the co<sub>2</sub> level in the silo tank, that can help to maintain the grain quality in the tank.

1. DHT22: The DHT22 sensor can either be purchased as a sensor or as a module. Either way, the performance of the sensor is the same. The sensor will come as a 4-pin package out of which only three pins will be used whereas the module will come with three pins.
2. MQ135 CO<sub>2</sub>: The MQ135 is a semiconductor gas sensor widely used for detecting a range of harmful gases such as carbon dioxide (CO<sub>2</sub>), ammonia (NH<sub>3</sub>), nitrogen oxides (NO<sub>x</sub>), benzene, smoke, and other volatile organic compounds (VOCs).

#### X.CONCLUSION

The Smart Food Grain Storage prototype developed using Arduino Uno, DHT22, and MQ gas sensor successfully demonstrated an efficient and low-cost method for monitoring essential storage parameters. The system continuously tracked temperature, humidity, and gas levels, providing reliable real-time information through the LCD display. The LED alert mechanism offered an immediate visual indication during unsafe conditions, enabling quick corrective action. Even with a simple hardware setup, the prototype proved effective in reducing the risk of grain spoilage by detecting early environmental changes. The compact design, low power requirement, and easy programmability make the system suitable for small warehouses and home-scale grain storage. Overall, the project highlights how basic sensors and microcontroller technology can significantly improve grain preservation and support safer, smarter storage practice.

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