

Onion Spoilage Early Detection In Cold Storage

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Abstract—Onion’s spoilage occurs in cold storage systems, which could be due to poor control over temperature, humidity, and harmful gases formed by decomposition. This causes huge losses to onion cultivators and suppliers. For tackling this problem, an IoT based Onions Spoilage Detection System has been designed, using MQ135 gas sensor, DHT11 temperature and humidity sensor, RFID and LCD display.

The system constantly measures environmental factors and gas content within the storage space. In case there is any indication of spoilage, the system will indicate any irregularities in gas emission and will warn the user at once. The role of RFID is to facilitate batch monitoring within the storage, while the LCD will display the relevant data.

Index Terms—Onion Spoilage Detection, Cold Storage Monitoring, MQ135 Sensor, DHT11 Sensor, RFID, IoT System, Gas detection, Buzzer alert, LCD display

I. INTRODUCTION

Onion is considered among the widely stored agricultural products. However, when stored, it may be easily damaged. The damage mainly occurs due to excess moisture content, microbial growth, and emission of gases such as ammonia and carbon dioxide. As a result, onions experience weight loss, develop an unpleasant smell, and their quality is reduced.

Most conventional refrigeration units control only the temperature parameter. Such units cannot monitor any signs of spoilage. Therefore, in most cases, the damage caused to the onions becomes evident only when most of the stock has already gone bad.

While analysing the previous approaches, it was found that all the approaches concentrated on the analysis of one particular parameter, like temperature or humidity. Few systems have gas analysis features, but there are no systems with alerting or tracking features. To overcome these problems, we developed an IoT-based

Onion Spoilage Detection System. This system combines environmental monitoring, gas detection, and RFID-based tracking. It continuously checks storage conditions and sends real-time updates through the cloud. This helps in detecting spoilage at an early stage and prevents major losses.

II. LITERATURE SURVEY

After reviewing many research works about the early detection of the spoiling of onions kept under refrigerated conditions, each of which had its advantages, it was also possible to determine their shortcomings. Avashti and Ashok Pawar [1] Early detection of onion spoilage. It helps detect spoilage early. But this system’s suitable only for small-scale storage. Gawade and Shedje DN [2] proposed an GSM Based Smart Electronics Nose for Onion Preservation: A Sustainable Solution for Agriculture. This system was not developed for onion preservation. This system uses sensors to monitor important parameters such as temperature, humidity, and gases like methane. But systems require regular maintenance and calibration, which is difficult for farmers. Khemnar and Sayyad Hamja Kayyum [3] developed IoT Based Onion Storage Monitoring and Automation Control System. This System is used large-scale agriculture. But problem in remote areas without stable electricity for Continuous monitoring systems require like Power supply and Backup systems. Rohit Ganjure and Payal R Patil [4] Smart Onion storage Using Arduino. They used Automation & Smart Control for ventilation and environmental conditions. But it is not suitable for large warehouses or commercial storage. However, most existing systems do not Combine gas detection in cold storage detection + environmental monitoring + identification (RFID) together. Our system improves this by integrating all these features.

III. METHODOLOGY

When the system is powered ON, the DHT11 sensor is used to keep track of the temperature and humidity inside the cold storage area. It is extremely necessary to maintain proper temperatures and humidity to ensure the long-term freshness of onions. These values are constantly monitored by the sensor and sent to the controller. Exceeding the required value can result in deterioration of onions. Therefore, the controller raises an alarm and informs the administrator.

This gas detector called MQ135 will detect the presence of air inside the cold storage. The moment that there is an onset of spoilage of the onions, there will be the release of harmful gases such as ammonia and carbon dioxide. This detector will monitor the air continuously, and once there is a rise in the presence of gases above the expected levels, there will be an onset of spoilage. This is reported to the microcontroller, which then triggers an alarm or activates other processes such as ventilation.

The Liquid Crystal Display is employed for displaying the values in real time. The information such as temperature, humidity, and gas concentrations is displayed using this component in order to make the user aware of what is going on in the chamber. In case of any failure that causes spoilage, a warning message is displayed.

The RFID technology is employed to tag the various lots of onions. Each lot can be tagged using the RFID tag, and the database will have information regarding the time period for storage, the location of the lot, and its condition. Using the RFID tag, the relevant data is easily accessible in the database.

Block Diagram of the System:

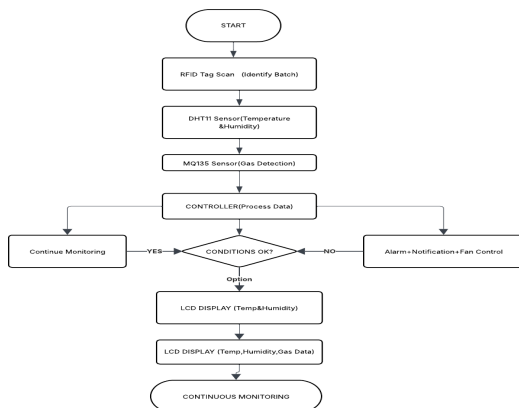


Fig 1

IV. HARDWARE IMPLEMENTATION

Fig 2 below depicts the whole hardware implementation for detecting the early spoilage of onions in cold storage.

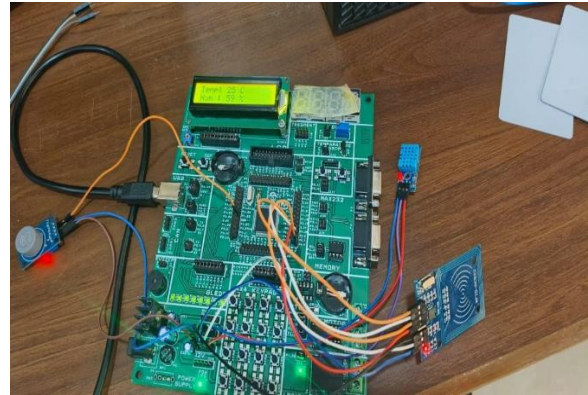


Fig 2. Complete Hardware

The system is divided into different layers

1. Sensing Layer:

MQ135 detects gases like ammonia and CO₂
DHT11 measures temperature and humidity

2. Processing Layer:

In the processing stage, the microcontroller plays the role of the brain for the entire system. It receives data from all sensors and compares the readings with safe threshold values. If any reading is beyond the set limit, then it recognizes the spoilage.

3. Output Layer:



Fig 3. LCD Display

Feedback is given to the user through the output layer. The LCD monitor will indicate real-time information such as temperature and humidity as depicted in fig 3 above. Alerts are created when there is any case of spoilage, which enables fast actions by the user.

4. Identification Layer:

Identification layers use RFID technology to detect various batches of onions stored in the storehouse. Every batch of onions will be provided with a special RFID tag, which allows tracking exactly where or which batch is facing spoilage.

5. IoT Layer:

Lastly, the data collected can then be transferred to cloud computing through IoT Layers. This allows making the system more efficient and user-friendly.

Table And Graph:

The below fig 4 shows the complete table of the system

Time t	# room_humidity	# room_temperature	# air_quality	T workers_status	# workers_count
Dec 30 03:48:02 PM	60 city	30 city	777 city	MONITORING	2 city
Dec 30 03:48:02 PM	60 city	30 city	785 city	MONITORING	2 city
Dec 30 03:48:05 PM	60 city	30 city	789 city	MONITORING	2 city
Dec 30 03:48:05 PM	60 city	30 city	779 city	MONITORING	2 city
Dec 30 03:48:08 PM	60 city	30 city	782 city	MONITORING	1 city
Dec 30 03:48:13 PM	60 city	30 city	773 city	MONITORING	1 city
Dec 30 03:48:15 PM	60 city	30 city	778 city	MONITORING	2 city
Dec 30 03:48:19 PM	60 city	30 city	776 city	MONITORING	1 city
Dec 30 03:48:21 PM	60 city	30 city	774 city	MONITORING	1 city
Dec 30 03:48:21 PM	60 city	30 city	783 city	MONITORING	1 city
Dec 30 03:48:22 PM	60 city	30 city	789 city	MONITORING	1 city
Dec 30 03:48:22 PM	60 city	30 city	780 city	MONITORING	1 city
Dec 30 03:48:23 PM	60 city	30 city	774 city	MONITORING	1 city
Dec 30 03:48:27 PM	60 city	30 city	783 city	MONITORING	0 city

Fig 4 Complete Table

The tablet shows a live monitoring screen that records environmental and work details for a room at specific times

The below fig 5 shows the real time monitoring chart

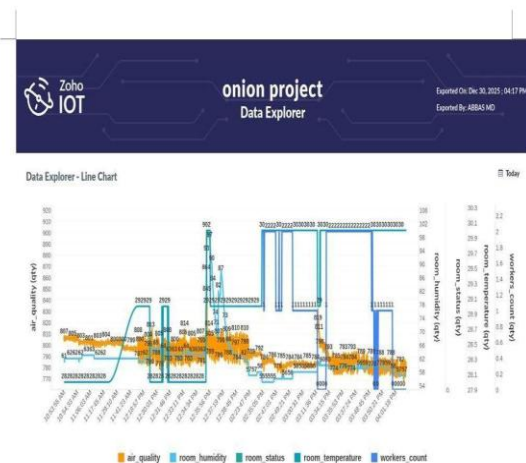


Fig 5 Data Live Chart

The graph represents real-time monitoring of storage conditions for onions using IoT sensors. It shows variations in air quality, room humidity temperature, room status, and workers count over time. These parameters are crucial for maintaining the quality and shelf life of stored onions

V. RESULTS & DISCUSSION:

The system provides:

- 1 Early detection of onion spoilage
- 2 Continuous monitoring without manual effort
- 3 Accurate detection using gas and environmental data
- 4 Reduced storage losses
- 5 Better quality control

Future improvements can include:

1. AI-based spoilage prediction

VI. CONCLUSION:

The Onion Spoilage Early Detection System is a smart and efficient solution for modern agriculture. By using sensors and IoT technology, it helps in detecting spoilage at an early stage, reducing losses and improving

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