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Review on Agri Safe v5.0 IoT Based Onion Spoilage Detection System

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Abstract : *AGRI SAFE v5.0 is an IoT-based system designed to monitor onion storage conditions and detect possible early signs of spoilage. The main objective is to reduce post-harvest losses and improve onion storage quality. The system uses an ESP8266 microcontroller, DHT11 temperature and humidity sensor, SGP30 air-quality sensor, and ESP32-CAM module. These sensors continuously monitor environmental conditions inside the storage area. The collected data is processed by the ESP8266 and transmitted through Wi-Fi to an IoT platform. The ESP32-CAM captures images for visual inspection of onions. If abnormal conditions are detected, a buzzer and LED provide alerts to the user. A relay-controlled fan helps maintain suitable storage conditions. This project provides a smart, cost-effective, and efficient solution for onion storage monitoring and helps farmers minimize spoilage losses*

Keywords: Internet of Things (IoT), Onion Spoilage Detection, ESP8266, ESP32-CAM, DHT11 Sensor, SGP30 Sensor, Temperature and Humidity Monitoring, Air Quality Monitoring, Smart Agriculture, Real-Time Monitoring, Spoilage Alert System.

I. INTRODUCTION

1. AGRI SAFE V5.0 – IoT-Based Onion Spoilage Detection System is an innovative smart agriculture project developed to monitor onion storage conditions and identify possible spoilage at an early stage. The system uses IoT technology, ESP8266 microcontroller, DHT11 temperature and humidity sensor, MQ-series gas sensor and ESP32-CAM module to collect environmental data and capture onion images. It helps monitor important storage parameters that affect onion quality and freshness.
2. The proposed system provides real-time monitoring through an IoT platform and generates automatic alerts when abnormal temperature, humidity or gas levels are detected. It also uses a buzzer, LED, relay and fan for warning and ventilation control. The system aims to reduce post-harvest losses, minimize manual inspection, improve storage management and help farmers maintain better onion quality through smart monitoring technology.

II. HARDWARE ARCHITECTURE & SYSTEM INTEGRATION

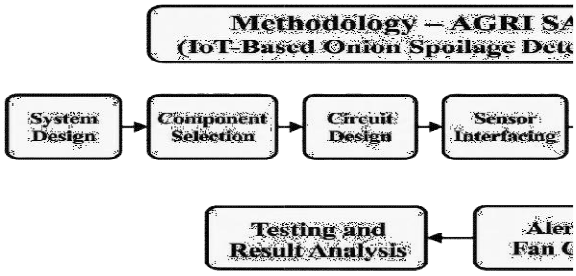
The AGRI SAFE V5.0 system consists of various hardware components integrated to detect and monitor onion spoilage. The ESP8266 microcontroller acts as the main processing unit, while the DHT11 sensor measures temperature and humidity inside the storage area. The MQ-series gas sensor detects changes in gas concentration that may indicate onion spoilage. The ESP32-CAM module captures images of onions for visual inspection. All sensor data is processed and transmitted to the IoT platform through Wi-Fi for real-time monitoring. A buzzer and LED provide alerts when abnormal conditions are detected. The relay controls the fan to maintain proper ventilation inside the storage area. This hardware integration helps in early spoilage indication, reduces manual monitoring and improves onion storage management..

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III. TECHNICAL SPECIFICATION & POWER DISTRIBUTION

Component Name	Specification/ Model	Key Technical Role
Microcontroller	ESP8266	Processes sensor data and provides Wi-Fi connectivity
Temperature & Humidity Sensor	DHT11	Measures storage temperature and humidity
Gas Sensor	MQ-135 / MQ-series	Detects changes in gas concentration
Camera Module	ESP32-CAM	Captures onion images for visual spoilage inspection
Buzzer	5V Active Buzzer	Generates audio alerts
LED	3mm / 5mm LED	Provides visual indication
Relay Module	5V Single Channel	Controls fan operation
DC Fan	5V / 12V DC Fan	Provides air circulation and ventilation
Power Supply	5V / 12V DC Adapter	Supplies power to the system
Connecting Wires	Jumper Wires	Provides electrical connections between components

IV. SYSTEM INTERCONNECTION & SIGNAL FLOW



V. METHODOLOGY & DUAL – OPERATIONAL MODES

1. Automatic Mode: The system continuously monitors temperature, humidity and gas levels using sensors. The ESP8266 processes the data and automatically activates the buzzer, LED and relay-controlled fan when abnormal conditions are detected.

2. Manual Mode: The user monitors sensor readings and onion images through the IoT platform and manually controls the fan and other connected devices whenever required.

VI. RESULTS & PREFORMANCE ANALYSIS

The AGRI SAFE V5.0 system integrates IoT-based sensors and a camera module to monitor onion storage conditions and identify possible spoilage. It provides real-time monitoring, automatic alerts and ventilation control, helping improve storage management and reduce potential losses.

Parameter	Expected System Performance	Result
Temperature Monitoring	Temperature Monitoring	Temperature Monitoring
Humidity Monitoring	Storage humidity measurement	Sensor data displayed
Gas Detection	Detect changes in gas levels	Abnormal levels indicated
Image Monitoring	Onion image capturing	Visual inspection
Fan Control	Automatic ventilation	Relay-based operation
IoT Monitoring	Remote data monitoring	Dashboard display

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1. The system enables continuous monitoring of onion storage conditions.
2. It provides early warnings of possible spoilage and supports better storage management.

VII. CONCLUSION & FUTURE WORK

The AGRI SAFE V5.0 system provides an IoT-based solution for monitoring onion storage conditions and detecting possible spoilage through sensors and camera technology. It enables real-time monitoring, automatic alerts and ventilation control, helping reduce potential onion losses.

In the future, AI and Machine Learning can be integrated for more accurate spoilage detection, along with mobile application notifications and advanced cloud-based monitoring to improve system performance.

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