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IOT Based Onion Storage Monitoring and Automation Control System

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Abstract: *Onions are a staple crop globally, consumed in various culinary dishes and food products. However, their post-harvest preservation presents a significant challenge. Onions are sensitive to moisture, temperature, and humidity variations, making them prone to rot and spoilage during storage. Traditional storage methods often rely on periodic manual checks and manual intervention, which can be ineffective and resource-intensive. This project aims to address these challenges by implementing an Internet of Things (IoT) based solution that leverages moisture sensors, temperature and humidity sensors, microcontrollers, and an IoT platform to continuously monitor and regulate storage conditions, ensuring optimal onion quality and extended shelf life. Onions, a fundamental and widely consumed vegetable in global culinary traditions, face significant postharvest preservation challenges. Sensitivity to variations in storage conditions, such as temperature, humidity, and moisture levels, often leads to spoilage and a rapid decline in quality. Traditional storage methods reliant on manual monitoring prove resource-intensive, prone to human error, and lack real-time insights into the evolving storage environment. This project introduces an innovative solution, an Internet of Things (IoT)-based onion storage monitoring system, to address these challenges. The system deploys sensors to continuously collect data on storage conditions, transmitting it to a cloud-based platform for real-time analysis. The analysis identifies trends and anomalies, triggering alerts and recommendations via a user-friendly interface. The anticipated outcomes of this project include enhanced onion quality, reduced spoilage, and increased resource efficiency for farmers and storage facility operators. This technology-driven approach contributes to the availability of high-quality onions in the market, serving both agricultural and culinary sectors. The IoT-based onion storage monitoring system represents a substantial step forward in post-harvest preservation, marking a promising advancement in the agriculture industry*

Keywords: Rotten Onions, Automation. Gas sensors, Internet of Things, Onion Storage

I. INTRODUCTION

The Internet of Things (IoT) is a computing concept that describes the idea of everyday physical objects being connected to the internet and being able to identify themselves to other devices. Internet of Things focuses on connection of different sensors to physical object and transmits information to internet.

It has a significant role in the field of agriculture in terms of control and protection, providing real time information and communicating with the physical world. Onion storage methodology to reduce its degradation. Focuses on studying various monitoring systems that have been designed and implemented in the field of agriculture. Internet of Things plays an important role in smart agriculture monitoring system.

Smart farming is an emerging concept, because IoT sensors are capable of providing information about their fields. The main feature is monitoring temperature and humidity in agricultural field. This monitoring is done by using sensors and sending the message to the farmer. The main purpose is to propose a grid system onion storage methodology which will help to reduce onion degradation due to temperature and humidity. If in the storage of Onions, one of the onions starts degradation then this system will send the message to the farmer. This will help to improve yield better quality onion and save the farmers from the major economic loss. India is the second most populated country of world after china

Population of India is 1.37 billion. Onion is one of the biggest vegetable crops in India. India is the Second Largest Producer of Onion in the World. Onion is one of the most important commercial crops of India. In India, onion crop is grown in above 1.20 million hector area with an animal production 19.14 million tons with productivity 16.12 tons per hectors. By considering survey, we observed 60 to 75 percent onions are get wasted from total production. These are big loss to our farmer and our nations. To overcome from this problem and save the money of our farmers and nation, we are working on this project.

Need of Project:

The cleanliness Onion is one of the most important commercial crops of India. In India, onion crop is grown in above 1.20 million hector area with an animal production 19.14 million tons with productivity 16.12 tons per hectors. By considering survey, we observed 60 to 75 percent onions are getting wasted from total production. These are big loss to our farmer and our nations. Our project would to help monitor and determine the condition of onion. By using smell sensor we will try to find how much onion are rotted in storage. By placing the sensor on the shed by considering their range. System will send collected data through sensor to the farmer by using message and by checking they easily get notification about how many onions are rotten in storage

II. LITERATURE SURVEY

• Onion Post-Harvest Challenges: Numerous studies emphasize the challenges associated with onion storage, including vulnerability to moisture, temperature fluctuations, and humidity levels. Research has highlighted the impact of these factors on onion quality and shelf life.

• Traditional Storage Methods: Literature also documents traditional storage practices, such as drying, curing, and ventilated storage rooms. These methods have been practiced for generations but are limited by their inability to provide real-time insights into the storage environment.

• IoT in Agriculture: A significant body of literature explores the applications of IoT in agriculture. IoT has been employed in monitoring soil conditions, crop growth, and pest control. However, there is limited research on its application in onion storage.

• Sensor Technologies: The literature reveals various sensor technologies used in agricultural applications. For onion storage, sensors measuring temperature, humidity, and moisture levels are crucial. These sensors can be integrated into IoT systems.

• Cloud-Based Monitoring: The adoption of cloud-based data storage and processing for agricultural monitoring has gained attention. The scalability, accessibility, and real-time capabilities of cloud platforms have advantages for onion storage.

Data Processing and Analytics: Research has shown the importance of data processing and analytics for identifying trends and anomalies in agricultural data. Machine learning and predictive analytics can enhance the effectiveness of monitoring systems.

Technological Survey

• IoT Sensors: Various sensor types are available for monitoring environmental conditions. These include temperature sensors, humidity sensors, and moisture sensors. Advancements in sensor technology have improved accuracy and reliability.

• Gateway Devices: Gateways are essential for collecting data from sensors and transmitting it to the cloud. They come in various forms, such as IoT gateways and edge computing devices, and may offer features like data preprocessing.

• Cloud Platforms: Leading cloud service providers, such as Amazon Web Services (AWS), Microsoft Azure, and Google Cloud, offer IoT and data storage solutions. These platforms facilitate data storage, processing, and real-time analysis.

• Data Processing Tools: For data processing and analytics, tools like Python, R, and specialized agricultural analytics software can be used. Machine learning libraries and algorithms enable the development of predictive models.

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• User Interfaces: User interfaces can be web-based applications or mobile apps, enabling users to access real time data, set alerts, and receive recommendations. Development frameworks like React and Flutter are commonly used for user interface design.

Communication Protocols: IoT devices communicate using various protocols, including MQTT, CoAP, and HTTP. The choice of protocol affects data transmission efficiency and security.

• Security Measures: Data security is crucial in IoT applications. Technologies such as SSL/TLS encryption, device authentication, and network security protocols are employed to protect data integrity and privacy. The literature and technological survey informs the development and implementation of the IoT-based onion storage monitoring system. By leveraging existing knowledge and technologies, this project aims to address the post-harvest challenges of onions and enhance their storage management

1. Vinit Kumar Gunjan explained Wireless System for Onion Storage condition Detection and reporting using Temperature sensor and GPS. In this paper, Gas sensor is used to detect the ammonia. In case of its presence, the system sends automated message to the preprogrammed number such as family member and even display the container temperature.

2. The slot of onion gets detected and is informed the same to the owner. The authors used both humidity and temperature sensor for capturing such incidents. Based on the situation detected during the humidity sensor gathers the information and sends to the micro controller. The suggested method provides optimum solution and time required for completing the overall process is very less. But the onion must be removed immediately by the farmer to avoid any further loss to his onion yield.

3. Designed an onion rotting prevention system based on the microcontroller. The webpage address and configuration file of the paired devices is stored in the ROM embedded in the microcontroller. With the help of method, emergency alerts can be sending at the correct time. Depending upon the microcontroller and GSM module used, the accuracy of message to reach the farmer is based on whether the farmer's device is connected to the GSM network or not.

4. Used the integrated system to provide the alert information about the incident through the GSM module and Webpage. Based on the gas sensor, it will alert the onion is starting to rot. The alert message is send to the registered user via through the wifi and the rack in which the onion is located is given to the user.

III. SYSTEM DESIGN

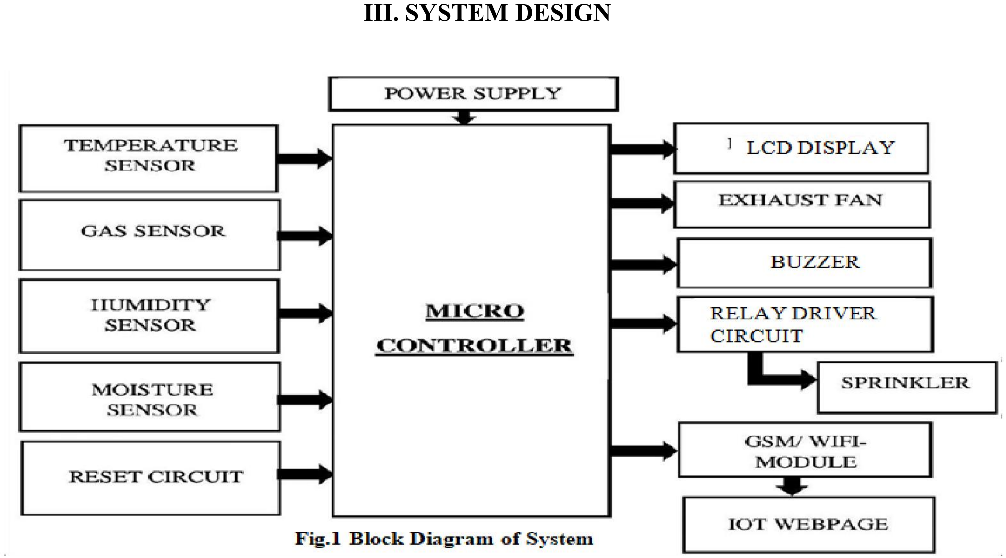

Fig. 1. Block Diagram

Onion harvesting detection is done using Arduino, LM35 temperature sensor, humidity sensor, gas sensor, and GSM module. The objectives of this quality of onion using Arduino is to sense the ammonia gas, temperature, and humidity with the help of the LM35 temperature sensor, gas sensor MQ 137, and send SMS alerts to mobile numbers stored

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inside the Arduino program, if onion quality is selected using global system for mobile communication (GSM). This paper introduces an advanced system that will help the user to control such parameters affecting positive feedback against different onion losses.

• Shed net is used here because it improves the thermal behavior significantly decreasing the inside temperature. The system works on the principle of sensing emitted gases by onions and attempting to control them within the desired parameter range of temperature and so humidity and also gives an online record observation facility. In this novel methodology, a system is introduced, which is an IoT based food monitoring system.

• In this system, sensors related to food safety, like CO2, humidity, and nitrogen sensing elements are used, and IoT play an important role as it gives the alert to users at a remote location.

IV. METHODOLOGY

Component Description

A. ATmega328 Microcontroller(Arduino Uno)

The A microcontroller is a heart of every automation system. It is a small, low cost and self-contained on chip computer. Microcontrollers usually must have low-power requirements since many devices they control are battery-operated.

As per our requirements, microcontroller ATMEGA328P matches perfectly. Features of ATMEGA328P microcontroller are as follows:

Features:

• 28 pin IC with 20 GPIO pins
• Inbuilt 6 channel ADC
• 2kb SRAM, 1kb EEPROM
• 32 General purpose registers
• Works on 5V
• Low power Sleep mode
• Multiple software tool support

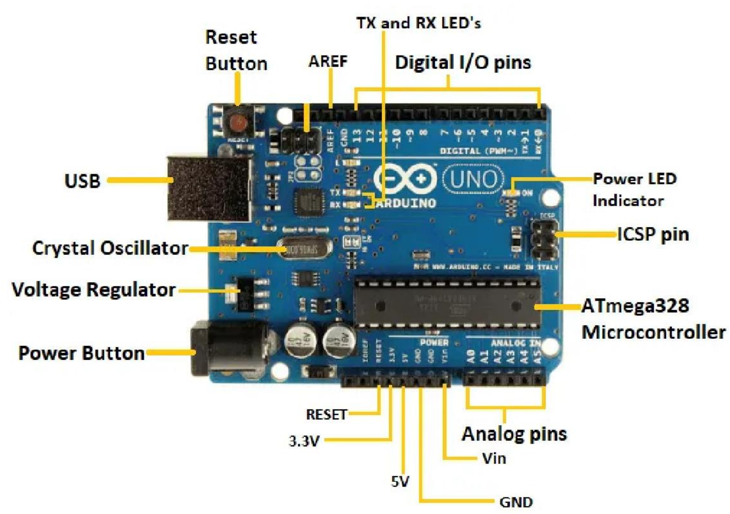

Fig. 2. Arduino Uno

B. GSM Module

Its great This GSM modem has a SIM800A chip and RS232 interface while enables easy connection with the computer or laptop using the USB to Serial connector or to the microcontroller using the RS232 to TTL converter. Once you

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connect the SIM800 modem using the USB to RS232 connector, you need to find the correct COM port from the Device Manger of the USB to Serial Adapter. Then you can open Putty or any other terminal software and open an connection to that COM port at 9600 baud rate, which is the default baud rate of this modem. Once a serial connection is open through the computer or your microcontroller you can start sending the AT commands. When you send AT commands for example: "AT\r" you should receive back a reply from the SIM800 modem saying "OK" or other response depending on the command send.

Fig. 3. GSM Module

C. DHT11 temp humidity sensor

This DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability. This sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a highperformance 8-bit microcontroller, offering excellent quality, fast response, anti-interference ability and cost-effectiveness. Each DHT11 element is strictly calibrated in the laboratory that is extremely accurate on humidity calibration. The calibration coefficients are stored as programmes in the OTP memory, which are used by the sensor's internal signal detecting process. The single-wire serial interface makes system integration quick and easy. Its small size, low power consumption and up-to-20 meter signal transmission making it the best choice for various applications, including those most demanding ones. The component is 4-pin single row pin package. It is convenient to connect.

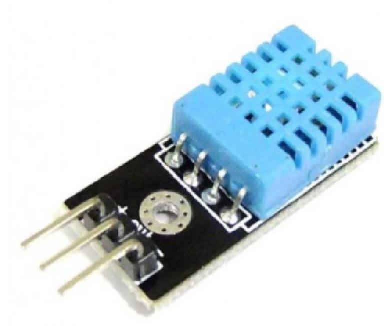

Fig. 4. DHT11 Sensor

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D. Moisture Sensor

This sensor measures the volumetric content of water inside the soil and gives us the moisture level as output. The sensor is equipped with both analog and digital output, so it can be used in both analog and digital mode. In this article, we are going to interface the sensor in both modes.

Specification:

Input Voltage 3.3 – 5V

Output Voltage 0 – 4.2V

Input Current 35mA

Output Signal Both Analog and Digital

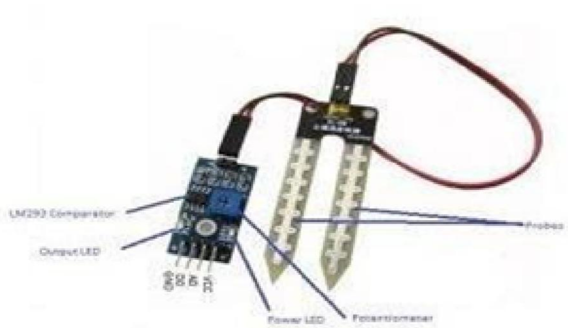

Fig. 5. Moisture Sensor Sensor

E. Gas Sensor

MQ135 is an air quality or air pollution measuring sensor device. It can detect various chemical contents in air and give appropriate voltage variation at the output pin depending on the chemical concentration in air. It can detect the presence of ammonia(NH3),alcohol, Benzene, smoke, NH3, butane, propane etc. if anyone of the stated chemical concentration rises, the sensor convert the chemical concentration in air to appropriate voltage range, which can be processed by Arduino or any microcontroller. It cannot tell what kind of chemical concentration rose in the air.

Fig. 6. MQ135 Gas Sensor

V. CONCLUSION

Our project onion warehouse monitoring system is useful to store onions that long life which are under harvest and prevent the storage losses inside the warehouse. With the help of this system, onions can be preserved for up to 8 to 10 months preventing the onions get rottenstone onions which shows water contact, change in gas levels and temperature changes the system if found any set of onion about to rot it will alert the rotting problem to the onion to the owner. The owner after being intimated will check the segment number in which the onions are rotting and try to empty that set of onions first. So basically, this project helps to sell the near rotting batch of onions which helps the owner into loss by

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rotten onions. Compared to the traditional method of storing onions this onion warehouse monitoring will have less loss of onions. Hence by this method, the losses can be controlled to the maximum extent.

The other advantage of this product is it is used for analysis purposes the sensor values that is the gas levels and temperature, humidity values are being updated in the cloud (Thing speak) frequently. The owner can check the cloud for analysis purposes like in which year how much is the loss percentage. After analysis of losses, the owner can perform necessary advancements to the warehouse to prevent the losses which will be an added advantage to continuously update the method for more benefits to the owner and with minimized loss of onions.

VI. FUTURE SCOPE

This system can be interfaced with automated machine that can separate the rotting onion from the container to prevent any further damage, immediately. This can also be developed by interconnecting a prosthetic arm to the controller module that can clasp the onion and remove it without any human intervention.

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