Smart Onion Storage System

Present By

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PROBLEM STATEMENT

Develop and design a product which can control the humidity and temperature of onion, enabling farmers to store onions for a year.

OBJECTIVES

- Minimize post-harvest losses by effectively controlling environmental factors.
- Monitor and regulate key parameters such as temperature, humidity, ammonia (NH3), and carbon dioxide (CO2) levels using sensors.
- Improve onion storage conditions to reduce wastage and spoilage.
- Enhance profitability for farmers and the nation by preserving onion quality during storage.

BACKGROUND AND MOTIVATION

- **India's Onion Production**: India is the world's second-largest producer of onions, making it a vital commercial crop with significant economic impact.
- **High Wastage**: Between 60% to 75% of onion production is wasted due to poor storage conditions, causing severe financial losses for farmers and the nation.
- **Climatic Vulnerability**: Onions stored in traditional sheds face spoilage from fluctuating climate conditions, with key factors like temperature, humidity, and gas concentrations (ammonia and CO2) affecting their quality.
- **Need for Improved Storage Systems**: The substantial post-harvest losses of onions highlight the urgent need for better storage solutions. Improving storage conditions could reduce wastage, thereby boosting profitability for farmers and contributing to the national economy.
- **Technological Intervention**: The proposed system aims to leverage technology, specifically sensors and IoT, to monitor and control environmental parameters within onion storage facilities. This approach seeks to maintain optimal conditions that prevent spoilage and extend the shelf life of onions.

LITERATURE SURVEY

- **Study on Onion Storage in Rajasthan's Jhunjunu District:** 54.66% of onions are stored at the farm level, with 14.68% losses during storage, but a 34.24% return due to market shortages, showing a 9.98% average profit over six months. Despite improved storage methods, there are still knowledge gaps.**(Reference Paper No.1)**
- **Smart Onion Storage System:** Utilizes sensors to detect gases, regulate temperature and humidity, and offers remote access to improve product quality and reduce losses.(**Reference Paper No.4)**
- **Paper on IoT in Onion Storage:** Highlights how real-time monitoring can enhance crop yield but notes challenges such as costs and maintenance, with a research gap in long-term IoT effectiveness. (**Reference Paper No.2)**
- **Impact of Climate on Onion Cultivation in India:** Uses an IoT-based system to monitor and provide alerts, aiding farmers in optimizing conditions and reducing crop failures caused by climate variations. **(Reference Paper No.11)**

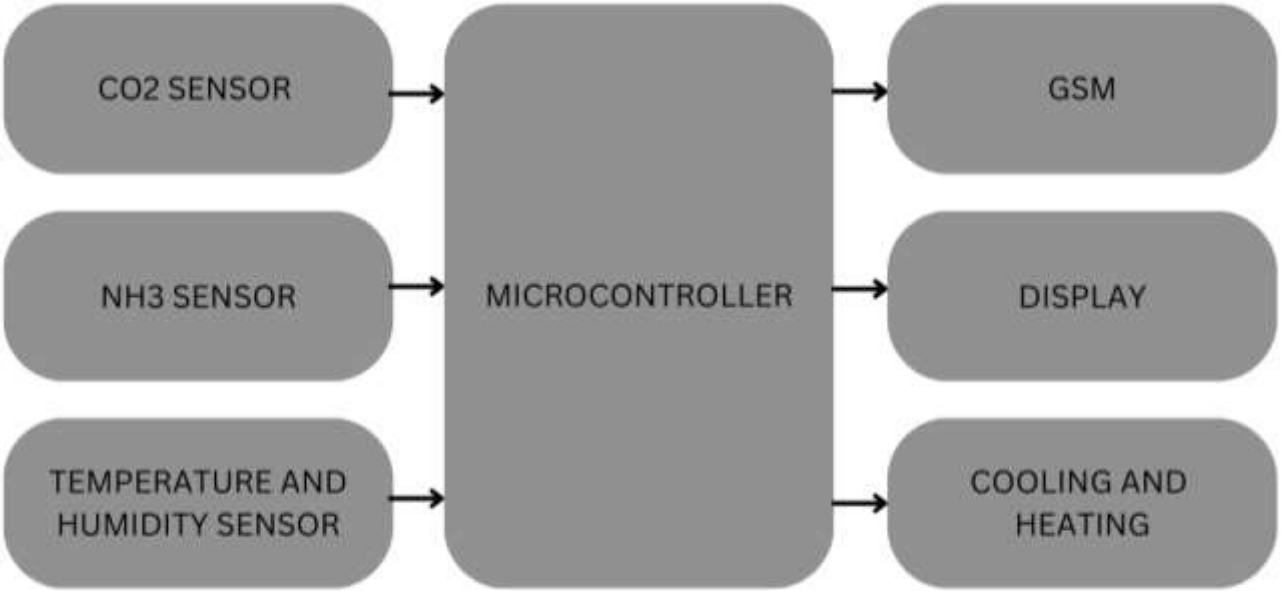
METHODOLOGY

- **Components**: The system includes a CO2 Sensor, NH3 Sensor, Temperature and Humidity Sensor, GSM Module, and LCD Display.
- **Principle of Operation**: Responds to variations in NH3, CO2, humidity, and temperature by providing active audio-visual feedback to users.
- **Design Elements**: Features ventilation and roofing sheets to regulate temperature and humidity levels within the shed.
- **Mitigation of Issues**: Maintains temperature between 30°C and 40°C and humidity at approximately 75% to 80% to prevent issues such as rotting, weight loss, rooting, and sprouting of onions.

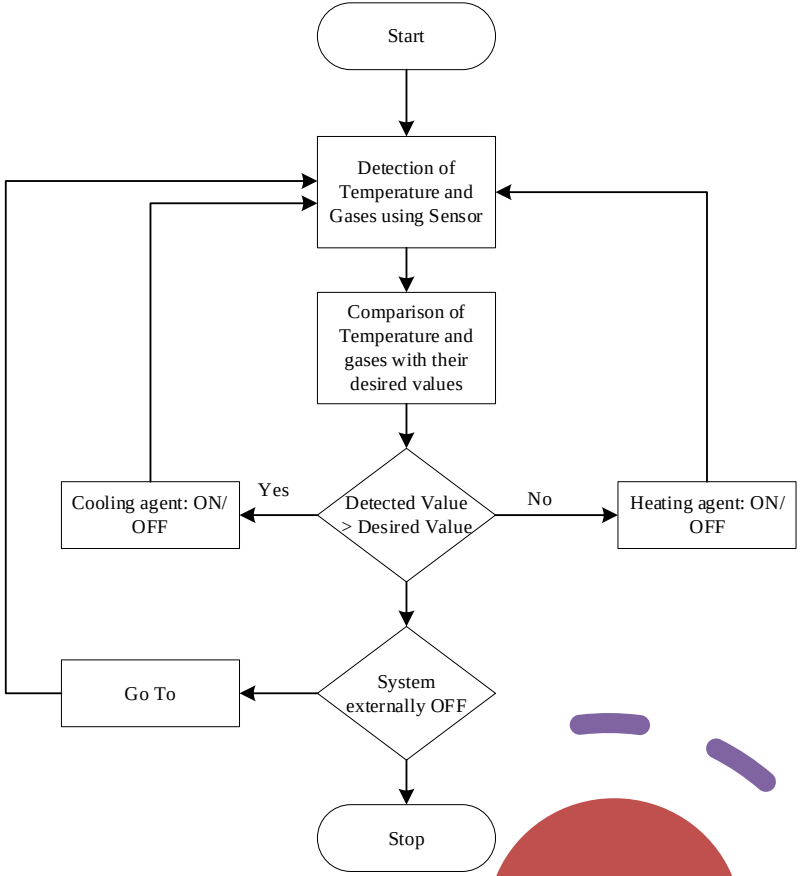
METHODOLOGY

- **Temperature Regulation**: Uses green netting and stepped-up roofing sheets to keep the shed 2°C to 4°C cooler than the external environment.
- **Monitoring and Control**: Incorporates sensors, actuators, microcontrollers, and GSM technology for comprehensive monitoring and control.
- **Wireless Reporting**: Provides real-time and one-time wireless reporting capabilities for precise temperature control and enhanced efficiency.
- **Ventilation Systems**: Efficient ventilation systems help in creating optimal storage conditions for onions.

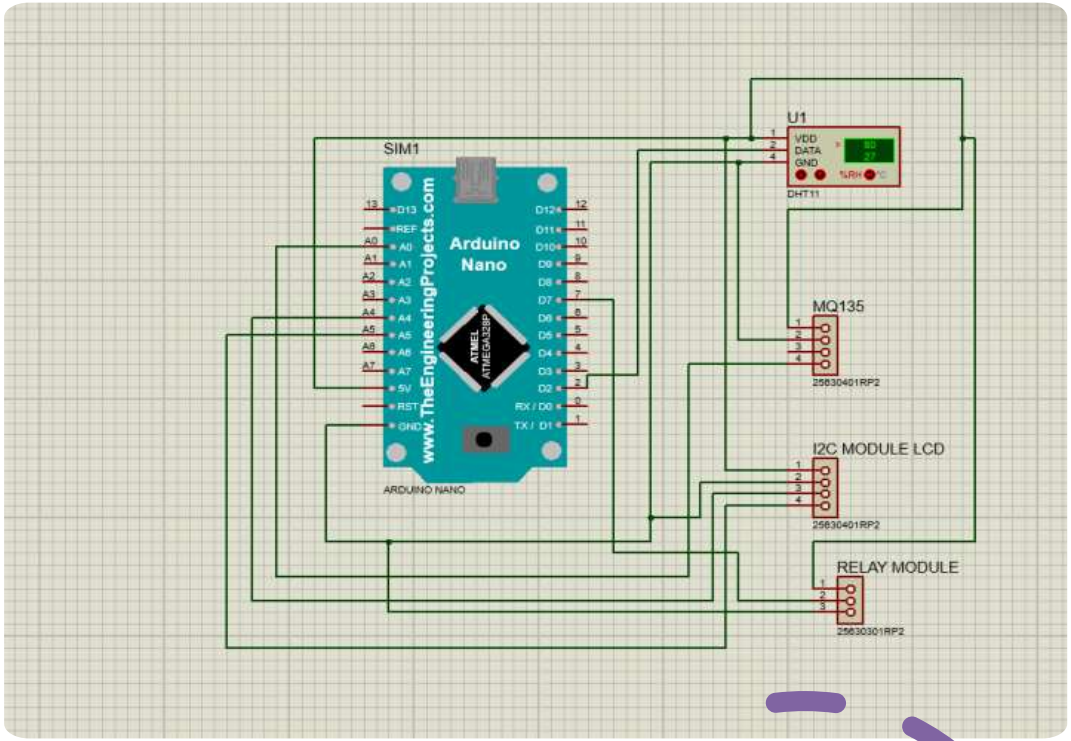
Block Diagram



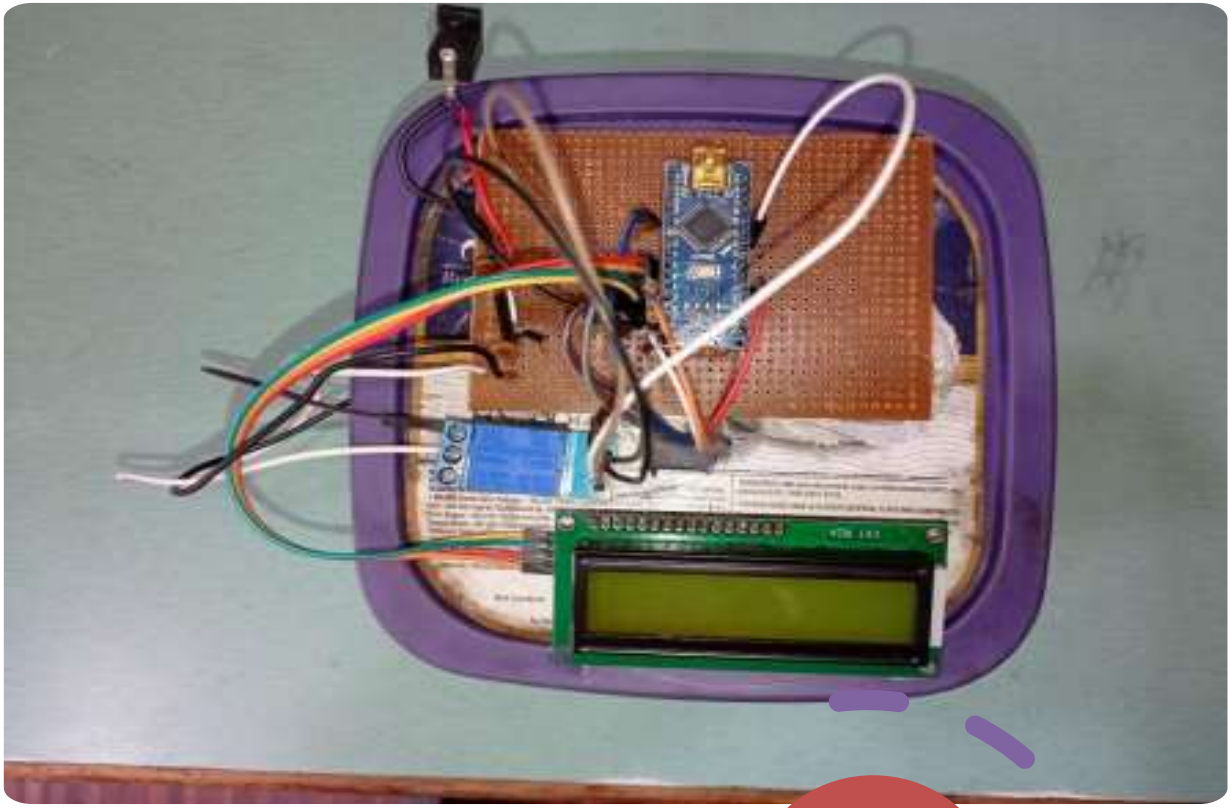
Flowchart


Start
Detection of Temperature and Gases using Sensor
Comparison of Temperature and gases with their desired values
Detected Value > Desired Value
Yes
No
Cooling agent: ON/ OFF
Heating agent: ON/ OFF
System externally OFF
Go To
Stop

Circuit Diagram



Prototype



SOFTWARE & HARDWARE DETAILS

Software Requirement :

- Proteus
- Arduino IDE

Hardware Requirement :

- Arduino Nano
- Sensor – DHT11 Sensor, MQ-135 Sensor, NH3 Sensor
- 16x2 LCD Display
- GSM Module
- Relay Module

Advantages and Limitation

Advantages:

- Extended Shelf Life: These systems often regulate temperature and humidity levels to help onions stay fresh longer, reducing spoilage and food waste.
- Optimized Conditions: They provide precise control over the storage environment, ensuring onions are kept at the ideal conditions, which can vary for different types of onions.
- Efficiency: Smart systems can be energy-efficient, using sensors and automation to adjust conditions only when necessary, saving energy costs.
- Remote Monitoring: Many smart storage systems allow remote monitoring and control, making it easier to manage storage conditions and receive alerts for any issues
- Reduced Labor: Automation can reduce the labor required for manual monitoring and adjustments, saving time and labor costs.

Limitations:

- Initial Investment Cost: Implementing the smart storage system can be costly, as it requires the purchase and installation of specialized sensors, monitoring equipment, and software. Small-scale farmers or businesses with limited budgets may find it challenging to adopt this technology.
- Maintenance Complexity: The system's sensors and monitoring equipment require regular maintenance and calibration to ensure accuracy. This maintenance can be time-consuming and may require specialized technical knowledge, potentially posing challenges for some users.
- Power Dependency: Smart storage systems typically rely on electricity to operate sensors and maintain a controlled environment. In regions with unreliable power sources, power outages may compromise the system's effectiveness.

Conclusion

1.Enhanced Preservation Efficiency:

- The utilization of gas emission detection technology has significantly improved the efficiency of onion preservation, enabled the accurate prediction of onion health status and facilitating timely interventions to prevent potential losses.

2.Real-Time Monitoring and Control:

- The implementation of wireless reporting mechanisms has allowed for real-time monitoring of onion health, ensuring immediate actions, particularly in controlling temperature and humidity, to maintain optimal storage conditions and minimize post-harvest losses.

3.Extended Shelf Life:

- Leveraging the system's capabilities has resulted in the successful preservation of onions for an extended duration of 11 to 13 months, contributing to the sustainability of the agricultural sector and ensuring a stable food supply.

4.Impact on Agricultural Sustainability:

- The innovative preservation system has not only revolutionized onion preservation techniques but has also played a crucial role in preserving India's rich agricultural heritage, promoting sustainable practices for the future generations and contributing to the long-term food security of the nation.

Future scope

- **Expansion to Other Crops**: While the current system is designed for onions, the technology could be adapted to store other perishable crops, allowing for broader applications in agriculture.
- **Data Analytics for Predictive Maintenance**: By analyzing the data collected over time, predictive maintenance of the storage systems could be implemented to prevent failures and optimize performance.
- **IoT-Enabled Solar Monitoring:** Solar panels could be integrated with IoT devices to monitor their performance, energy production, and efficiency in real-time, allowing for predictive maintenance and optimizing storage conditions.
- **Enhanced IoT Capabilities**: Expanding the IoT capabilities of the system, such as remote monitoring and control through mobile devices, would provide farmers with greater flexibility and real-time insights into storage conditions.

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