IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 9, June 2026
Impact Factor: 8.2

Automation of Onion Storage and Monitoring System Using PLC

Mr. S. S. Pandharkar[1], Asmita Bhagwat[2], Aditya Behale[3], Pranjali Lokhande[4]
Department of Automation and Robotics[1-4]
Pravara Rural Engineering College Loni, Maharashtra, India
adityabehale2004@gmail.com, pranjalilokhande32@gmail.com

Abstract: *This paper presents the design and development of anautomated onion storage and monitoring system using a programmable logic controller (PLC) and Arduino. Proper storage of onions is very important to reduce post-harvest losses, as onions are highly sensitive to environmental conditions such as temperature, humidity, and harmful gases. In traditional storage systems, the absence of continuous monitoring and control leads to spoilage, sprouting, and quality degradation. To overcome these challenges, the system uses sensors like DHT22 and MQ135 to continuously monitor temperature, humidity, and gas inside the storage unit. An Arduino Microcontroller collects the data and processes it, which acts as an interface between sensors and the PLC. For real-time monitoring and easy visualisation of storage conditions the system uses a SCADA interface, which helps operators to track performance and respond accordingly. Proper airflow inside the storage unit is ensured by hardware design, which helps to detect excess heat, harmful gases and moisture. Overall, the system reduces manual efforts, improves storage efficiency and minimises onion spoilage. The system is reliable and cost-effective for both small and large-scale applications.*

Keywords: PLC, Arduino, Onion Storage, DHT22 sensor, MQ135 Sensors, Environmental conditions, SCADA interface

I. INTRODUCTION

Onion is one of the primary drivers of an indian agricultural economy because India is one of the largest onion-producing countries. Due to its year-round demand, maintaining consistent availability of onions and an uninterrupted supply chain is critical for market stability. Hence, onion producers suffer from post-harvest losses primarily driven by inadequate and substandard storage infrastructure. As the crop is highly sensitive to its immediate microclimate, sustaining onion quality over extended post-harvest periods presents significant technical challenges. Localised gas concentrations, ambient temperature, and relative humidity are the primary determinants of storage longevity. The accumulation of metabolic gases, such as carbon dioxide and Ammonia, drastically accelerates tissue decay within confined storage spaces.

Traditional storage methods mainly depend on ambient ventilation and manual inspections. Farmers usually store onions in open-air structures without any proper control systems. Environmental conditions keep changing and cannot be monitored continuously, so these methods are not efficient. Manual inspections often fail to detect problems at an early stage and are time-consuming, resulting in large losses. To minimise these losses, integrating modern automation into agricultural post-harvest management has become necessary. Modern industrial systems utilising Programmable Logic Controller and Supervisory Control and Data Acquisition System offer a robust mechanism for continuous environmental regulation. The real-time data is synthesised from humidity, temperature and gas sensors; these automated systems modulate corrective hardware, including a bulb, an exhaust fan and ventilation extensions. This reduces manual efforts, minimises losses, and provides a reliable and scalable solution for storage systems.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 9, June 2026
Impact Factor: 8.2

II. PROBLEM DEFINITION

Conventional onion storage methods mainly depend on basic ventilation and manual supervision, which are not sufficient to maintain stable humidity and temperature conditions. As a result, onions are often exposed to unfavourable environments that cause moisture buildup, quality deterioration and decay. The lack of continuous monitoring and immediate control further increases the risk of losses. In addition, manual handling reduces consistency and efficiency in storage management. Therefore, to monitor such environmental conditions in real time and regulate them effectively, an advanced automated system is required. Implementing such a system can reduce losses, improve storage performance, and ensure better preservation of onions.

Aim:

To design and develop an automated onion storage and monitoring system using a PLC that ensures efficient control of temperature and humidity, reduces post-harvest losses, and improves storage conditions in agricultural environments.

Objectives:

1. To identify the limitations of existing onion storage methods and analyse their effectiveness in terms of environmental control, storage efficiency, and post-harvest losses.
2. To design a PLC-based automated system that ensures accurate and continuous monitoring of temperature and humidity in the storage environment.
3. To integrate sensor-based monitoring and automatic ventilation control into a single system for efficient and reliable storage management.
4. To develop an intelligent control system that automatically operates fans based on real-time environmental conditions to maintain optimal storage conditions.

III. LITERATURE SURVEY

1. Sharma et al. (2020): Studied temperature-controlled storage systems. Found that proper temperature reduces spoilage and increases shelf life. Emphasised controlled environments over traditional storage.
2. Patil et al. (2021): Worked on PLC-based automation systems. Concluded that PLC provides accurate, reliable, and real-time control, reducing human error and improving efficiency.
3. Singh et al. (2022): Developed an IoT-based monitoring system using sensors. Enabled continuous monitoring of temperature and humidity with improved decision-making.
4. Kumar et al. (2023): Focused on humidity control. Found that high humidity causes fungal growth. Implemented automated ventilation to reduce spoilage.
5. Gupta et al. (2022): Designed a sensor-based warehouse monitoring system. Provided continuous feedback and automatic control, reducing storage losses.
6. Verma et al. (2021): Studied ventilation systems. Concluded proper airflow prevents heat and moisture buildup. Mechanical ventilation is more effective.
7. Rao et al. (2023): Explored SCADA systems. Found that real-time monitoring, visualisation, and fault detection improve system efficiency.
8. Jain et al. (2022): Developed a sensor-based automation system. Reduced manual effort and improved operational consistency.

IV. METHODOLOGY

Components :

01 – DHT22

Specification: Measures humidity (60–70%) and temperature (25–30°C). Quantity: 3

02 – MQ135

DOI: 10.48175/IJARSCT-37126

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 9, June 2026
Impact Factor: 8.2

Specification: Detects gases like ammonia, CO_2, and other harmful gases.
Quantity: 3
03 – Arduino Uno
Specification: A microcontroller board operating at 5V, used for reading and processing sensor data.
Quantity: 1
04 – SMPS
Specification: Converts 230V AC input into a regulated DC output of 5V or 24V for system components. Quantity: 1
05 – MCB
Specification: An electrical protection device that prevents overload and short-circuit faults. Quantity: 1
06 – Relay (5V)
Specification: An electrically operated switch controlled by a 5V signal to operate low-power circuits. Quantity: 4
07 – Relay (24V)
Specification: A switching device operated by a 24V signal to control high-power loads. Quantity: 1
08 – PLC
Specification: An industrial controller used for automation and real-time control of system operations. Quantity: 1
09 – PWM to 0–10V Converter Module
Specification: Converts a PWM input signal (0–5V) into a proportional analog output of 0–10V DC. Quantity: 6
10 – Fan
Specification: An electrical device used to circulate air and control temperature inside storage. Quantity: 1
11 – Indicating Lamp
Specification: Turns ON when gas is detected. Quantity: 3

System Flow :
Power Input ➜ Sensor Detection ➜ Data Processing ➜ PLC Control ➜ Relay Operation ➜ Environmental Control ➜ **Final Output**

1. Power Input:
The system starts when power is given to the setup. MCB protects the system from electrical faults. SMPS converts the power into the required voltage for components.
2. Sensor Detection:
Sensors detect temperature, humidity, and gas levels. They continuously monitor the storage environment. The sensed data is sent to the controller for further action.
3. Data Processing:
Arduino receives the data from sensors. It processes and prepares the data for control. Then it sends the information to the PLC.
4. PLC Control:
An Arduino sends the processed data to the PLC, and it compares the values with preset conditions. Based on this, it decides whether action is needed or not.
5. Relay Operation:
The relay module gets a signal from the PLC, which acts like a switch for electrical devices. It helps to turn the connected components ON or OFF.
6. Environmental Control:
To reduce temperature and maintain airflow, the Fan is used. The bulb works when the temperature becomes low, and the harmful gases are detected by the red indicating lamp.

7. Final Output:
Onion spoilage is effectively reduced. Without manual effort, the system works automatically by maintaining proper environmental conditions.

Block Diagram :

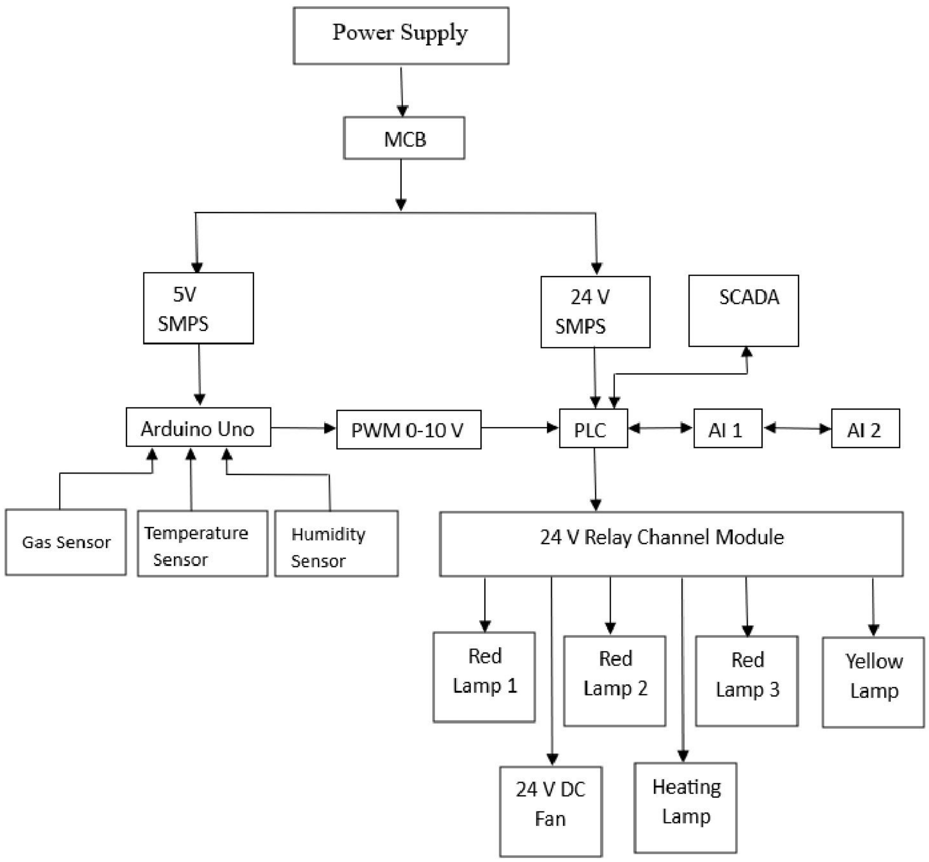

Fig. 1: System Diagram

V. WORKING PRINCIPLE

Working of the Model :

Fig. 2 shows an onion storage system developed as a cylindrical structure designed to ensure proper ventilation and controlled environmental conditions for stored onions. To move air freely in all directions, the storage unit is made using a mesh or perforated cylindrical enclosure. To prevent the accumulation of heat and moisture, this system helps in maintaining uniform conditions inside the storage, which are the main causes of onion spoilage. A vertical perforated PVC pipe is installed at the centre of the structure, which plays the role of an air distribution channel. To supply air evenly distributed throughout the storage volume, the pipe contains multiple holes along its length.
Fig. 3 shows that the fan is mounted at the top of the structure for ventilation, which plays a major role in maintaining airflow inside the storage system. To allow uniform distribution of air around all stored onions, the fan operates and

pushes or circulates air through the central perforated pipe. This continuous airflow helps in controlling humidity levels and temperature inside the storage and improves the overall shelf life of the onions.

Fig.4 shows that the monitor environmental conditions, temperature and humidity, DHT22 sensors are placed inside the storage unit at appropriate positions. These sensors continuously measure real-time values of humidity and temperature, and it sends the data to the PLC system. The PLC acts as the main control unit of the system and continuously compares the received sensor values against predefined threshold limits. When the temperature or humidity rises above the set limit, the PLC automatically activates the ventilation fan to bring the conditions back to normal. The PLC switches OFF the fan to save energy and ensure efficient operation once the required environmental conditions are achieved. This system eliminates the need for manual monitoring and operation.

Fig. 5 shows that the SCADA software is used to monitor and control the entire system, which provides a graphical interface for real-time visualisation of temperature, humidity, and fan status. It allows the operator to take manual control if required and to monitor system performance.

Overall, this working model ensures proper airflow, continuous environmental monitoring, and automatic control using PLC and SCADA, thereby reducing post-harvest losses and increasing the storage life of onions. Also, this system provides an efficient and low-cost automated solution for onion storage management.

Fig. 2: Onion Storage Structure

Fig. 4: Fan Mounting

Fig. 3: Sensor Mounting

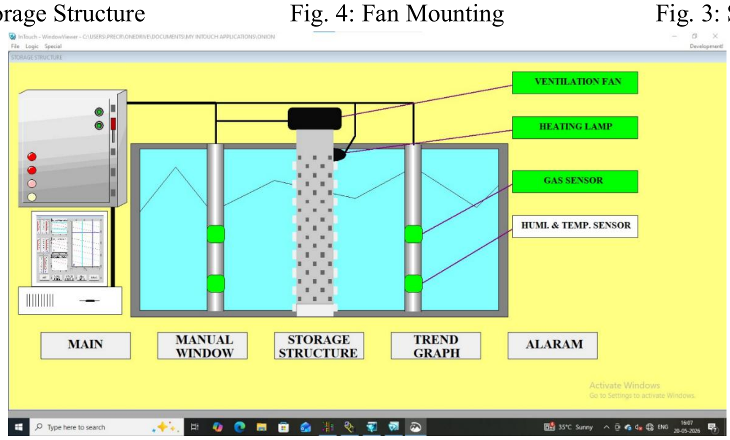

Fig. 5: SCADA Design

DOI: 10.48175/IJARSCT-37126

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 9, June 2026
Impact Factor: 8.2

VI. RESULT

The implemented onion storage system based on PLC and SCADA was successfully tested under real-time conditions and showed satisfactory performance in maintaining the required storage environment. The system continuously monitored temperature and humidity inside the storage unit using sensors, and the data was accurately processed by the PLC. It was observed that the control system responded immediately whenever the environmental conditions crossed the preset limits.

During operation, when the temperature or humidity increased beyond the defined range, the ventilation fan was automatically switched ON, allowing fresh air circulation through the perforated pipe system. This helped in restoring normal storage conditions effectively. Once the parameters returned to safe levels, the fan was turned OFF automatically, confirming proper functioning of the control logic and energy-saving operation.

Fig. 6 shows the SCADA Trend Graph window, which displays real-time temperature and humidity data collected from sensors. Temperature and humidity values are shown through indicators and trend graphs. The system also calculates and displays average temperature and humidity values. These graphs help the operator monitor environmental conditions, observe changes over time, and detect abnormal conditions easily. The navigation buttons provide access to different SCADA screens such as Main, Manual, Storage, Trend Graph, and Alarm.

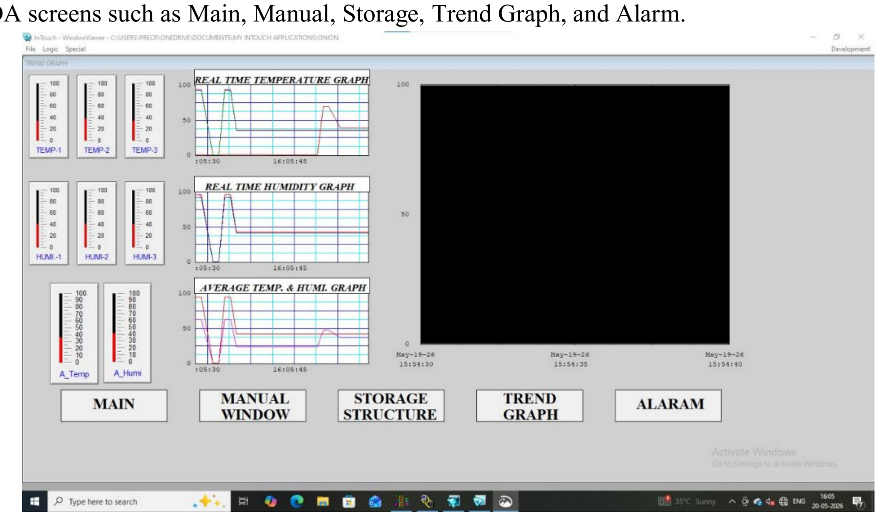

Fig. 6: SCADA Monitoring

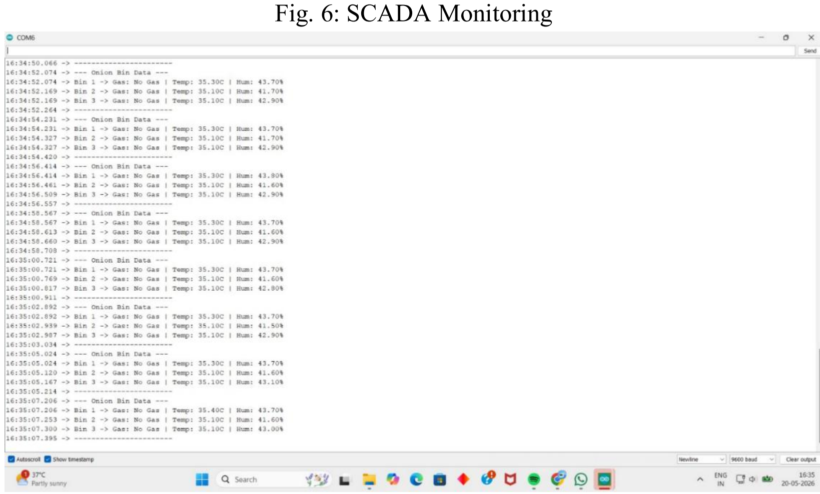

Fig. 7: Serial Monitor Output

The overall performance of the system proved that the model is reliable, efficient, and suitable for practical application in onion storage. It effectively reduces spoilage, improves storage conditions, and minimises the need for manual intervention.

VII. CONCLUSION

The designed onion storage system based on PLC and SCADA successfully achieves controlled storage conditions by maintaining proper temperature and humidity inside the structure. The model ensures that environmental parameters are continuously monitored and regulated in an automated manner, reducing the need for manual supervision. The integration of sensors with the PLC allows accurate real-time monitoring, while the control logic ensures automatic operation of the ventilation fan whenever required. This helps in maintaining stable conditions inside the storage unit and prevents spoilage caused by excess moisture or heat. The SCADA system provides effective visualisation of all process parameters, making the system easy to monitor and operate. The cylindrical perforated design with a central air distribution pipe ensures uniform airflow throughout the storage area, which improves overall storage efficiency. The system also supports energy saving by operating the fan only when environmental conditions exceed the set limits.

In conclusion, the proposed system is a practical and efficient approach for onion storage. It enhances storage quality, reduces losses, and demonstrates the effective use of automation in agricultural applications.

ACKNOWLEDGEMENTS

We would like to express our deep gratitude to Pravara Rural Engineering College, Loni, and the Department of Automation and Robotics Engineering for providing us with the opportunity to undertake and complete our project titled “Automation of onion storage and monitoring system using PLC”

First and foremost, we are sincerely thankful to Mr S.S. Pandharkar, our project guide, for her valuable guidance, constant support, and encouragement throughout the development of this project. Her insightful suggestions, technical expertise, and constructive feedback played a crucial role in improving the quality and completion of our work.

We are also grateful to Dr L. B. Abhang, Head of the Department of Automation and Robotics Engineering, for providing us with the necessary facilities, laboratory resources, and a supportive environment to carry out this project successfully.

We would like to extend our heartfelt thanks to all the faculty members and supporting staff of the department for their timely help and cooperation during various stages of the project development.

Finally, we express our sincere gratitude to our parents, friends, and classmates for their continuous encouragement, moral support, and motivation throughout this endeavour.

REFERENCES

[1] Frank D. Petruzella, Programmable Logic Controllers, McGraw-Hill Education.

[2] John W.Webb and Ronald A.Reis, Programmable Logic Controllers: Principles and Applications, Pearson Education.

[3] Stuart A. Boyer, SCADA: Supervisory Control and Data Acquisition, ISA (International Society of Automation).

[4] W. Bolton, Programmable Logic Controllers, Newnes (Elsevier).

[5] D. Patranabis, Sensors and Transducers, Prentice Hall of India.

[6] FAO (Food and Agriculture Organisation), Manual on Post-Harvest Handling and Storage of Onions, United Nations.

[7] Indian Council of Agricultural Research (ICAR), Guidelines for Storage and Preservation of Onion and Other Bulb Crops, Government of India publications.

[8] Research articles on controlled atmosphere storage and post-harvest loss reduction in onions published in the International Journal of Agriculture Engineering and Agricultural Engineering Today.