

# Smart Poly House Farming Using Iot and Artificial Intelligence

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doi.org/10.64643/IJRTV12I11-201422-459

**Abstract**—Smart polyhouse farming is an advanced agricultural approach that integrates modern technologies such as the Internet of Things and Artificial Intelligence to enhance crop production and resource efficiency. Traditional farming methods often face challenges like unpredictable weather conditions, inefficient irrigation, and lack of real-time monitoring. This project proposes an intelligent polyhouse system that automates environmental control and improves decision-making. The system utilizes IoT sensors to continuously monitor critical parameters such as temperature, humidity, soil moisture, light intensity, and carbon dioxide levels. The collected data is analyzed using AI algorithms to predict crop requirements and optimize growing conditions. Based on this analysis, automated actions such as irrigation, ventilation, and lighting control are performed. This smart system reduces human intervention, conserves water and energy, and increases crop yield and quality. It also enables farmers to monitor and control the polyhouse remotely through mobile or web applications. Overall, the integration of IoT and AI in polyhouse farming ensures sustainable agriculture, improved productivity, and efficient resource management.

## I. INTRODUCTION

Agriculture plays a vital role in the economic development of many countries, especially in regions like India. However, traditional farming practices are increasingly affected by climate change, water scarcity, and labor shortages. To overcome these challenges, modern farming techniques such as polyhouse cultivation have been introduced. A polyhouse is a controlled environment structure that allows crops to grow under optimal conditions by regulating temperature, humidity, and light. While polyhouse farming offers significant advantages, manual monitoring and control can be inefficient and time-consuming. This is where technologies like the

Internet of Things and Artificial Intelligence play a crucial role. IoT enables real-time data collection through sensors installed inside the polyhouse, providing accurate information about environmental conditions. AI processes this data to make intelligent decisions, such as predicting irrigation needs, detecting plant diseases, and optimizing resource usage. Together, these technologies create an automated and smart farming system. The main objective of this project is to develop a smart polyhouse system that enhances crop productivity while minimizing resource wastage. By leveraging IoT and AI, farmers can achieve higher efficiency, reduce operational costs, and ensure sustainable agricultural practices. This system represents a significant step towards the future of precision agriculture.

## II. SYSTEM ARCHITECTURE

Sensing:

Soil moisture sensors for irrigation control, DHT11/DHT22 sensors for temperature and humidity monitoring, LDR sensors for light intensity detection, and CO<sub>2</sub> sensors for air quality tracking. These sensors continuously collect environmental data inside the polyhouse using the Internet of Things.

Control & Protection:

Relay modules are used to automatically control and protect devices like water pumps, fans, and lights. They ensure safe switching and automatic disconnection during abnormal conditions such as overwatering or overheating.

Microcontroller:

ESP32 / Arduino board is used for processing sensor data, executing control logic, and communicating with

the cloud. It acts as the central unit of the system. — Processing (AI System): Artificial Intelligence is used to analyze sensor data, predict crop requirements, and make intelligent decisions such as when to irrigate or adjust temperature.

### III. METHODOLOGY AND IMPLEMENTATION

Sensors collect data like temperature, humidity, soil moisture, and light using the Internet of Things. The data is sent to a microcontroller and uploaded to the cloud. Artificial Intelligence analyzes the data and decides actions such as irrigation and temperature control. The system then automatically controls devices like pumps, fans, and lights. Implementation Sensors are connected to an ESP32/Arduino microcontroller.

The system sends data to the cloud and processes it using AI. Based on the results, relay modules control actuators like water pumps, fans, and lights. Users can monitor and control the system through a mobile app.

### IV. PARAMETER ESTIMATION

Parameter estimation is the process of determining optimal values for temperature, humidity, soil moisture, light intensity, and CO<sub>2</sub> levels using sensor data collected through the Internet of Things; these values are analyzed and adjusted with the help of Artificial Intelligence to maintain ideal conditions for crop growth and maximize yield.

### V. LITERATURE REVIEW

Recent advancements in agriculture focus on improving productivity and sustainability through smart technologies. The integration of the Internet of Things and Artificial Intelligence has led to the development of precision farming systems, especially in controlled environments like polyhouses. Several studies have shown that IoT-based monitoring systems can effectively collect real-time data such as temperature, humidity, soil moisture, and light intensity. These systems use sensors and wireless communication to provide continuous updates, enabling farmers to make informed decisions.

Researchers have demonstrated that automated irrigation systems based on soil moisture sensors significantly reduce water wastage and improve crop health. In addition, AI techniques such as machine learning and data analytics have been widely used to analyze environmental data and predict crop requirements. Studies indicate that AI-based systems can optimize irrigation schedules, detect plant diseases at early stages, and improve overall yield. Predictive models help in maintaining ideal growing conditions by adjusting parameters dynamically. Some research also focuses on integrating cloud computing with IoT devices, allowing remote monitoring and control through mobile applications. This approach enhances accessibility and reduces manual labor.

Cloud platforms store large amounts of data, which can be further analyzed for long-term agricultural planning. Despite these advancements, certain challenges remain, such as high initial cost, complexity in implementation, and the need for reliable internet connectivity. However, continuous improvements in sensor technology, low-cost microcontrollers, and AI algorithms are making smart polyhouse systems more affordable and efficient. Overall, the literature suggests that combining IoT and AI in polyhouse farming can significantly increase productivity, reduce resource consumption, and support sustainable agriculture.

### VI. PARAMETER MONITORING

Parameter monitoring is a key function in smart polyhouse farming, where environmental conditions are continuously observed and controlled to ensure optimal crop growth. Using the Internet of Things, various sensors are deployed inside the polyhouse to measure important parameters such as temperature, humidity, soil moisture, light intensity, and carbon dioxide (CO<sub>2</sub>) levels in real time. Temperature and humidity are monitored using sensors like DHT11/DHT22 to maintain a suitable climate for plant growth. Soil moisture sensors help in determining the water content in the soil, ensuring that crops receive the right amount of irrigation without wastage. Light intensity is measured using LDR sensors to provide adequate lighting conditions, especially during low sunlight periods. CO<sub>2</sub> sensors track air quality, which directly affects photosynthesis

and plant productivity. The collected data is transmitted to a microcontroller and then uploaded to a cloud platform for storage and analysis. Artificial Intelligence processes this data to identify patterns, detect abnormalities, and predict future requirements. Based on this analysis, the system automatically controls actuators such as water pumps, fans, and lights to maintain optimal environmental conditions. Continuous monitoring also helps in early detection of unfavorable conditions, allowing timely corrective actions. Alerts and notifications are sent to the user through a mobile application, enabling remote supervision and control. This improves efficiency, reduces manual effort, and ensures better crop yield and quality. Overall, parameter monitoring plays a crucial role in achieving precision agriculture by maintaining a balanced and controlled environment inside the polyhouse.

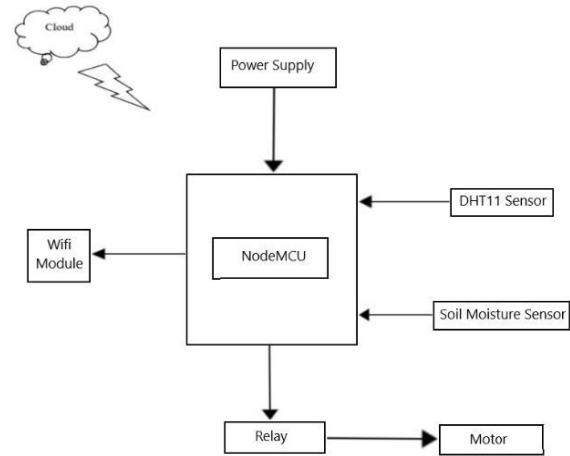
#### VII. FAULT DETECTION AND ALERT SYSTEM

The fault detection and alert system continuously monitors the polyhouse environment and device status to identify abnormal conditions using the Internet of Things. It checks parameters like temperature, humidity, soil moisture, and CO<sub>2</sub> levels against predefined safe limits. If any parameter exceeds the threshold (for example, high temperature or low soil moisture), the system detects it as a fault condition.

It also identifies hardware issues such as sensor failure, communication loss, or actuator malfunction. Once a fault is detected, the system immediately takes corrective actions like turning OFF/ON devices through relay modules to protect crops and equipment. At the same time, notifications are sent to the user via mobile app, SMS, or email alerts.

Artificial Intelligence can also be used to predict possible faults in advance by analyzing patterns in the data, helping to prevent failures before they occur. This system ensures safety, reduces crop damage, and enables quick response, making the polyhouse farming system more reliable and efficient.

#### VIII. BLOCK DIAGRAM



#### IX. RESULT AND DISCUSSION

The proposed smart polyhouse farming system using the Internet of Things and Artificial Intelligence was successfully implemented and tested under different environmental conditions. The system continuously monitored key parameters such as temperature, humidity, soil moisture, light intensity, and CO<sub>2</sub> levels, and automatically controlled the polyhouse environment. Results The results showed that the system effectively maintained optimal conditions for crop growth. Soil moisture levels were regulated efficiently, reducing unnecessary water usage through automated irrigation. Temperature and humidity were maintained within desired ranges using fans and ventilation systems. Light intensity was adjusted using artificial lighting when natural sunlight was insufficient. The integration of AI improved decision-making by analyzing real-time and historical data. The system was able to predict irrigation needs and adjust environmental conditions accordingly. This resulted in improved crop health, faster growth, and increased yield compared to traditional methods. The remote monitoring feature allowed users to access real-time data through a mobile application, reducing the need for manual supervision. Alerts were generated during abnormal conditions, enabling quick corrective actions. — Discussion The implementation demonstrates that combining IoT and AI technologies can significantly enhance the efficiency and productivity of polyhouse farming. The system reduced water consumption, minimized human effort,

and ensured precise control of environmental parameters. However, some challenges were observed during implementation. Initial setup cost is relatively high due to sensors and hardware components. The system also depends on stable internet connectivity for real-time data transmission. Sensor calibration and maintenance are necessary to ensure accurate readings. Despite these limitations, the long-term benefits such as increased yield, resource optimization, and reduced labor costs make the system highly effective. With further improvements, such as advanced AI models and low-cost sensors, the system can be made more affordable and scalable for small and medium-scale farmers.

## X. CONCLUSION

The smart polyhouse farming system using the Internet of Things and Artificial Intelligence provides an efficient solution for modern agriculture by automating environmental control, reducing water and energy consumption, and improving crop yield and quality. The system enables real-time monitoring, minimizes human effort, and ensures optimal growing conditions, making it a reliable and sustainable farming approach.

Future Work In the future, the system can be enhanced by integrating advanced AI models for better prediction and decision-making, using low-cost and high-accuracy sensors to reduce overall cost, and implementing renewable energy sources like solar power for sustainability. Additional features such as disease detection using image processing, voice-based control, and improved wireless communication can further increase efficiency and make the system suitable for large-scale and small-scale farming.

## XI. FUTURE ENHANCEMENTS

The smart polyhouse farming system can be further improved by integrating advanced features using the Artificial Intelligence and Internet of Things. More accurate machine learning models can be developed to predict crop growth, weather changes, and irrigation needs with higher precision. Image processing techniques can be added for early detection of plant diseases and pest attacks. The system can be enhanced by using low-cost and high-precision sensors to make it more affordable for small-scale farmers. Integration

of renewable energy sources like solar panels can reduce dependency on electricity and improve sustainability. Advanced communication technologies can be implemented to ensure reliable data transmission even in remote areas. Future versions can include a fully automated mobile application with voice control and multilingual support for ease of use. Data analytics and historical data tracking can help farmers make better long-term decisions. Additionally, the system can be expanded to support large-scale farming with centralized monitoring and control of multiple polyhouses. These enhancements will make the system more efficient, cost-effective, and widely adaptable for modern agriculture.

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