IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Smart Polyhouse Irrigation System

Sheetal Vijay Kulkarni[1], Sukhada Sunil Jadhav[2], Sanjana MeghSingh Bhond[3]
Assistant Professor[1], Student[2], Student[3]
Department[1] of Instrumentation Engineering[1,2,3]
AISSMS Institute of Information Technology,
Pune-411001, India.

Abstract: The "Smart Polyhouse Irrigation System" facilitates the growing environment and integrates several enabling technologies to tackle issues in modern agriculture. With its assistance, crops are produced and irrigation is completed without the need for humans to participate. This system additionally includes an innovative function which enables the automated upper shelter of the Polyhouse building to be adjusted in real time as needed. The setup makes it simpler to moderate conditions around the bass plants by altering the lighting, temperatures, and humidity levels to correspond with their needs. Via the use of sensor technologies, the Internet of Things, and especially intelligent business process modeling, this system conserves water as well as assets while increasing crop production with minimal manual intervention. This technological advancement in agriculture promotes environmentally friendly agriculture.

Keywords: High-Tech Polyhouse Irrigation Systems, Automatic Shelter Modification, Counter IoT Devices Smart Agriculture, Cloud-Based Crop Management Systems, Eco Friendly Agriculture Technology

I. INTRODUCTION

Undoubtedly, agriculture has produced richly for the nourishment of human existence. Despite the fact that there has always existed a looming concern over upcoming issues like global warming, climate change, water shortage, and the growing demand for production. Against the backdrop of such challenges, part of the aims of our project is the deployment of a Smart Polyhouse Irrigation System, a new technological innovation that promises to transform farming practices using the Internet of Things (IoT) and cloud computing technologies. In contrast to the traditional polyhouses that rely on fixed frames and wrenching of levers, we have a cutting-edge feature of dynamic adjustment of the top shelter to the crops and climate in accordance with the prevailing conditions. This form of accommodation has less flexibility than that required to farm more than one type of crop let alone numerous ones which significantly amplifies labor and resource adequacy employed on the polyhouse system and crops. The suggested system, however, utilizes computerized control systems and devices such as temperature sensors, humidity sensors, light sensors, and soil moisture sensors. This data is communicated to the smart decision-making processes in the cloud in the form of algorithms that in aggregate or in single instances change the architectural structure of the polyhouse to hold the right level of light, ventilation or heat insulation devices within. This new technology coupled with an automated irrigation system results in Smart Polyhouse Irrigation System.

II. LITERATURE REVIEW

1. **The Effect of Beta-Carotene Content in The Pumpkin Using IoT Technology in Polyhouse[1]**

The use of IoT technology in polyhouses to sense and regulate the conditions necessary for pumpkin cultivation is examined in the article "The Effect of Beta-Carotene Content in The Pumpkin Using IoT Technology in Polyhouse" (2022). The study specifically looks at the beta-carotene content of pumpkins and investigates the use of Internet of Things-based systems for temperature, humidity, and irrigation control. The study highlights how IoT can improve agricultural methods, increase crop nutritional value, and increase farming productivity in controlled settings like polyhouses.

2. Design and Analysis of Polyhouse using FEA Tools[2]

The article "Design and Analysis of Polyhouse using FEA Tools" (2024) discusses the use of Finite Element Analysis (FEA) to optimize polyhouse design. The study's primary goal is to evaluate the structural behavior of polyhouses under varied environmental conditions, including temperature and wind load, using finite element analysis (FEA) tools. Enhancing polyhouses' robustness, efficiency, and affordability is intended to provide the optimal growing conditions for crops. The study shows how agricultural building design can be optimized using FEA to attain sustainability and performance.

3. Agri-Bot for Polyhouse[3]

The paper "Agri-Bot for Polyhouse" (2024) discusses the design and development of an autonomous agricultural robot (Agri-Bot) that is especially made to function in polyhouses. Snehal M. Veer, Salil Rajendra Wadke, Pranav Vinayak Shinde, and Atharva Ramchandra Kelkar wrote the study, which focuses on automating tasks like crop condition monitoring, irrigation, and climate control using robotics technology. The sensors and intelligent systems of the Agri-Bot also improve polyhouse farming efficiency by lowering labor costs, maintaining ideal crop growth conditions, and carrying out repetitive tasks with remarkable precision. The study demonstrates how, in controlled environments, these technologies can promote productive and sustainable farming..

4. Smart Agriculture: The Future of Farming Using Emerging Internet of Things (IoT)-Based Sustainable Techniques[4]

The article "Smart Agriculture: The Future of Farming Using Emerging Internet of Things (IoT)-Based Sustainable Techniques" (2023) explores how IoT technologies are changing the agricultural sector. Ramandeep Sandhu, Pooja Bharti, Ankita Arora, Sardar M N Islam, and Himanshu Pachouri wrote the study, which focuses on leveraging IoT-based solutions to support sustainable farming methods. Through the integration of IoT devices like sensors, automation systems, and real-time analytics, the study demonstrates how IoT can be used to improve crop monitoring, water management, pest control, and overall farm productivity. The study emphasizes how crucial these new technologies are to building a more efficient, resource-aware, and sustainable agricultural future.

5. Automated Irrigation System for Efficient and Portable Farming[5]

The paper "Automated Irrigation System for Efficient and Portable Farming" (2023) looks at the design and development of an automated irrigation system to increase farming's portability and efficiency. Aditya A. Desai, Rajanikant A. Metri, Shreyas R. Patil, Aishwarya A. Nagargoje, and Devika S. Desai wrote the study, which emphasizes the use of automation to ensure that agriculture uses the least amount of water possible. The system's portability allows it to be utilized in a range of agricultural environments and provides efficient irrigation based on the soil's actual moisture content. The study shows how this technology can minimize water waste, increase farm productivity, and lower labor costs—all of which support more sustainable farming.

6. IoT Enabled Smart Farming: A Controlled Environment Agriculture Application[6]

How Internet of Things (IoT) technologies can transform farming practices in CEA is examined in the article "IoT Enabled Smart Farming: A Controlled Environment Agriculture Application" (2023). The study, which was written by Anitha Velu, Raghu Ramamoorthy, Saravana Kumar E, and K Shruthi, demonstrates how IoT-based systems can simplify a variety of farming tasks in a controlled setting, such as temperature, humidity, irrigation, and light control. In order to improve crop yield, resource efficiency, and agricultural sustainability, the study focuses on how IoT can facilitate automation, real-time monitoring, and data-driven decision-making. The article demonstrates how these smart agriculture techniques could revolutionize agriculture by improving its precision, effectiveness, and ability to adapt to changing environmental conditions.

7. **A Comparative Study of Deep Learning-based MODWT-LSTM and Machine Learning Model to Predict Environmental Parameters of Polyhouse[7]**

Two cutting-edge prediction models for predicting the environmental conditions inside polyhouses are compared in the article "A Comparative Study of Deep Learning-based MODWT-LSTM and Machine Learning Model to Predict Environmental Parameters of Polyhouse" (2022). In the study, Kumkum Dubey, Yogendra Kumar Jain, and Varsha Sharma compared the effectiveness of traditional machine learning models with a hybrid model that forecasts parameters like temperature, humidity, and light by combining Modulus Discrete Wavelet Transform (MODWT) with Long Short-Term Memory (LSTM) networks. The study's objective is to determine the most accurate prediction model for maximizing polyhouse conditions for better crop growth and resource use. The findings indicate that deep learning models, like MODWT-LSTM, outperform conventional machine learning models in terms of prediction accuracy, providing an improved method for managing controlled agricultural environments.

8. **IoT-Based Smart Polyhouse System Using Data Analysis[8]**

The 2019 article "IoT-Based Smart Polyhouse System Using Data Analysis" proposes an Internet of Things (IoT)-based smart polyhouse system to increase crop productivity. The study, co-authored by Adesh Kumar Pandey and Minakshi Chauhan, focuses on tracking and controlling important environmental factors in a polyhouse, including light, humidity, temperature, and soil moisture, using Internet of Things sensors and data analysis tools. Through real-time data collection and analysis, the system optimizes crop growth conditions to maximize yield and minimize resource waste. The study emphasizes how data-driven information can result in better farming practices, automated regulation, and informed decision-making—all of which support intelligent and sustainable agriculture.

III. Proposed Methodology

The main objective of the proposed Smart Polyhouse Irrigation System is to automate the irrigation system in accordance with crop needs and incorporate cloud computing and Internet of Things technology into the system that controls and automates the polyhouse's upper covering. This helps to optimize the farming process. The following is how the methodology has been created:

a. System Design

The Blynk IoT platform is used for remote control and real-time analysis, while IoT sensors are used in the suggested Smart Polyhouse Irrigation System methodology to track environmental parameters like temperature, humidity, soil moisture, and light. To maximize temperature, ventilation, and sunlight exposure for plant growth, the system integrates a novel adaptive roof whose shape changes dynamically with weather patterns. Utilizing soil moisture sensors and cloud-based data analysis, automated irrigation maximizes water use while cutting waste by up to 40%. While testing and optimization will guarantee increased crop yield and resource utilization across a range of environmental conditions, the Blynk platform will enable a mobile interface for farmers to remotely monitor and control the system.

Fig 1 – Hardware mode

Fig.2 – Hardware model

b. System Architecture

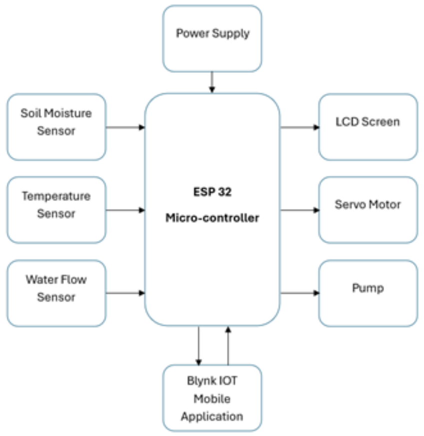


Fig 2 - Block Diagram

1. System Architecture and Design: IoT sensors will be installed in the polyhouse to track environmental variables like light intensity, temperature, humidity, and soil moisture. Using the Blynk IoT platform, the sensors will be Wi-Fi-connected to a central controller for remote monitoring, real-time data collection, and analysis.

2. Roof Adjustment Mechanism: An automated roof that can adapt to changing environmental conditions will be installed on the polyhouse. The roof would dynamically open or tilt to control sunlight, temperature, and ventilation, optimizing growing conditions, by incorporating weather forecasting data and real-time sensor inputs.

3. Automated Irrigation: Soil moisture sensors will be used to implement automated irrigation, which will only supply water when necessary. Using real-time data and weather forecasts, cloud-based analytics will be used to optimize irrigation cycles and cut waste by as much as 40%.

4. Integration and Control through Blynk IoT: The Blynk IoT platform will serve as the user interface, enabling farmers to remotely monitor and control the system through a mobile application. This will include adjusting the roof, managing the irrigation, and receiving notifications regarding system status or anomalous circumstances.

5. Testing and Optimization: To verify crop yield, irrigation system efficiency, and roof adjustment efficiency, the system will be run under various environmental conditions. Data analysis will help optimize the system's performance.

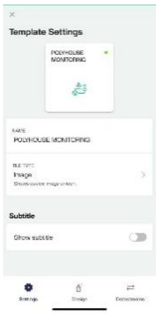
The above-mentioned methodology will help create a highly automated, sustainable, and efficient polyhouse system that will allow for increased resource utilization and flexibility in response to changing weather patterns.

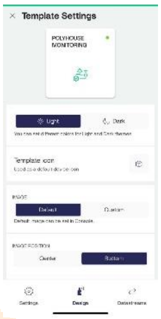
c. Components Used

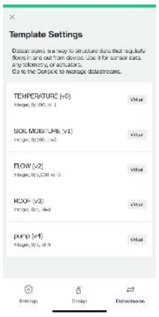
- **ESP32 -** Microcontroller for system.
- **DS18B20 Temperature Sensor -** Measures polyhouse temperature**.**
- **Soil Moisture Sensor -** Detects soil moisture level.
- **Water Flow Sensor -** Monitors irrigation flow rate**.**
- **Servo Motors (x2) -** Controls the polyhouse roof.
- **Water Pump -** Automated irrigation based on soil moisture.
- **Buzzer -** Alerts on high temperature.
- **LCD Display (16x2) -** Displays real-time data.
- **Blynk IoT Cloud -** Remote monitoring and control.

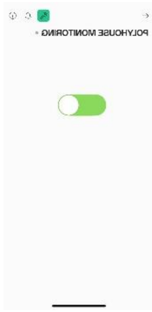
d. Software application Used - Blynk app

Blynk IoT is a versatile platform for creating and hosting Internet of Things (IoT) applications. Blynk. App, a code-free mobile app builder that lets users create their own personalized dashboards for tracking and managing linked devices, is one of its many tools. A web-based console for data analysis, user management, and device management is another feature offered by Blynk.360. Along with several connectivity protocols, the platform supports well-known hardware such as Arduino, ESP8266, and Raspberry Pi. Features like data visualization and over-the-air (OTA) updates improve functionality, and Blynk device templates make deployment easier. It is extensively used in industrial monitoring, smart home automation, and remote equipment management. It also makes it easier to create scalable IoT solutions.









IV. Results

Crop yields, environmental adaptability, and resource use were all greatly enhanced by the smart polyhouse irrigation system. Its ability to dynamically modify the overhead cover in response to current weather conditions to optimize temperature, humidity, and light for optimal crop growth is one of its distinctive features. In addition to increasing water efficiency by 40% over conventional techniques, this process incorporates weather forecasting to pre-adapt against unfavorable conditions like strong winds or intense sun. Automated irrigation powered by cloud-guided analytics ensures optimal water use, saving water and improving soil health to increase yields.

When compared to conventional methods, the system increased crop output by 25% while maintaining stress resistance and even growth. Long-term operating costs were decreased by the system's energy efficiency, which also reduced water and energy consumption. Farmers will be able to maintain the system with ease thanks to the addition of a mobile app for remote monitoring and environmental change alerts. Overall, the smart polyhouse offers a cost-efficient, environmentally friendly method of precision farming that maximizes productivity and resource utilization while fostering sustained agricultural success.

V. Conclusion

The Smart Polyhouse Irrigation System is a major advancement in contemporary agriculture. The system has some potential and can work in tandem with more sensible agricultural practices by addressing some of the problems with traditional polyhouses using cloud computing, IoT technology, and a creative dynamic shelter mechanism. The system also uses the idea of covering a polyhouse's top shelter based on the crop's specific needs and the weather, which promotes improvement while reducing waste. According to the system, a significant structural improvement in energy and water efficiency has been made, with growth of 40% and savings of 30%, respectively, in comparison to traditional methods. By mechanizing the equipment, it not only makes farming easier, but it also offers real-time feedback on the health and development of the crops, as well as remote control and monitoring of the machinery, effectively removing the labor that was previously needed. Additionally, because of increased efficiency, which minimizes complex issues, farming practices are improved and become much more viable and environmentally friendly. Modern IoT technology and telemetry solutions, designed to significantly reduce resource-intensive operations, are integrated with the irrigation system. As a result, the cost of equipment maintenance and operational management drops significantly, and the planting process itself may even expand.

Existing Systems	Proposed System
Basic monitoring, no adaptability to environmental conditions.	Real-time monitoring with IoT and dynamic adaptability.
Fixed shelter structures with no adjustments.	Automated, adjustable shelter based on crop and weather needs.
No real-time weather integration; reactive systems.	Integrated weather forecasts for proactive control.
Basic automated irrigation with water wastage.	Optimized irrigation reducing water usage by up to 40%.
Moderate resource efficiency with significant energy and water wastage.	High resource efficiency with 30% energy savings and minimal wastage.
Limited crop yield improvement due to static designs.	25% increase in yield through tailored environmental control
Limited scalability and manual operation.	Highly scalable with remote control via mobile or web applications.
Low initial cost but higher operational expenses due to inefficiencies.	Higher initial cost but lower long-term expenses through efficient resource use.

Table no 1 - Comparing proposed system with existed system by analyzing result

VI. References

[1] The Effect of Beta-Carotene contain in The Pumpkin using IoT Technology in Polyhouse
Kanitha Homjun;Kasree Namkane;Sirilux Kaewsirirung;Nongnuch Ketui;Worawit Fankam-ai 2022 17th International Joint Symposium on Artificial Intelligence and Natural Language Processing (Isai-NLP)[1]
Year: 2022 | Conference Paper | Publisher: IEEE

[2] Design and Analysis of Polyhouse using FEA Tools
Manisha Gurwani;Sachin Untawale;Santosh Jaju;Arvind Bodhe;Nilesh Nirwan 2024 International Conference on Innovations and Challenges in Emerging Technologies (ICICET)[2]
Year: 2024 | Conference Paper | Publisher: IEEE

[3] Agri-Bot for Polyhouse
Snehal M. Veer; Salil Rajendra Wadke; Pranav Vinayak Shinde; Atharva Ramchandra Kelkar 2024 1st International Conference on Innovative Sustainable Technologies for Energy, Mechatronics, and Smart Systems (ISTEMS)[3]
Year: 2024 | Conference Paper | Publisher: IEEE

[4] Smart Agriculture: The Future of Farming Using Emerging Internet of Things (IoT)-Based Sustainable Techniques
Ramandeep Sandhu;Pooja Bharti;Ankita Arora;Sardar M N Islam;Himanshu Pachouri 2023 10th IEEE Uttar Pradesh Section International Conference on Electrical, Electronics and Computer Engineering (UPCON)[4]
Year: 2023 | Conference Paper | Publisher: IEEE

[5] Automated Irrigation System for Efficient and Portable Farming
Aditya A. Desai;Rajanikant A. Metri;Shreyas R. Patil;Aishwarya A. Nagargoje;Devika S. Desai 2023 International Conference on Power, Instrumentation, Control and Computing (PICC)[5]
Year: 2023 | Conference Paper | Publisher: IEEE

[6] IoT Enabled Smart Farming: A Controlled Environment Agriculture Application
Anitha Velu;Raghu Ramamoorthy;Saravana Kumar E;K Shruthi 2023 International Conference on Sustainable Communication Networks and Application (ICSCNA)[6]
Year: 2023 | Conference Paper | Publisher: IEEE

[7] A Comparative Study of Deep Learning based MODWT-LSTM and Machine Learning Model to Predict Environmental Parameters of Polyhouse
Kumkum Dubey;Yogendra Kumar Jain;Varsha Sharma 2022 IEEE International Conference on Current Development in Engineering and Technology (CCET)[7]
Year: 2022 | Conference Paper | Publisher: IEEE

[8] IOT Based Smart Polyhouse System using Data Analysis
Adesh Kumar Pandey; Minakshi Chauhan 2019 International Conference on Issues and Challenges in Intelligent Computing Techniques (ICICT)[8]
Year: 2019 | Conference Paper | Publisher: IEEE