IJARETY

International Journal of Advanced Research in Education and TechnologY (IJARETY)

Volume 12, Issue 1, January-February 2025

Impact Factor: 7.394

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

INNO SPACE
SJIF Scientific Journal Impact Factor

doi crossref

निस्केयर NISCAIR

www.ijarety.in editor.ijarety@gmail.com

International Journal of Advanced Research in Education and TechnologY(IJARETY)

| ISSN: 2394-2975 | www.ijarety.in| | Impact Factor: 7.394| A Bi-Monthly, Double-Blind Peer Reviewed & Refereed Journal |

|| Volume 12, Issue 1, January-February 2025 ||

DOI:10.15680/IJARETY.2025.1201021

Greenhouse Monitoring and Controlling System

Mr. Govind Vilas Shetye[1], Ms. Tanvi Krishna Kelji[2], Ms. Sayali Sanjay Narvekar [3], Mr. Dipak Bhagu Patil[4], Ms. Palak Krishna Shetkar[5], Mr. Tejas C. Mhapankar[6]

Student, Yashwantrao Bhonsale Institute of Technology, Sawantwadi, Maharashtra, India[1,2,3,4,5]

Faculty, Yashwantrao Bhonsale Institute of Technology, Sawantwadi, Maharashtra, India [6]

ABSTRACT: The aim of this project is to develop a greenhouse monitoring and controlling system to optimize plant cultivation in a controlled environment. A greenhouse, often referred to as a "land of controlled crops," provides a covered area for plant growth, protected from external climatic conditions. This system integrates advanced IoT technologies with sensors and computer automation to monitor and regulate key environmental parameters, such as temperature, humidity, and soil moisture, ensuring optimal conditions for crop development. Greenhouses are specialized structures with walls and roofs made primarily of transparent materials The proposed system employs an Arduino microcontroller to interface with sensors and external mechanical devices for real-time data collection and control. Climate-controlled greenhouses enable growers to enhance crop yields and maintain consistent quality by automating critical environmental factors. Unlike traditional manual methods, this system leverages IoT technology to facilitate wireless communication between sensors and a central control unit, enabling remote monitoring and operation via Bluetooth.

This project addresses the growing need for efficient agricultural practices, driven by increasing urbanization and limited arable land. The IoT-based greenhouse monitoring system not only supports year-round cultivation of seasonal crops but also promotes sustainable farming practices. By automating greenhouse operations and enabling precise environmental control, this innovative approach offers significant advantages for modern agriculture and contributes to addressing global food security challenges.

KEYWORDS: Greenhouse, Android Application, wireless communication, sensors, Arduino

I. INTRODUCTION

Greenhouses are specialized structures with walls and roofs made primarily of transparent materials, such as glass or polycarbonate, designed to create optimal conditions for plant growth. Scientifically, a greenhouse is defined as a covered environment that protects plants from harsh external climate conditions, mitigates diseases, and provides a controlled microenvironment for sustainable and efficient year-round cultivation. A modern greenhouse operates as a system, often referred to as a Controlled Environment Agriculture (CEA) or Control Environment Plant Production system.

With advancements in agricultural practices, greenhouse farming has emerged as a popular solution for improving crop yield and quality. Effective monitoring and control of greenhouse environments are crucial for maximizing productivity and minimizing resource wastage. These tasks can be efficiently achieved using low-cost and low-power consumption systems. The primary objective of greenhouse monitoring and controlling systems is to optimize climatic conditions in real-time, based on specific crop requirements. This involves the integration of various sensors to collect data on critical parameters such as temperature, light intensity, soil moisture, humidity, gas levels, and potential fire hazards. Additionally, alert mechanisms, like fire buzzers, enhance the safety and reliability of these systems.

This paper explores the design, implementation, and performance of a greenhouse monitoring and controlling system, focusing on cost-effectiveness, energy efficiency, and the potential for sustainable agricultural practices.

II. SYSTEM ANALYSIS

A. PROBLEM STATEMENT

Monitoring and managing climatic parameters such as humidity, soil moisture, temperature, and illumination is a complex challenge, as these factors directly or indirectly influence plant growth and yield. Agricultural practices in different regions of India face distinct challenges. For instance, regions like Punjab, which benefit from abundant water through river and canal irrigation, often encounter soil salinity problems due to excessive irrigation. Conversely, arid regions like Rajasthan face acute water shortages, making efficient water use critical for agriculture.

International Journal of Advanced Research in Education and TechnologY(IJARETY)

| ISSN: 2394-2975 | www.ijarety.in| | Impact Factor: 7.394| A Bi-Monthly, Double-Blind Peer Reviewed & Refereed Journal |

|| Volume 12, Issue 1, January-February 2025 ||

DOI:10.15680/IJARETY.2025.1201021

Additionally, the excessive use of fertilizers, insecticides, and pesticides depletes soil fertility, increases pest resistance, and pollutes groundwater and nearby water bodies during rainfall. Different crops require specific environmental conditions, including varying levels of moisture, humidity, temperature, and light wavelengths. To address these issues, modern agricultural systems are adopting mobile technologies and wireless data acquisition systems to provide real-time, global access to farm-related information. In this context, a greenhouse monitoring and control system is proposed

B. IMPLEMENTATION

In this greenhouse monitoring and controlling system, we used Arduino Uno to design the circuits. We have connected, a sensor, LCD, Bluetooth, Serial Communication to the Arduino. Here we used components are microcontroller ESP32, Relay, Sensors which are flame sensor, LDR sensor, Soil moisture and Temperature And humidity Sensor and also buzzer for flame detection sound.

1. **Temperature and humidity:** A microcontroller is connected to temperature and humidity sensor which is DTH11connect to pin 13 of ESP32 microcontroller also has a Bluetooth connection and microcontroller connect to direct LCD. The LCD is connected to the microcontroller through the serial connection.
2. **Flame sensor:** a microcontroller is connected to Flame sensor which is MSIR flame detector. Which detects the flames.it outputs the signal when flame is detected. This sensor connected to pin 12 of the ESP32 microcontroller.
3. **LDR sensor:** A LDR (light Dependent Resister) is detect or sense a light intensity. Its resistance changes with light intensity. The LDR sensor connected to pin 14 of ESP32 microcontroller.
4. **Soil moisture sensor**: here we used soil moisture sensor for measuring the water level content in soil. It is indicating moisture level in soil through signal output. This soil moisture sensor connected to pin 4 of the ESP32 microcontroller.

A powerful microcontroller that acts as the brain of the system. It receives input from sensors, process the data and control the output device. An electrically controlled switch connected to pin 18 of the ESP32. When the microcontroller sends a signal to the relay, it closes the circuit, allowing electricity to flow through it to activate an external device. Similar to Relay 1, it's connected + pin 19 of the ESP32 microcontroller. A sound-producing device connected to pin 5 of the ESP32. The microcontroller can control the buzzer to create different tones.

LCD (Liquid Crystal Display): A display screen connected to the ESP32 via SDA (Serial Data) pin 21 and SCL (Serial Clock) pin 22. The ESP32 can display information like temperature, humidity, light intensity, and soil moisture on the LCD. A wireless communication module connected to the ESP32, enabling the microcontroller to send data to and receive data from a smartphone or other↓ Bluetooth-enabled devices. It allows you to control the system remotely.

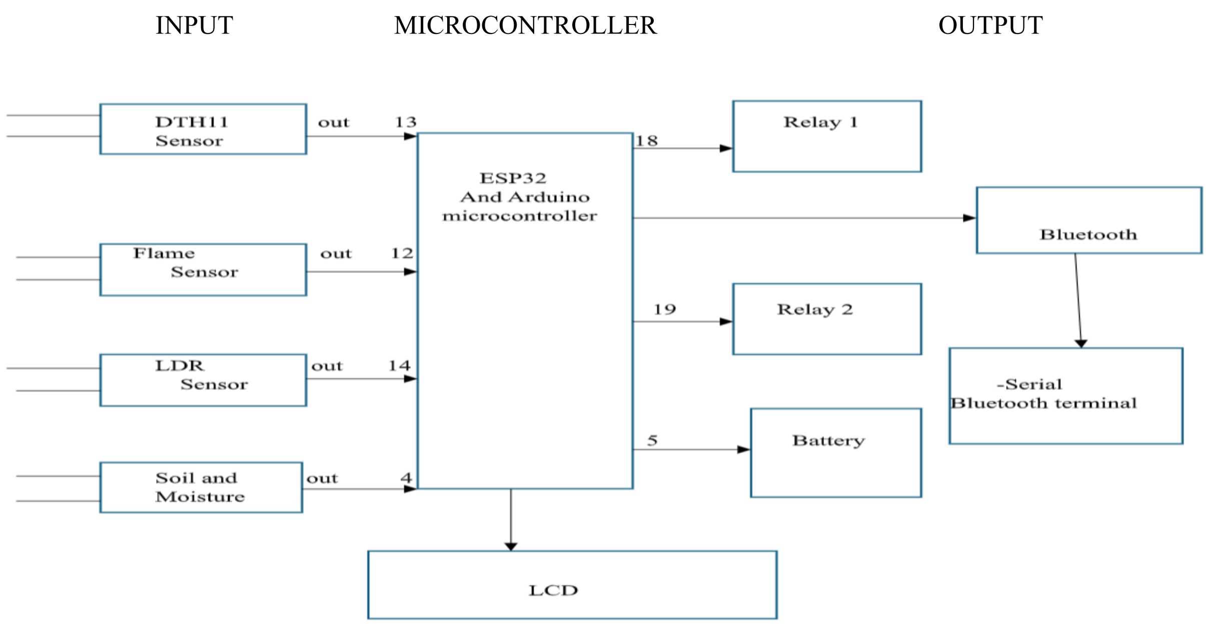

Fig1. Block Diagram of greenhouse monitoring and controlling system

| ISSN: 2394-2975 | www.ijarety.in| | Impact Factor: 7.394| A Bi-Monthly, Double-Blind Peer Reviewed & Refereed Journal |

|| Volume 12, Issue 1, January-February 2025 ||

DOI:10.15680/IJARETY.2025.1201021

III. OBJECTIVE OF PROJECT

The primary objective of this project is to enhance agricultural practices by developing a smart, automated greenhouse monitoring and control system. The system ensures optimal climatic conditions within the greenhouse by monitoring key environmental parameters such as temperature, humidity, soil moisture, and illumination using sensors, and regulating them with mechanical devices. Real-time data is transmitted to the cloud and displayed on a web interface for analysis and remote control.

Specific Objectives:

1. Ease of Access and Maintenance: Design a user-friendly system that simplifies greenhouse management and reduces maintenance efforts.

2. Advanced Connectivity: Enable seamless connectivity of physical devices and sensors over a wide network for real-time monitoring and control

3. Data Logging and Analysis: Maintain a historical record of environmental parameters for analysis and informed decision-making.

4. Miniature Greenhouse Prototype: Develop a scaled-down greenhouse model equipped with an automatic monitoring and control system for demonstration and testing purposes.

5. Environmental Regulation: Constantly monitor and control environmental factors such as temperature, light intensity, soil moisture, and humidity to sustain preset optimal levels.

6. Remote Monitoring and Control: Provide users with the ability to observe greenhouse conditions and control the system remotely via a web-based interface.

7. Resource Optimization: Focus on water conservation, increased efficiency, and reducing the environmental impact of crop production to promote sustainable agricultural practices.

IV. CONCLUSION AND FUTURE WORK

A. CONCLUSION

The development of a greenhouse monitoring and controlling system offers a sustainable and efficient solution for addressing the challenges of modern agriculture. By integrating advanced technologies, sensors, and automation, the system ensures optimal environmental conditions, leading to enhanced crop yield, quality, and resource conservation. This project demonstrates the potential of smart agricultural practices to mitigate regional farming challenges, promote sustainability, and contribute to global food security. The proposed solution empowers farmers with real-time data, remote monitoring, and precise environmental control, paving the way for innovative and sustainable agricultural advancements.

B. FUTURE WORK

1. Artificial Intelligence Integration: AI-driven systems for precise optimization of growth conditions, predictive maintenance, and autonomous pest and disease management.

2. Autonomous Greenhouse Drones: AI-powered drones for real-time monitoring, efficient pruning, and enhanced pollination.

3. Smart Glass and Climate Control: Advanced electrochromic glass and intelligent climate regulation for superior light and temperature management.

4. Robotics and Automation: Fully automated solutions for planting, harvesting, and packaging to boost efficiency and reduce labour requirements.

5. Advanced Water Management: AI-enhanced irrigation systems and water recycling technologies for sustainable resource utilization.

6. Renewable Energy Integration: Greenhouses powered by solar, wind, or geothermal energy for eco-friendly and cost-efficient operations.

7. Edge Computing for Real-time Analytics: Local data processing enabling instant analytics and decision-making to optimize performance.

8. 5G and 6G Connectivity: Ultra-fast, low-latency networks for seamless operation and communication between greenhouse systems and devices.

These innovations promise to revolutionize greenhouse agriculture, driving sustainability, efficiency, and productivity to new heights

ACKNOWLEDGEMENT

We extend our heartfelt gratitude to everyone who contributed to the development and compilation of our Greenhouse Monitoring and Controlling System project. Your unwavering support and valuable inputs have been instrumental in bringing this project to fruition. A special note of appreciation goes to our guide Prof. T. C. Mhapankar project co-ordinator Prof. R. C. Dhandekar and HOD Prof. P. D. Kate for their constant support, insightful guidance, and invaluable suggestions. Their expertise and encouragement have significantly contributed to refining our project, enhancing its functionality, and ensuring its success. We also express our sincere gratitude to the faculty members of our department for their constructive feedback, valuable time, and unwavering support throughout this journey. Their insights have been crucial in shaping the quality and effectiveness of our work. Lastly, we extend our appreciation to all those who directly or indirectly contributed to the successful completion of this project. Your support and encouragement have been truly invaluable.

REFERENCES

[1] Hugo Sampaio, Shu Saburo Motoyama,"Implementation of a Greenhouse Monitoring System Using Hierarchical Wireless Sensor Network",978-1- 5386-2098- 4/17/$31.00 ©2017 IEEE.

[2] Hendrik Porter and Oscar Nagel, “The role of biomass allocation in the growth response of plants to different levels of light, CO2, nutrients and water: a quantitative review”, International Conference on Assimilate Transport and Partitioning, Newcastle, NSW, August 1999,27(12) pp.1191 – 1191.

[3] Muhammad Faizan Siddiqui, Asim Ur Rehman Khan, Neel Kanwal, Haider Mehdi, Aqib Noor, M. Asad Khan, “Automation and Monitoring of Greenhouse",978-1-5386-2186- 8/17/$31.00 c 2017 IEEE.

[4] Mitra A P., 1991. “Greenhouse Gas Emission in India, A Preliminary Report”. Editor: A P Mitra. Global Change Scientific Report number no. 1, CSIR, June 1991.

[5] P. P. Reddy, Sustainable Crop Protection Under Protected Cultivation: Springer. 13-21, 2016.

[6] Kodandaramaiah, Dr. G. N. “Cloud IoT Based Greenhouse Monitoring System.” (2015).

[7] Thangavel Bhuvaneswari, Joshua Tan Hong Yao Faculty of Engineering and Technology, “Automated Greenhouse",2014 IEEE International Symposium on Robotics and Manufacturing Automation.

IJARETY

International Journal of Advanced Research in Education and Technology

ISSN: 2394-2975 Impact Factor: 7.394

www.ijarety.in editor.ijarety@gmail.com