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IOT Based Green House Monitoring and Control System

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Abstract: ***This project presents an IoT-based greenhouse monitoring and control system utilizing a Node MCU (ESP8266) microcontroller, various environmental sensors, an automated irrigation system, and a remote monitoring platform. Unlike traditional greenhouse systems that require manual supervision, this smart system automates climate control by adjusting temperature, humidity, and soil moisture levels in real-time. The Node MCU continuously collects and processes environmental data, ensuring optimal growing conditions while reducing manual intervention. Furthermore, IoT connectivity allows users to monitor and control the greenhouse remotely, enabling data-driven decision-making and improving overall efficiency.***
Keywords: IoT, Greenhouse Automation, NodeMCU, Smart Agriculture, Remote Monitoring, Environmental Sensors, Precision Farming.

I. INTRODUCTION

In modern agriculture, maintaining the right environmental conditions inside a greenhouse is crucial for healthy plant growth and higher yields. Traditional greenhouse management often relies on manual monitoring, which can be inefficient, labor-intensive , and prone to human error. Additionally, climate fluctuations can negatively impact crops if not managed promptly.

With advancements in Internet of Things (IoT) technology, smart greenhouse systems have emerged, offering real-time monitoring, automation, and remote control. Existing IoT-based systems mainly focus on monitoring temperature, humidity, and soil moisture while sending alerts. However, many of these systems lack an automated response mechanism to adjust environmental factors in real-time.

This project proposes an IoT-based greenhouse monitoring and control system using NodeMCU (ESP8266), temperature & humidity sensors, soil moisture sensors, an automated irrigation system, and a mobile application for remote monitoring. The system ensures an optimal greenhouse environment by automatically adjusting irrigation and ventilation based on real-time sensor data. The IoT connectivity allows farmers to receive alerts and remotely control the system, ensuring efficient resource management and improved crop productivity.

II. EXISTING SYSTEM

Current greenhouse monitoring systems mainly use IoT and Arduino technologies for real-time environmental monitoring. Research by various experts has explored IoT-based solutions that track temperature, humidity, and soil moisture. However, most systems only provide alerts without automated environmental adjustments, requiring manual intervention.

For example:

1) Some IoT-based monitoring systems use temperature and soil moisture sensors to detect unfavorable conditions, but they do not control irrigation or ventilation automatically.
2) Other systems integrate Arduino or Raspberry Pi for data collection but lack real-time automation, limiting their effectiveness.

These limitations highlight the need for an integrated system that not only monitors the greenhouse conditions but also automatically takes corrective actions, reducing reliance on manual labor.

III. PROPOSED SYSTEM

To overcome these limitations, this project introduces an IoT-based greenhouse monitoring and control system that integrates both real-time monitoring and automated environmental control. The system consists of:

1) NodeMCU (ESP8266) microcontroller for data processing and IoT connectivity.
2) Temperature and humidity sensors to monitor the greenhouse climate.
3) Soil moisture sensors to determine the need for irrigation.
4) An automated irrigation system that activates based on soil moisture levels.

5) Ventilation control to regulate temperature and humidity.
6) A mobile application for remote monitoring.

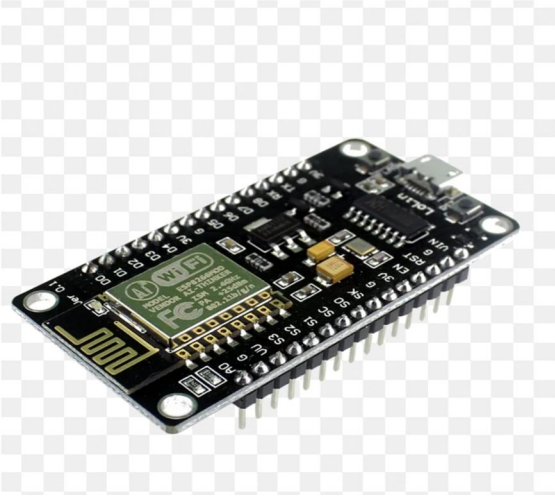
A. How it Works
1) The system continuously monitors temperature, humidity, and soil moisture using sensors.
2) If temperature or humidity exceeds a predefined threshold, the ventilation system automatically activates to regulate the environment.

B. General Block Diagram
1) If the soil moisture level falls below the optimal range, the irrigation system is triggered to water the plants.
2) The IoT module transmits real-time data to a mobile application, allowing farmers to monitor conditions remotely and control systems manually if needed.

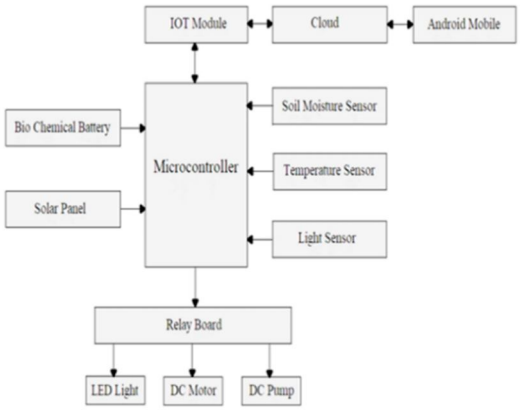
By integrating automation and remote monitoring, this system improves greenhouse efficiency, reduces water waste, and enhances crop productivity.

IV. SYSTEM ARCHITECTURE

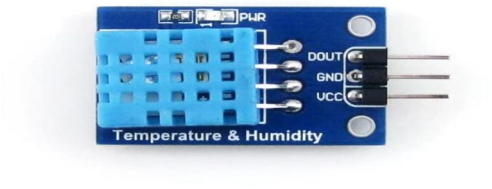
A. Compoents Used and Description
1) NodeMCU (ESP8266)



The NodeMCU ESP8266 is a Wi-Fi-enabled microcontroller that serves as the system's brain. It processes sensor data, controls irrigation and ventilation, and enables IoT connectivity for real-time monitoring.

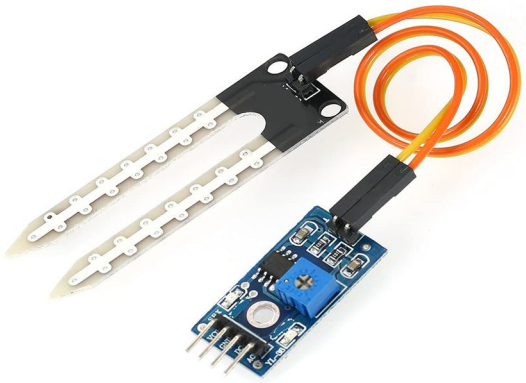


2) Temperature & Humidity Sensor (DHT11)



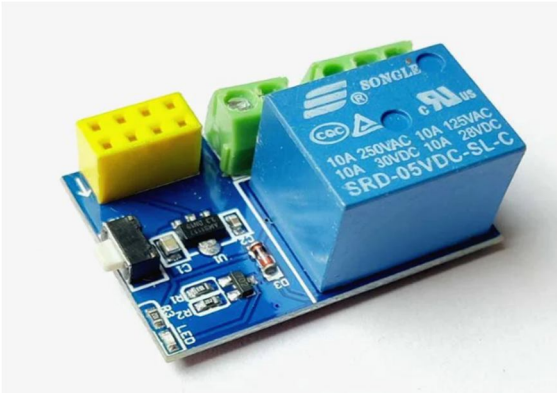
This sensor continuously measures temperature and humidity levels inside the greenhouse and sends the data to the NodeMCU. If temperature or humidity exceeds the predefined range, the system activates ventilation fans or a cooling system.

3) Soil Moisture Sensor



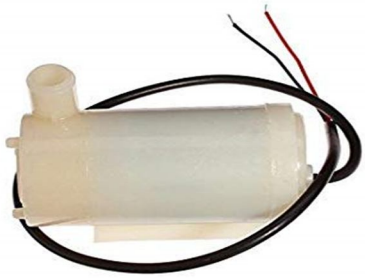
The soil moisture sensor determines the water content in the soil. If moisture levels fall below the threshold, the system automatically triggers irrigation, ensuring crops receive the right amount of water.

4) Relay Module



The relay module acts as a switch to control irrigation pumps and ventilation fans. When the NodeMCU detects unfavorable conditions, it sends a signal to the relay, which then activates the necessary components.

5) Automated Irrigation System



An electric water pump or solenoid valve is connected to the system, allowing automatic irrigation when needed. This eliminates the need for manual watering, ensuring crops get the right amount of moisture.

6) Ventilation Control System

When the temperature or humidity exceeds optimal levels, the system activates fans or vents to regulate the greenhouse climate, ensuring a stable growing environment.

7) Website

The Website provides remote control features, allowing users to:

- Monitor temperature, humidity, and soil moisture levels in real-time.
- Receive alerts and notifications if environmental conditions exceed predefined limits.
- Manually activate irrigation or ventilation systems if needed.
- Only users connected to that Particular Wifi can access the website in a secular manner.

V. WORKING OF THE SYSTEM

1) Continuous Monitoring: Sensors collect real-time data on temperature, humidity, and soil moisture.
2) Data Processing: The NodeMCU processes sensor data and determines if corrective actions are needed.
3) Decision Making:
- If temperature/humidity is too high, the ventilation system activates.
- If soil moisture is too low, the irrigation system turns on.

4) Automated Actions: The system adjusts environmental conditions automatically based on sensor readings.
5) IoT-Based Notification: Real-time data is sent to a cloud platform and alerts are delivered via the mobile app.
6) Remote Monitoring & Control: Users can monitor and control the system remotely, ensuring optimal crop growth.

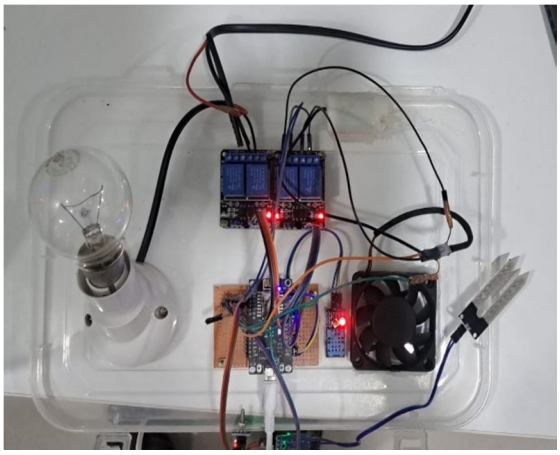
VI. RESULTS

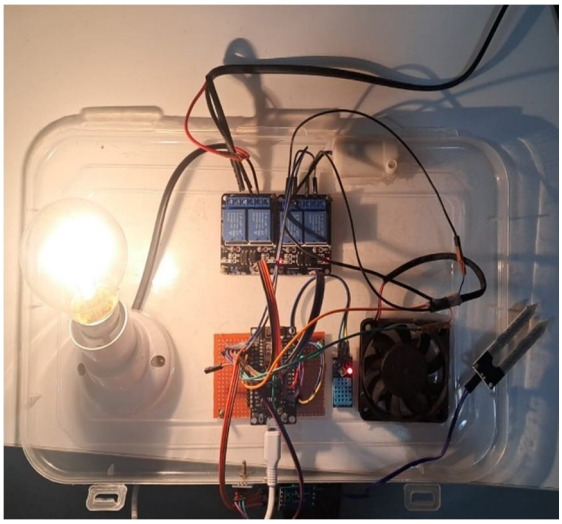
The implementation of this IoT-based greenhouse system has demonstrated significant efficiency in monitoring and controlling environmental conditions. During testing:

1) Temperature and humidity sensors effectively detected climate changes and triggered the ventilation system.
2) Soil moisture sensors successfully activated irrigation only when necessary, reducing water wastage.
3) IoT connectivity enabled real-time monitoring, allowing users to receive alerts and make informed decisions remotely.

The automation of greenhouse management has significantly reduced manual intervention, leading to increased productivity and efficient resource utilization.

A. Implemetation Result





B. Work Status

VII. CONCLUSION

The IoT-Based Greenhouse Monitoring and Control System provides an efficient, automated approach to maintaining optimal greenhouse conditions. By integrating real-time environmental monitoring, automated irrigation, and ventilation control, the system ensures better crop yields, resource efficiency, and reduced labor dependency.

The IoT connectivity allows farmers to monitor and control greenhouse conditions remotely, improving decision-making and productivity. Overall, this system represents a smart, scalable, and cost-effective solution for modern agriculture.

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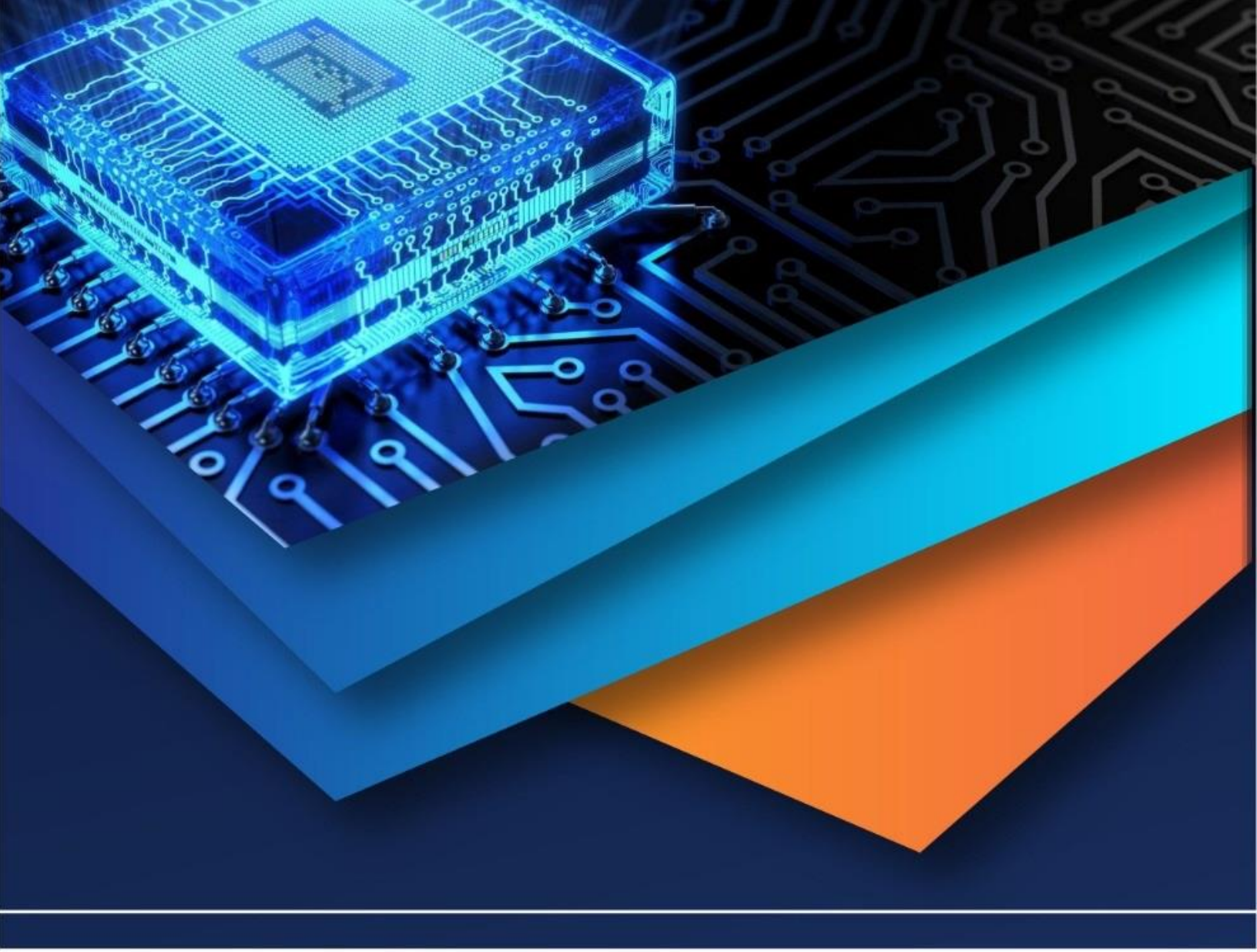

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