**A review on greenhouse monitoring technology and control system curve agrectural land using iot**

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# ABSTRACT

A greenhouse is a place where plants like flowers and vegetables are cultivated. Greenhouses heat up during the day when sunlight passes through them, which warms the plants, soil, and structure. Greenhouses assist in safeguarding crops from numerous diseases, especially those that are spread by soil and splash onto plants during rainfall. The greenhouse effect is a natural occurrence and advantageous to humans. Many farmers do not achieve significant profits from greenhouse crops due to their inability to manage two crucial factors, which influence plant growth and productivity. The temperature inside the greenhouse should not fall below a certain level. High humidity can lead to crop transpiration, condensation of water vapor on different greenhouse surfaces, and evaporation of water from the damp soil. To address such issues, this greenhouse monitoring and control system offers a solution. This project illustrates the design and implementation of various sensors for monitoring and controlling the greenhouse environment. This greenhouse control system is powered by an Atmega328 microcontroller and includes a temperature sensor, light sensor, soil moisture sensor, LDR sensor, LCD display module, 12v DC fan, bulb, and pump. The temperature sensor detects the temperature levels; if it rises, the DC fan activates, and when the temperature lowers, the fan switches off. The soil moisture sensor detects the water level; as the level declines, the pump is activated. In the absence of light, the LDR sensor detects it, and the bulb illuminates. In this manner, it becomes easier to monitor and control the system.

 ***KEYWORDS:*** *Greenhouses, ambulance detection, water evaporation, greenhouse control system*

INTRODUCTION

A

 Greenhouse is a structure where plants like

 flowers and vegetables are cultivated. Greenhouses heat up during daylight when sunlight penetrates through them, warming the plants, soil, and structure. Greenhouses assist in shielding crops from numerous diseases, especially those that are soil-borne and splash onto plants during rainfall. The greenhouse effect is a natural occurrence and advantageous to humans. Several farmers do not achieve substantial profits from greenhouse crops because they are unable to manage two crucial factors that influence plant growth and productivity. The temperature in a greenhouse should not fall below a specific degree. High humidity can cause crop transpiration, condensation of water vapor on various surfaces of the greenhouse, and evaporation of water from the moist soil. To tackle these challenges, this greenhouse monitoring and control system proves to be invaluable. This project illustrates the design and implementation of various sensors for monitoring and controlling the greenhouse environment. This greenhouse control system operates with an Atmega328 microcontroller and includes a temperature sensor, light sensor, soil moisture sensor, LDR sensor, LCD display module, a 12V DC fan, light bulb, and pump. The temperature sensor detects the temperature level; if it rises, the DC fan turns on, and when it drops, the fan turns off. The soil moisture sensor measures the water level; as it decreases, the pump activates. In low light conditions, the LDR sensor detects this and triggers the light bulb to illuminate. This method simplifies the monitoring and control of the system. The rapid advancement of technology has revolutionized traditional agricultural methods, enabling more efficient, precise, and sustainable farming techniques. Among these advancements, greenhouse monitoring and control systems that utilize the Internet of Things (IoT) are particularly transformative. A greenhouse monitoring and control system is created to enhance the conditions within a greenhouse, guaranteeing the most favorable environment for plant growth. These systems harness IoT technology to continuously monitor vital factors like temperature, humidity, soil moisture, light intensity, and carbon dioxide concentrations. By employing IoT devices, these factors can be measured in real time and adjusted automatically, ensuring that plants grow optimally under ideal conditions.

 LITERATURE SURVEY

**Title: Green House Environment Monitor Technology Implementation Basedon Android Mobile Platform**

 **Author: Wei Ai, Cifa Chen**

The advancements in greenhouse environment monitoring technology have resulted in improved crop quality, shortened growth cycles, and increased production, making it a topic of significant theoretical significance and value for research. In this paper, we propose the use of a mobile phone as a monitoring terminal for greenhouse environment monitoring. By leveraging the capabilities of a mobile phone, we aim to monitor and analyze the greenhouse environment in real-time, enabling efficient management and optimization of greenhouse conditions for enhanced crop growth and productivity.

**Title: Smart Green House for Controlling & Monitoring Temperature, Soil & Humidity Using IOT**

**Author: Akash Saha,Prinyaka Sarkar Das, Bipasha Chakrabarti Banik**

Agricultural economics plays a pivotal role in the overall economic development of a country, as a significant portion of the population depends on the agriculture sector for their livelihood. Higher agricultural productivity not only boosts rural incomes but also stimulates demand for industrial goods and services. In countries like India, where nearly 70 percent of the population relies on agriculture, agricultural development is crucial for overall economic growth. Agricultural development has a significant impact on farmers' incomes, leading to increased demand for farm inputs, services, and non-farm goods. Additionally, increased agricultural production creates a higher demand for processing facilities. Despite various challenges that may hinder agricultural development, smart farming has emerged as a management concept that utilizes modern technology to enhance the quantity and quality of agricultural products. Today, agriculture is increasingly leveraging sophisticated technologies such as robots, temperature and moisture sensors, aerial images, and GPS technology. These advanced devices, along with precision agriculture and robotic systems, enable businesses to operate more profitably and efficiently in the agriculture sector. Smart farming practices have the potential to revolutionize traditional farming methods, optimize resource utilization, minimize environmental impact, and improve overall agricultural productivity, leading to sustainable agricultural development and economic growth. The advancement in greenhouse environment monitoring technology has brought about safer and more environmentally friendly agricultural practices. The main objective of this paper is to design a smartphone-controlled greenhouse with an advanced monitoring system that can effectively control various parameters such as temperature, soil moisture, and humidity in agricultural processes. The prototype presented in this paper utilizes sensors, IoT (Internet of Things), and ISP (Internet Service Provider) to monitor and control temperature, soil moisture, and humidity levels. This innovative approach to greenhouse management enables farmers to have real-time access to critical environmental data and make informed decisions to optimize agricultural processes for improved productivity, resource utilization, and environmental sustainability.

 **Title: Green House Monitoring and Controlling Using Android Mobile Application**

 **Author: Aji Hanggoro, Mahesa Adhitya Putra, Rizki Reynaldo, Riri Fitri Sari**

The current system has the capability to monitor but lacks the ability to control indoor humidity levels in a greenhouse. To address this limitation, a comprehensive Greenhouse Monitoring and Controlling system has been designed to effectively monitor and control humidity levels inside a greenhouse. This system utilizes an Android mobile phone connected via WiFi to a central server, which in turn communicates with a microcontroller and humidity sensor through serial communication. The results obtained from testing show that the system performs according to the specifications provided in the sensor's datasheet, demonstrating its appropriateness in real-world conditions. The successful test results confirm the proper functioning of the system, indicating its effectiveness in monitoring and controlling greenhouse humidity levels.

 **Title: Wireless sensing and control for precision Green housemanagement**

**Author: Akshay C.1 ,Nitin Karnwal2 , Abhfeeth K.A.3 , Rohan Khandelwal4 ,Tapas Govindraju5 , Ezhilarasi D.6 , Sujan Y.7**

Precision greenhouse management in agriculture involves integrating information and production-based farming systems to optimize farm production in specific environments. This approach relies on intensive sensing of ground-level climate conditions and rapid communication of data to a central repository. Wireless sensor networks have emerged as a promising technology for monitoring and controlling agricultural parameters, enabling intelligent and automated systems inside greenhouses. The proposed system in this paper consists of a CPU for data monitoring using the LABVIEW platform, along with a Zigbee module and PIC microcontroller for establishing wireless communication between remote locations. The main objective of this work is to sense, monitor, and control temperature, humidity, and irrigation in a greenhouse from a remote location using Zigbee technology at a low cost. The wireless transceiver is configured using TMFT 2.6 software from Melange Systems, and the PIC microcontroller is programmed using Microchip's IDE version 8.2. This technology is intended to be simpler and more cost-effective compared to other WPANs (Wireless Personal Area Networks) such as Bluetooth or wireless internet nodes. In the current work, the data from the sensing node is amplified and fed to an ADC, which is then connected to the microcontroller. The microcontroller communicates with the Zigbee module to transmit the data to the receiving Zigbee module at the other end. The data is then displayed on the host computer through LABVIEW, and control sequences are generated to wirelessly control the greenhouse parameters from a control room.

 **Title: IOT Based environment change monitoring & controlling in greenhouse using WSN**

 **Author: D Shinde and N Siddiqui**

Monitoring and controlling greenhouse parameters are crucial for ensuring high quality crop production. The objective of this system is to design a simple circuit based on Raspberry Pi 3 to continuously monitor and read values of soil moisture, humidity, temperature, and light in the environment, which are critical for optimal plant growth. In this paper, we propose a system that utilizes wireless sensor nodes to monitor soil quality. Data from each sensor is acquired and analyzed in real-time. In the past, farmers had to rely solely on human efforts to protect their fields from various disasters caused by nature or human factors, which often required significant manpower and expenses. However, in this system, we utilize sensors such as temperature, humidity, soil moisture, and light intensity sensors to monitor the field conditions. This system helps to maintain optimal soil quality for specific crop growth. The system is validated using two crops, tomatoes, and brinjals, in a greenhouse environment. Furthermore, the total power consumption and expenditures incurred for controlling devices are estimated on a yearly basis. This enables farmers to predict the total cost of controlling actions for the next year, which can lead to increased product quality and quantity compared to crops grown without proper monitoring and controlling.

METHODOLOGY AND IMPLEMENTATION

The methodology involves a systematic approach to design, develop, and implement the IoT-based greenhouse monitoring and control system. Below are the key steps:

**1. System Requirements and Specification**

 Data to Monitor: Temperature, humidity, soil moisture, light intensity, CO2 levels. Control Mechanisms: Irrigation system, ventilation (fans), heating systems, lighting. Connectivity: IoTenabled microcontroller, wireless network (WiFi, LoRa, or Zigbee). User Interface: Mobile or web application for realtime monitoring and control.

**2. System Architecture Design**

• Sensors for data collection (temperature, humidity, soil moisture, etc.).

• Actuators for control mechanisms (pumps, fans, lights, etc.).

• Microcontroller (e.g., ESP32, Arduino, or Raspberry Pi) for interfacing sensors and actuators. Communication Layer:

• IoT protocols like MQTT or HTTP for secure and efficient data transmission to the cloud.

• Cloud and Data Layer:

• Cloud storage for logging data and enabling remote access.

• Data analytics for deriving insights and automation rules.

• Application Layer:

• Mobile or web application for user interaction, data visualization, and manual control.

**3. Hardware Setup**

• Install sensors strategically across the greenhouse to cover all critical zones.

• Calibrate sensors for accurate readings.Actuator Integration:

• Connect devices like pumps, fans, and heaters to the microcontroller.

• Test actuator responsiveness based on control signals.

**4. Software Development**

 Firmware for Microcontroller:

• Write and upload code to read sensor data, process it, and control actuators.

• Implement IoT communication protocols (e.g., MQTT for realtime data transfer). Cloud Integration:

• Send collected data to a cloud platform (e.g., AWS IoT, Firebase, ThingSpeak).

• Implement database structures to store historical data.

 User Interface (UI):

• Design a dashboard to display realtime data and historical trends.

• Include controls for manual override of actuators.

• Implement notification systems for critical alerts (SMS, email, or push notifications).

**5. Control Algorithms**

 Develop algorithms to automate responses based on predefined conditions:

• Temperature Control: Activate fans or heaters when temperature exceeds or falls below set thresholds.

• Humidity Control: Trigger misting or dehumidifiers to maintain ideal humidity levels.

• Irrigation Management:

• Use soil moisture data to automate irrigation scheduling.

• Lighting Control: Manage artificial lighting based on ambient light intensity and crop requirements.

• Feedback Mechanism: Realtime adjustments based on sensor feedback to prevent overcorrection.

WORKING

 The implementation procedure entails converting the suggested methodology into an operational system. This encompasses establishing hardware, creating software, merging IoT platforms, and installing the system in a greenhouse setting.



**Figure 1:** Module Diagram

**APPLICATIONS**

1. Commercial Agriculture

• Optimizes conditions for large scale production of vegetables, fruits, and flowers.

• Supports high value crop cultivation requiring precise control.

2. Research and Development

 Facilitates controlled experiments for studying crop growth under varying environmental conditions.

3. Urban and Vertical Farming

 Helps maintain ideal conditions in indoor or rooftop greenhouses in urban settings.

4. Smart Farming Solutions

 Provides real time insights for precision agriculture, reducing waste and maximizing yield.

5. Small and Medium Scale Farming

 Enables resource constrained farmers to improve productivity using affordable IoT systems

CONCLUSION

The execution of a greenhouse monitoring and control system utilizing IoT signifies a remarkable progression in agricultural technology. By utilizing IoT sensors and devices, the real-time observation of essential environmental factors like temperature, humidity, soil moisture, and light intensity is made possible. This system not only automates the oversight of greenhouse conditions but also guarantees ideal growth circumstances for plants, resulting in heightened productivity and resource efficiency.

The incorporation of cloud-based platforms enables data to be retrieved and evaluated from afar, facilitating predictive insights and knowledgeable decision-making. Automated control systems, such as irrigation and ventilation mechanisms, diminish manual labor and decrease human error. Moreover, the adoption of IoT technology fosters sustainable agricultural practices by optimizing water and energy consumption.

In spite of the difficulties tied to initial setup expenses and required technical knowledge, the long-term advantages of enhanced yield, diminished waste, and ecological sustainability render IoT-based greenhouse systems a worthwhile investment for contemporary agriculture. Future developments, including the integration of AI for predictive analytics and blockchain for supply chain clarity, can further enhance the capabilities of this technology.

In summary, IoT-driven greenhouse monitoring and control systems create pathways for more intelligent, sustainable agriculture, addressing the escalating global food demands while conserving essential resources.

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