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Greenhouse Mangement System Using Esp8266 for Smart Farming

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Abstract— The IoT-based smart greenhouse system represents a groundbreaking solution for modern agriculture by utilizing interconnected sensors and devices to monitor and control environmental conditions. Special sensors track temperature, humidity, light levels, and soil moisture, communicating with a central computer that autonomously manages the greenhouse environment for optimal plant growth. This technology enables remote monitoring and real-time access via web or mobile interfaces, while also providing alerts for deviations from desired conditions. Additionally, the system automates tasks such as irrigation, ventilation, and shading, reducing manual labor and ensuring precise control. Overall, this innovative approach promises increased crop yields, resource efficiency, cost reduction, and enhanced sustainability, potentially revolutionizing agriculture to address food security challenges in a densely populated and resource-constrained world.

Keywords—greenhouse effect, iot based system, real-time access, iot cloud

I. Introduction

The foundation of Indian economic activity is agriculture. Agriculture employs more than 50% ofthe people in India and accounts for 14% of GDP. A greenhouse is a closed building that is used to shield plants from outside influences like weather, pollution, etc. The crop grown and raised in the enclosed environment of the environment has a significant impact on a greenhouse. A system has been established in IoT-driven smart greenhouse agriculture to autonomously manage watering while simultaneously overseeing the crop environment through sensors that detect factors such as light levels, humidity, temperature, and soil moisture, among others.

II. LITERATURE REVIEW

The primary aim of this endeavor is to leverage modern technology to improve existing agricultural methods, ultimately leading to higher crop yields. The smart greenhouse model introduced in this study enables farmers to automate farm operations, reducing the need for extensive manual supervision. Greenhouses, as enclosed structures, act as protective barriers for plants against adverse weather conditions such as wind, hail, UV radiation, and potential insect and pest infestations. They are particularly effective in safeguarding crops from various diseases, especially those that originate in the soil and can be transmitted to plants through rain splashes. Regrettably, many farmers struggle to achieve satisfactory profits from their greenhouse crops due to their limited control over two crucial factors that impact plant growth and production.[1]

One of the environmentally friendly methods of clever agricultural cultivation is the greenhouse. It is seen as a different approach to dealing with the food issue brought on by rapid population increase, climate change, and environmental degradation. Even in harshclimate zones, this technology may maintain off- season crops within the enclosed space. It has been necessary to precisely and securely regulate and manage the crop characteristics in a greenhouse.

The emergence of the Internet of Things (IoT) has sparked a revolution in greenhouse farming, introducing intelligent systems for monitoring plants, regulating environmental factors, and managing irrigation. This examination spotlights vital components within IoT-based greenhouse agriculture, including categorizations, network technologies like cloud and edge computing, communication protocols for IoT, data analysis, and sensor applications. It also probes various greenhouse farming methodologies and evaluates the IoT technologies and mobile applications crafted for efficient greenhouse management. In essence, IoT has fundamentally reshaped and fine-tuned modern greenhouse agriculture in multiple ways. [2]

This investigation presents a unified greenhouse management system employing the ESP8266 NodeMCU board. It actively oversees critical environmental factors such as temperature, humidity, CO2 levels, and soil moisture, relaying this information via Wi-Fi to IoT platforms like Thingspeak and Blynk. Users can easily access real-time environmental data and remotely manipulate greenhouse conditions through a mobile application. This cost-effective solution is especially apt for compact indoor gardening and showcases promise for a range of smart agriculture applications.[3]

This paper outlines an IoT-based greenhouse monitoring system aimed at optimizing the production of food crops. It employs various sensors to collect data concerning parameters like temperature, humidity, soil temperature, soil moisture, and light intensity. These data points are transmitted to a central gateway via an access point. Within the gateway, the information is stored in an SQLite database and made available for real-time visualization through a Node-RED dashboard. [4]

This study developed a Greenhouse Remote Monitoring system using NodeMCU ESP8266 microcontroller and conducted experiments in a university greenhouse with hydroponic systems. The system, which included sensors for temperature, humidity, light, and TDS, successfully transmitted data to an Android display. Average errors were low for temperature (0.76%) and humidity (0.14%) readings but slightly higher for light (2.13%) and TDS (5%) due to greenhouse temperature fluctuations. Overall, the system offers promising greenhouse management capabilities.[5]

This study emphasizes the profitability of high-quality produce amid climate challenges. Greenhouse cultivation offers controlled conditions, with Wireless Sensor Networks improving precision through data transmission to the cloud. The findings benefit farmers and organizations seeking efficient, tech-driven farming solutions.[6]

This chapter highlights the use of IoT technology in agriculture, specifically for greenhouse monitoring. IoT offers real-time data for farming. The paper focuses on an IoT-based web app to help farmers monitor fields using affordable components like Arduino Uno and various sensors. This tech can enhance crop yield and quality by automating irrigation based on sensor data.[7]

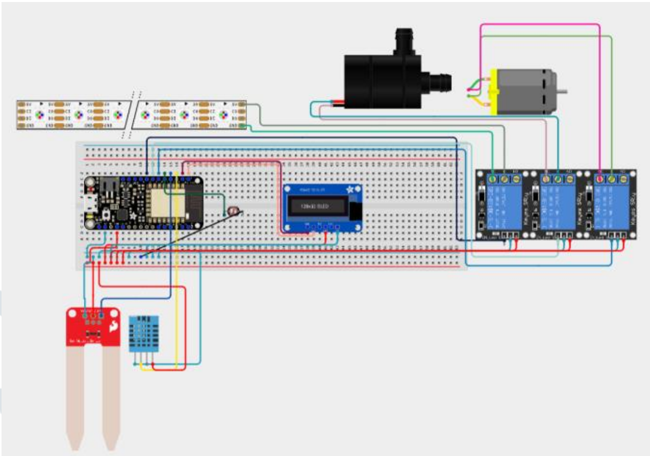
This paper suggests a solution for remotely monitoring small and medium-sized greenhouse environments using a combination of GSM technology and RF (radio frequency). The system establishes a network to observe local environmental data and facilitates seamless communication through RF. By integrating GSM-based remote communication technology, the system effectively supervises greenhouse conditions. The paper provides a detailed breakdown of the hardware structure and software workflow of the system, employing components like ATmega16A, the low-power chip PTR4000, and the Huawei wireless module GTM900-C. The study demonstrates that the system maintains stability, reliability, and the capacity for real-time monitoring of greenhouse environments.[8]

The quality and productivity of plants in greenhouses hinge on the monitoring and regulation of several criteria. However, certain factors, including temperature, humidity, soil moisture, light intensity, and soil pH, are essential for optimizing plant growth to achieve desired results. To oversee and manage the greenhouse environment effectively, a system built on Arduino technology has been developed.

III. METHODOLOGY

Fig:1 Circuit diagram of Smart Greenhouse

Esp8266 microcontroller is used to create a smartgreenhouse system for monitoring and controlling the environment. The detecting, controlling and monitoring and receiving components make up theproposed system. The temperature, humidity, soilmoisture, and light detection sensors are all acomponent of the monitoring portion. The variousenvironmental elements will be sensed by



these sensors.

On an LCD panel, values will be shown. The microcontroller Esp8266 which is the controllingcomponent, is coupled to these sensors. The instructions given to the microcontroller cause the actuators (Fan, Pump, and Bulb) to turn on. To display the situation within the greenhouse, an LCD is used. The sensors in the system detect a change when environmental conditions exceed a safety threshold, and the microcontroller interprets the data.The system's sensors detect a change when environmental parameters go above a safety threshold, and the microcontroller then reads the information from its input ports and takes the appropriate action to return the parameter to the desired level. The user will receive the weather report by utilising Iot cloud platform , and the CPU will continuously display the weather over the internet.

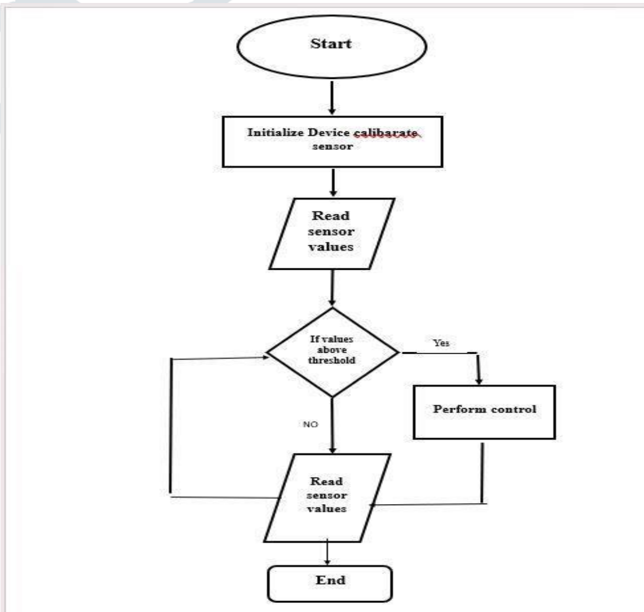


Fig:2 Flow Chart of Smart Greenhouse

BLOCK DIAGRAM

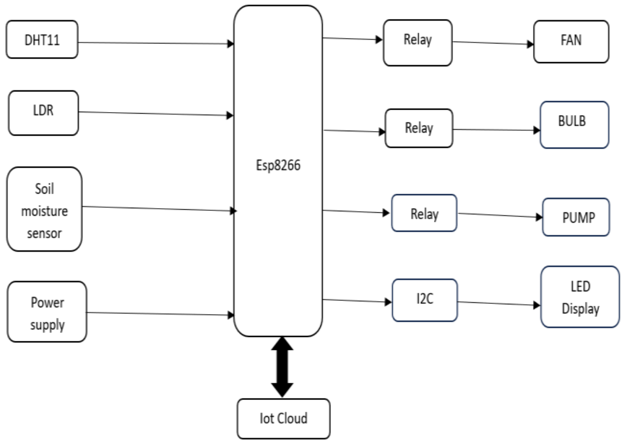


Fig: 3 Block Daigram of Smart Greenhouse

COMPONENTS

1. DHT11
2. Soil Moisture Sensor
3. LDR sensor module
4. LCD Display
5. ESP8266
6. DC Pump
7. LED Bulb
8. DC Fan

IV. RESULT AND DISCUSSION

TIME	TEMP READINGS	FAN STATUS
9:00 AM	20	OFF
11:00 AM	25	OFF
1:00 PM	29	ON
3:00 PM	32	ON
7:00 PM	21	OFF
9:00 PM	20	OFF

Fig:4 Readings from DHT11

The threshold set for sensor is 26°C.

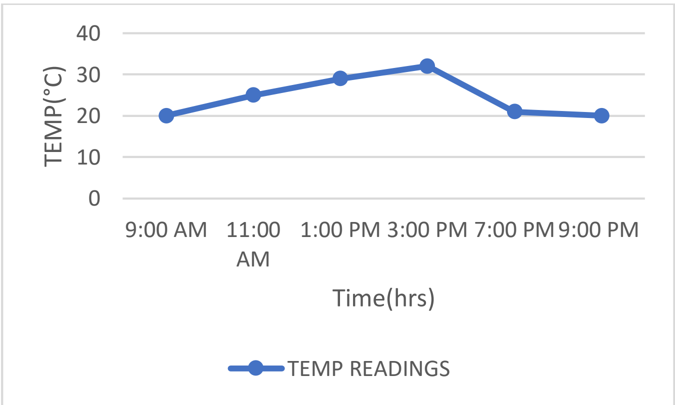


Fig:5 Graph of temperature over time

TIME	LIGHT READINGS	LIGHT STATUS
9:00 AM	182	OFF
11:00 AM	190	OFF
1:00 PM	250	ON
3:00 PM	360	ON
7:00 PM	50	OFF
9:00 PM	20	OFF

Fig:6 Reading from LDR

The threshold value set for LDR Sensor is 210.

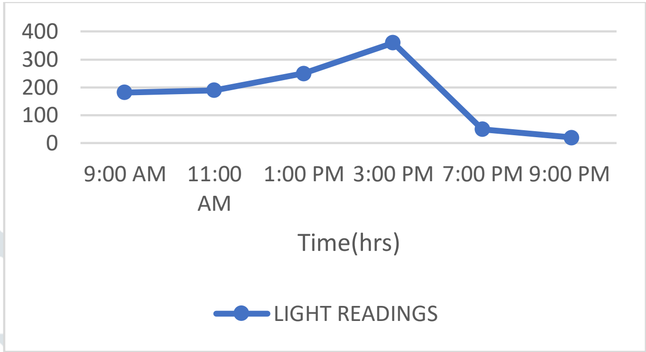


Fig:7 Graph of light intensity over time

TIME	MOISTURE READINGS	LIGHT STATUS
9:00 AM	80	OFF
11:00 AM	50	OFF
1:00 PM	35	ON
3:00 PM	20	ON
7:00 PM	70	OFF
9:00 PM	90	OFF

Fig:8 Reading from Soil Moisture sensor

The threshold set for soil moisture sensor will be <40 is ON

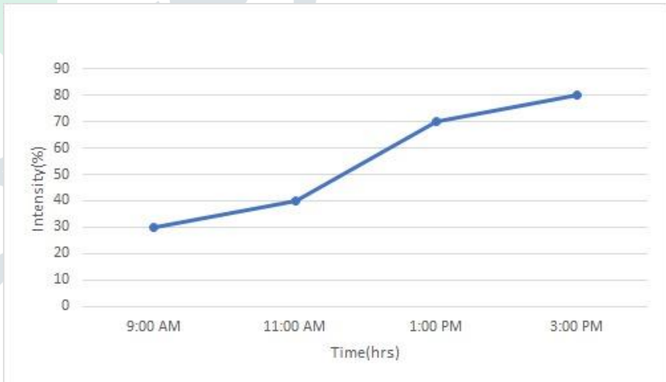


Fig:9 Graph of soil moisture(%) over time

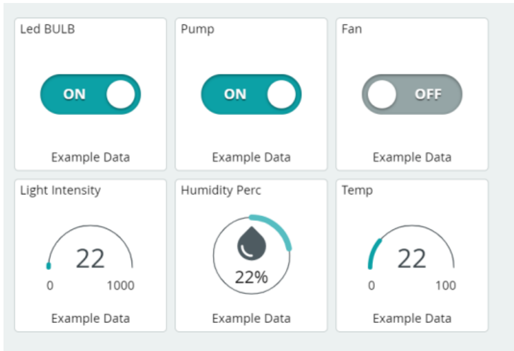


Fig :10 Screenshot of Iot Cloud Dashboard

This comprehensive control device is equippedwith essential sensors for monitoring moisture,temperature, and light levels to create an optimal environment for plants. It incorporates a smallwater tank to ensure plants receive the right amount of hydration. Powered by a 5V supply, it features a miniature fan and LED to regulate temperature and light conditions. Users can easilyaccess real-time temperature and moisture data onthe display console, enabling precise control and management of their plant environment for healthy

V. CONCLUSION

A smart greenhouse monitoring system has been devised, grounded in the Internet of Things (IoT) concept, and it offers substantial benefits to the agriculture sector. In contrast to the labor-intensive traditional greenhouse monitoring techniques, this innovative solution conserves both time and resources effectively. It establishes a controlled environment for plants, leading to an augmented overall yield.

Future scope :- We can use MQTT so that the notifications and messages can be sent to the user regarding the greenhouse.

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