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Hydroponic Monitoring System Using IoT

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ABSTRACT-

This paper the IoT technology into hydroponic systems for monitoring and irrigation. Hydroponic farming, known for its precise environmental control, benefits from IoT's real-time monitoring and automation. The review covers hydroponics basics, IoT's role in agriculture, monitoring parameters sensor types, and hardware/software components. It evaluates existing systems, discusses challenges, and outlines future directions. Ultimately, IoT promises to revolutionize hydroponic agriculture, enhancing sustainability and productivity.

Keywords- Hydroponic Monitoring, DHT11, Node MCU, IOT, Blynk.

1.INTRODUCTION

Hydroponic farming offers a optimistic solution for acceptable agriculture, requiring precise monitoring of environmental factors for perfect plant growth. The integration of IoT technology enhances this monitoring capability, enabling real time data collection and automated control in hydroponic systems. This review explores the synergy between hydroponics and IoT, examining their principles, applications, and benefits. Key topics include sensor-based monitoring, existing IoT-enabled systems, challenges, and future directions in IoT-driven hydroponic agriculture.

Specifically, we will cover:

Background and significance of hydroponic farming, highlighting its advantages and potential for addressing global food security challenges.

Introduction to IoT technology and its applications in agriculture, with a focus on its role in enabling precision farming practices.

Objectives of the paper, including the exploration of IoT-enabled hydroponic monitoring systems, the review of existing technologies and research, and the identification of challenges and future directions in this field.

2.OBJECTIVES OF THE STUDY

1. To Study the hydroponics farming and related detail.

2.To design and implement Hydroponic Monitoring system using IoT for monitoring various parameters such as water level, nutrient contain in water, soil moisture, temperature and humidity.

3.To provide real time access of the hydroponic Monitoring system on Blynk application to monitor and improve crop yield.

In this analysis work aim is to design and implement Hydroponic Monitoring system using IoT for monitoring various parameter of crops.

3.LITERATURE REVIEW

Several studies explore hydroponic systems and their monitoring using IoT technology. They highlight the advantages of hydroponics, where plants grow without soil but with nutrient-rich water instead. IoT-enabled systems utilize sensors to monitor crucial factors like pH, temperature, humidity, and nutrient levels in real-time. These sensors transmit data to mobile applications for remote monitoring and control. Additionally, machine learning algorithms are employed for disease detection and nutrient prediction in hydroponic plants. By analyzing data from various sensors, these algorithms can predict nutrient requirements, detect diseases early, and optimize growth conditions. Overall, the integration of IoT and machine learning in hydroponic systems holds promise for enhancing agricultural practices and ensuring food security.

4.FLOW CHART

Fig.4.1 Flow Chart of Hydroponic Monitoring System

1. Start: The process begins here.

2. Connect to Wi-Fi Network: The system first attempts to establish a connection to a Wi-Fi network.

3. Initialize Blynk App: Once connected to Wi-Fi, the Blynk app is initialized, presumably to configure how data will be transmitted between the system and the app.

4. Read Sensor Data: The system reads data from various sensors that monitor the hydroponics system. The specific sensors used can vary, but they typically measure factors like level of water, temperature, pH, and nutrient concentration in the nutrient solution.

5. Check Water Level: The system checks the level of water in the hydroponics tank. If the level of water is too low, the process moves to step 8. Otherwise, it goes to step 6.

6. Is Temperature Too Low/High: The system checks the water temperature reading. If the temperature is too low or high, the process moves to step 11 (activate fan). Otherwise, it goes to step 7.

7. Check Moisture Level: The system checks the level of moisture of the plant roots. If the level of moisture is too low, the process moves to step 8 (activate water pump). Otherwise, it goes to step 9.

8. Activate Pump/Fan: The system activates the water pump to add water to the reservoir or the fan to regulate temperature, depending on the outcome of the previous step.

9. Display All Data on LCD: All the sensor data is displayed on the LCD screen for the user to monitor the system.

10. Stop: The process pauses here, presumably waiting for new sensor data or user interaction. It likely loops back to step 4 to continuously monitor the system.

11. Notify User: If the temperature was outside the desired range, the system triggers a notification to the user through the Blynk app.

5.BLOCK DIAGRAM OF THE SYSTEM

In this below block diagram (fig. 1), we can see that three sensors used are: water level sensor for check the water level in soil, DHT11 sensor for temperature and humidity and Soil Moisture Sensor for the check the Moisture of soil. For communication signal bus data format is used and synchronization between DHT11 and MCU sensors.

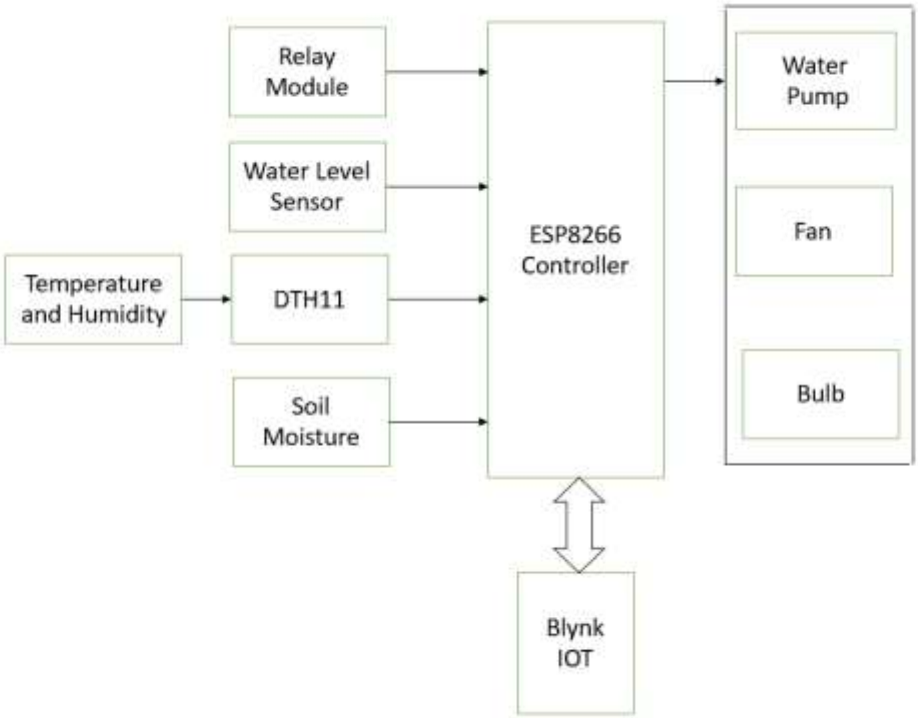

Fig. 5.1: Block Diagram of Hydroponics Monitoring System

Hydroponic monitoring system built with IoT technology. Sensors track the health of the plants by measuring factors like nutrient concentration, water level, temperature, humidity, and acidity. An ESP8266 microcontroller acts as the brain, collecting sensor data and sending it to the Blynk cloud platform. This cloud platform stores the data and allows visualization through a mobile app, enabling remote monitoring of the hydroponic system. This system empowers growers to identify trends, detect issues, and take corrective actions to optimize plant growth.

Sensors:

Water Level Sensor: Monitors the water level in the tank.

Temperature and Humidity Sensor **(DHT11):** Monitors the air temperature and humidity around plants.

Soil Moisture: Program the microcontroller to read sensor data and transmit it to an IoT platform.

Visualize data, set alerts, and automate irrigation based on soil moisture levels for efficient hydroponic monitoring.

ESP8266 Controller: An ESP8266 microcontroller is used to control the transmission of data between the sensors and the cloud platform. ESP32 typically integrates Wi-Fi and Bluetooth connectivity, eliminating the need for a separate Wi-Fi module.

Nutrient Pump: A pump that adds nutrients to the water reservoir as needed based on sensor readings and control algorithms.

Blynk (IOT): The cloud platform where the sensor data is sent and stored. Blynk allows you to create a user interface for your hydroponics system on a mobile application.

6.CIRCUIT DIAGRAM

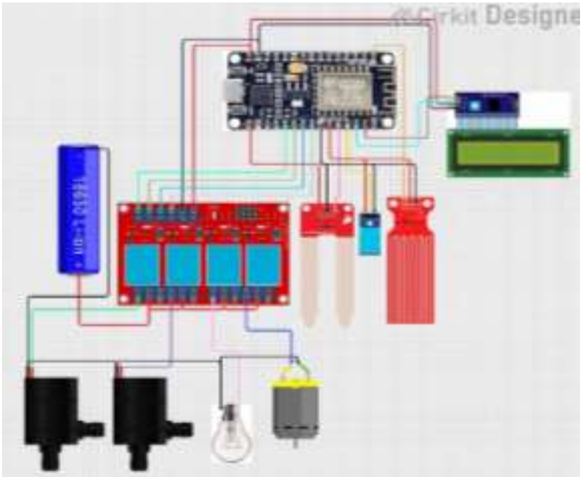

Fig. 6.1 Circuit Diagram of Hydroponics Monitoring System

Microcontroller (ESP8266): A Wi-Fi-enabled microcontroller that collects sensor data, automates actions, and transmits information for remote monitoring and control.

4-Channel Relay Module: This module contains four relays that can each turn on or off a device. In a hydroponics system, the relays might be used to control things.

Water Pump: A relay could be used to turn on a water pump to add water to the reservoir when the water level sensor detects a low water level.

Grow Light: A relay could be used to turn on or off grow lights depending on the time of day or light levels in the grow space.

Fan: A relay could be used to turn on a fan to circulate air and regulate temperature.

Sensors: The hydroponics system might use various sensors to monitor conditions such as:

Water Level Sensor: This sensor detects the water level in the tank and sends a signal to the microcontroller.

Air Temperature Sensor: This sensor monitors the air temperature around the plants and sends a signal to the microcontroller.

Humidity Sensor: This sensor monitors the humidity levels around the plants and sends a signal to the microcontroller.

LED: The LED (Light Emitting Diode) provides a visual indication of the soil moisture level. When the soil is dry, the LED might be off. When the soil is moist, the LED might be on.

7. CROP GROWTH SYSTEM

Day-1

Fig.7.1 day-1

Day-2

Fig.7.2 day-2

Day-3

Fig.7.3 day-3

Day-4

Fig.7.4 day-4

7.1. OBSERVATION AND MEASUREMENTS

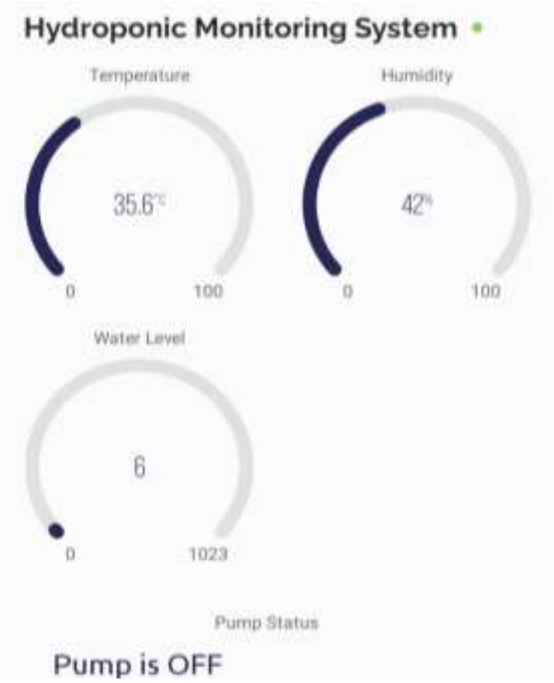

Fig.7.1.1 Observation and Measurements

The Fig 7.1.1 is sent is a hydroponic monitoring system app. It displays various sensor readings and system statuses. Here's a breakdown of the information:

Temperature: 35.6 c

Humidity: 42%

Water Level: 6 (1023 Likely a numerical representation of water level sensor reading)

8.ADVANTAGES & APPLICATIONS

8.1 Advantages of a Hydroponic Monitoring System using IoT:

1. Improved Crop Growth and Yield:

Real-time monitoring of crucial factors like temperature, humidity, pH, nutrient levels, and water levels allows for precise adjustments to ensure optimal growing conditions.

Early detection of potential issues like nutrient imbalances or fluctuations in temperature can prevent problems before they impact plant health.

2. Reduced Labor Costs:

Automation of tasks like watering, nutrient delivery, and climate control minimizes the need for manual intervention, freeing up time for farmers to focus on other aspects of their operation.

Remote monitoring allows farmers to check on their systems from anywhere with an internet connection, reducing the need for frequent physical visits.

3. Enhanced Resource Efficiency:

Sensors can detect the exact amount of water and nutrients needed by the plants, minimizing waste and saving resources.

Automated systems ensure that resources are delivered only when necessary, reducing overall consumption.

4. Better Data-Driven Decision Making:

IoT systems collect and store data over time, allowing farmers to analyze trends and identify areas for improvement.

This data can be used to optimize growing conditions for specific crops and varieties, leading to consistently high yields.

5. Reduced Risk of Disease and Pests:

By maintaining optimal growing conditions, hydroponics systems can help to reduce the spread of diseases and pests.

Early detection of problems through real-time monitoring allows for swift intervention to prevent outbreaks.

8.2 Applications of a Hydroponics Monitoring System using IoT:

1. Commercial Hydroponic Farms:

Large-scale operations can benefit greatly from automated monitoring and control for consistent and efficient production.

2. Urban and Vertical Farming:

Space-constrained environments necessitate precise control over growing conditions, which IoT systems can effectively provide.

3. Research and Development:

Precise monitoring allows researchers to study the impact of various factors on plant growth in a controlled setting.

4. Hobbyist Hydroponics:

Enthusiasts can leverage IoT systems for convenient monitoring and control, even if they have limited experience.

5.Educational Applications:

Schools and universities can use IoT-based hydroponics systems to teach students about plant science and sustainable agriculture.

9. RESULTS AND DISCUSSION

IoT-based hydroponic monitoring systems have demonstrably improved crop growth and yield by providing real-time data for precise control over growing conditions. They optimize resource use by minimizing waste and reduce labor requirements through automation. Data collected by these systems empowers data-driven decision making and facilitates early detection of problems. However, upfront costs, scalability across diverse setups, and cybersecurity concerns remain points of discussion. Future integration of AI and machine learning promises even greater efficiency and productivity in hydroponic agriculture.

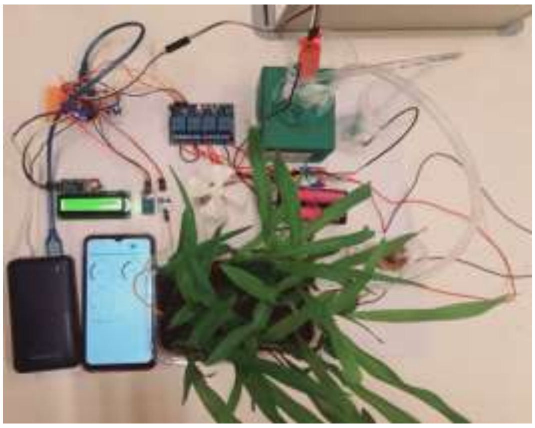

Fig.9.1 Result

Fig.9.2 Result

10. CONCLUSION

In conclusion, Hydroponics Monitoring Systems utilizing IoT technology represent a significant advancement in the field of agriculture. By enabling real-time monitoring, precise control, and data-driven decision making, these systems offer a multitude of advantages. From improved crop yield and resource efficiency to reduced labour costs and minimized disease risk, IoT-based hydroponics empowers farmers to achieve greater success. These systems hold immense potential for commercial farms, urban agriculture initiatives, research endeavours, and even hobbyist setups. As technology continues to evolve, we can expect even more sophisticated and user-friendly hydroponics monitoring systems to emerge, further revolutionizing the way we cultivate crops and ensuring a sustainable future for agriculture.

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