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IoT Based Soilless Cultivation

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Abstract: *An inventive technique for growing plants without soil is IoT-based soilless agriculture, which uses nutrient-rich water to increase growth efficiency. This research introduces an Internet of Things-based automated soilless farming system that maximizes plant health by combining automated control and real-time monitoring. The system makes use of Node MCU for cloud-based data transmission to Thing Speak, allowing for remote monitoring and control, and Arduino for local processing. Optimal growing conditions are ensured by key sensors, such as an ultrasonic sensor for water level detection, a pH sensor for nutrient level monitoring, a DHT11 for tracking temperature and humidity, and an LDR for measuring light intensity. Water circulation and nutrient delivery are automated by two water pumps. While a CPU fan guarantees adequate air circulation and LEDs provide artificial lighting. Relays use sensor data to regulate the lighting and pumps. By automating tasks like lighting controls, water refills, and nutrient distribution, the system minimizes human involvement and maximizes resource use. Users can remotely monitor and adjust environmental conditions using real-time sensor data posted to Thing Speak, increasing the sustainability and efficiency of soilless farming. Crop productivity is increased, resources are saved, and precision agriculture is supported by an Internet of Things-based system.*

Keywords: Arduino Uno, node MCU, GSM module, LDR sensor, PH sensor, DHT11 sensor, relay, lcd, ultrasonic sensor, CPU fan.

1. INTRODUCTION

An innovative agricultural technique called IoT-based soilless agriculture uses nutrient-rich water in place of soil to improve plant growth efficiency. With the help of Arduino for local processing and Node MCU for cloud-based data transmission to Thing Speak, this project presents an automated system that integrates IoT for real-time monitoring and control. By keeping an eye on temperature, humidity, light intensity, water levels, fertilizer levels, and DHT11, pH, LDR, and ultrasonic sensors, key sensors help to guarantee ideal growing conditions. Relays control activities based on sensor readings, while automated water pumps, LEDs, and a CPU fan control lighting, irrigation, and air circulation. By automating lighting controls, water refills, and nutrient distribution, the system minimizes manual involvement while increasing crop output and resource efficiency. This Internet Images obtained under low-light conditions tend to have the characteristics of low-grey levels, high-noise levels, and indistinguishable details. Image degradation not only affects the recognition of images, but also influences the performance of the computer vision system. The low-light image enhancement algorithm based on the dark channel prior de-hazing technique can enhance the contrast of images effectively and can highlight the details of Things-based technology facilitates precision farming, resource conservation, and sustainable soilless farming by providing remote monitoring and fine-tuning through Thing Speak.

2. LITERATURE SURVEY

IoT based Automated Hydroponics System, over the years traditional farming for harvesting with the use of soil takes longer time to decompose making it prone to diseases and expensive. Hydroponics system means growing plants without soil with better results, especially in areas with space and environment unsuitable. Commercial Hydroponics is the upcoming technology that grows plants through an inert media instead of natural soil. This system has no adverse effects on environment or quality on crops. In contrast, it provides better nutrient value and allows controlling the nutrients via

nutrient solution. Its main aim is to save water, improve quality of crops avoiding the adverse effects of pesticides and factors affecting quality of soil and save land. This paper provides an overview about the cost-effective implementation of Hydroponics for small farmers in India. An Intelligent IoT Based Hydroponics for Smart Soilless Agriculture is the backbone of human existence because it provides the bulk of the world's food supplies and a variety of other raw materials. It's a major factor in the growth and prosperity of any country. It also provides them with several commercial opportunities. Improvements to the national economy depend critically on progress in the agricultural sector. Planting is made more difficult in an uncontrolled environment by global warming. Farmers that practice sustainable agriculture rely on soil that is high in organic matter and naturally rich in minerals. It also needs a lot of space and water, and there are associated labour costs for ploughing and weeding. When it comes to seasonal plants, the harvest falls short of both consumer demands and producers' hopes for increased output. As a result, farmers should seek out a technique that allows them to easily regulate environmental variables like temperature, humidity, and light intensity throughout the year while spending as little as possible. Hydroponic farming, in which plants are grown in a nutrient-rich solution rather than in soil and direct sunlight, is presented in this suggested study. In hydroponics, the roots of the plants are kept above ground and fed a solution of minerals and water. This technique is a form of indoor agriculture that is not affected by the weather and saves money by not necessitating ploughing or other labour-intensive practices. Humidity, temperature, and water level are monitored and adjusted using a microcontroller Kit coupled to a wireless sensor network with internet. This Internet of Things technology would allow the authorized individual to check in on the plant's progress in real time, wherever they might be. In addition, LSTM, a deep learning model, is employed to anticipate potential outcomes. An Intelligent IoT Based Hydroponics for Soilless Agriculture plays a major function on improving the financial system of the United States. Modern-day farming technique like Hydroponics is in rise which is soilless farming tradition and the flowers have been grown with the help of nutrient solutions. The Aquicultural device can be learned via a device mastering technique like artificial Neural Networks (ANN). Net of things (IoT) allows device to device conversation and monitoring the hydroponic arrangement and intelligently. This painting is evolved a wise IoT based hydroponic device by applying ANN. The hydroponic system imparting a sensor like temperature, humidity, suitable manage over the sprinkler and water waft for the aquiculture atmosphere primarily based at the multiple input parameters collected from sensors

3. PROPOSED METHOD

Real-time monitoring, automated decision-making, intelligent resource distribution, and remote optimization are the guiding principles of the suggested Internet of Things-based soilless farming. Essential parameters like pH, EC, water levels, temperature, humidity, light intensity, and dissolved oxygen are all continuously monitored by sensors. This information is sent to a cloud-based system, where AI-powered algorithms assess the situation and make accurate corrections. Automated pumps regulate the concentration if nutrients are inadequate, cooling fans or misting systems activate if the temperature rises over the optimal range, and the system automatically supplies acid or base solutions if the pH is out of balance. Using a smartphone or online dashboard, farmers can also remotely monitor and control the system, getting real-time warnings and insights to help them make better decisions.

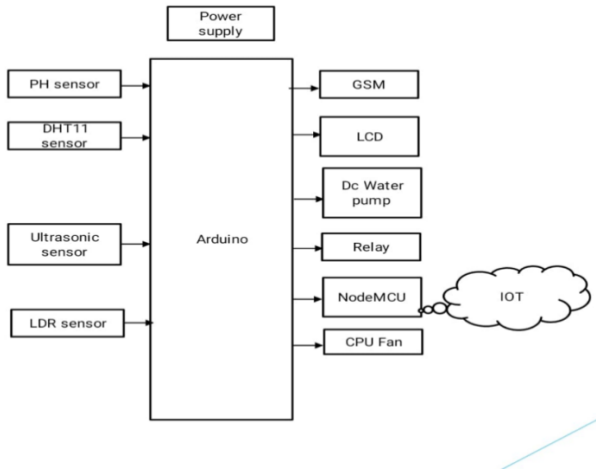


FIGURE 1. Block diagram of IOT based soilless cultivation

This method uses IoT, automation, and AI to produce a fully optimal growing environment without soil, increasing crop output, decreasing resource waste, and promoting sustainable farming.

4. RESULTS

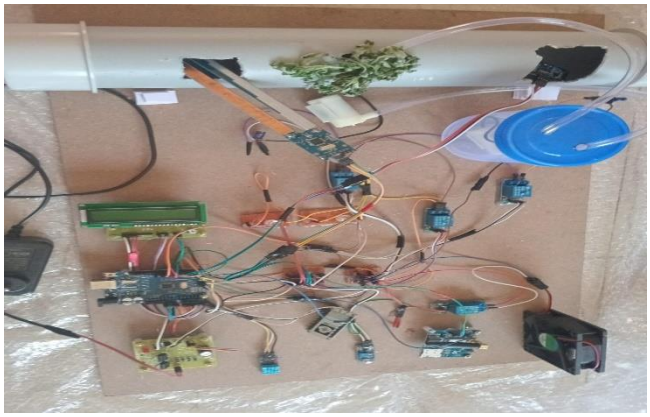


FIGURE 2. Real-time monitoring and control kit

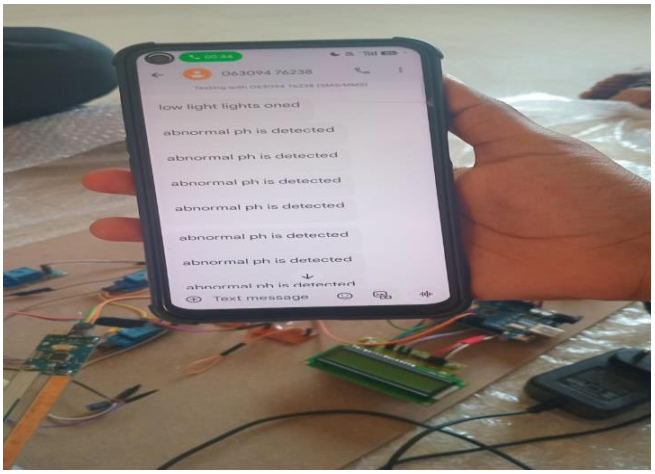
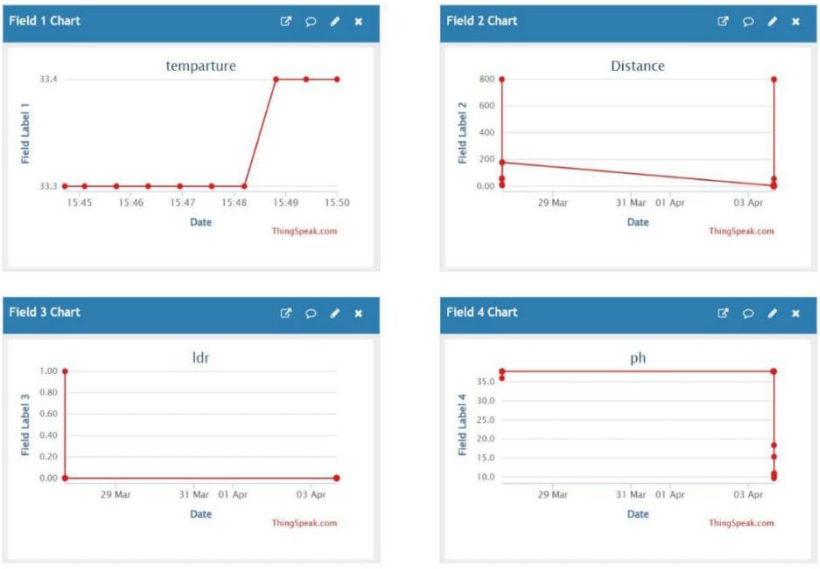


FIGURE 3. Alert Messages in mobile phone (if any abnormal ph levels and light intensity is detected).



. **FIGURE 4.** Sensor data visualization dashboard thing speak

5. CONCULSION

By incorporating real-time monitoring and control, the Internet of Things-based soilless cultivation system provides a productive, automated, and sustainable method of contemporary farming. Through controlled nutrient distribution, water management, lighting control, and air circulation, the system guarantees optimal plant growth by utilizing Arduino and Node MCU for both local and cloud-based processing. Continuous environmental monitoring using sensors improves accuracy while lowering resource waste and manual intervention. Thing Speak allows customers to remotely adjust settings for increased crop productivity. Soilless farming is a realistic and scalable alternative for future food production because of this creative method, which maximizes agricultural efficiency while also encouraging resource conservation.

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