OPTIMISING CROP CARE BY INTELLIGENT HYDROPONIC WITH SENSOR FUSION

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ABSTRACT
Hydroponic farming, characterized by its soil-less cultivation method, offers a promising avenue for sustainable and efficient crop production. However, optimizing growth conditions and ensuring plant health in hydroponic systems require real-time monitoring. In response, this project presents a sensor fusion-based intelligent hydroponic farming and nursing system designed to enhance crop yield and health. The system employs a diverse array of sensors to collect data on critical environmental parameters such as temperature, humidity, pH levels, nutrient concentrations. Through sophisticated data fusion techniques, these disparate data streams are integrated to provide a holistic view of the hydroponic environment. Actuators within the system respond to these decisions by modulating nutrient delivery and managing other environmental variables crucial to plant health. Concurrently, the system continuously monitors crop growth and health to assess plant development and detect potential issues early on. By amalgamating sensor fusion, intelligent decision-making, and real-time control, this project endeavors to establish a robust framework for maximizing crop yield and sustainability in hydroponic farming practices.
Key words: Hydroponics, Real-time data acquisition, Automated farming, Smart plant farming.

INTRODUCTION
Soil-based agriculture is currently experiencing difficulties. Due to a variety of man-made factors, including industrialization, urbanization, natural disasters, climate change and the unrestricted use of chemicals in agriculture. Soilless agriculture, or hydroponics, is a relatively recent alternative crop-production technique. Hydroponically, plants are grown by immersing them in a nutrient-rich water solution. With hydroponics, a wide variety of plants, crops, or vegetables can be grown. food cultivated hydroponically typically has higher yield quality, flavor, and nutritional value than food grown natively in soil. In order to meet the future demand for global nutrition as well as to produce a variety of fruits, vegetables, and livestock feed, hydroponics would be a superior method. IoT-enabled hydroponic systems can also be used to automate or preprogram important functions like lighting control, water management, and nutrient distribution. Because of this automation, there is less human labor involved and resources are used clearly and efficiently, which boosts output, lowers waste and the majority of tasks in greenhouse farming can be automated with hydroponics and IoT [1]. Significant advantages of IoT integration in hydroponics include better crop quality and quantity, enhanced sustainability, enhanced scalability, and effective resource management. Incorporating technology and sustainable agriculture, the talk emphasizes how Internet of Things hydroponic systems may transform contemporary agriculture. Our proposed model enables the hydroponics integrated with IoT which enables the automatic nutrient supply, lighting and required amount of water to the plants.

LITERATURE SURVEY
[1]Akshay Mendon; Bhavya Manoj Votavat; Shashank Singh- Design and construction of automated hydroponics system with remote monitoring and control this focuses on developing a hydroponic framework that is completely automated and built on the Internet of Things (IoT) technology Successful growth of the roots of spinach. Spinach was grown by controlling the pH range to be 6-7 and the EC range to be 1.8 - 2.3. [2]J. B. Jones- Complete guide for growing plants hydroponically this books helps to give a useful knowledge

by covering a variety of systems, nutrient management, plant care, pest control and provides a clear guide to hydroponic gardening. [3] Nur Anas Sobri; Izanoordina Ahmad; Siti Marwangi Maharum; Zuhanis Mansor; Abdul Halim Abd Rahman; Azman Abdul Aziz- c here data monitoring in real time via IoT as well as to test the performance by collecting real-time data and accurately results the sensor value in the ThingSpeak and spread sheet by use of wifi-module. [4]Ravi Lakshmanan; Mohamed Djama; Sathish Kumar Selvaperumal; Raed Abdulla - Automated smart hydroponics system using internet of things in this cloud-based monitoring and IoT devices are present.

EXISTING METHOD

[4]This paper centers on the challenges posed by the world's growing food demand and the need for sustainable farming practices, with a particular focus on integrating Internet of Things technology into hydroponic systems. The design and implementation of an automated smart hydroponics system using cloud- based monitoring and Internet of Things devices are presented in this paper. In a hydroponic system, measuring obstacles with an ultrasonic sensor might not directly relate to the plants themselves but rather to the infrastructure and environment surrounding them.

Figure.1. Block diagram for existing model

[3] The system was controlled by the Arduino-Uno project, which also collected data from all of the sensors, including pH, temperature, EC, and water level. Using an Internet of Things, the farmer will be able to monitor plant performance through to the Wi-Fi module's wireless data transmission to ThingSpeak and Spreadsheet.

Figure.2. Block diagram for existing model

PROPOSED METHOD

Figure.3. Block diagram for proposed method

ESP32 is a multipurpose microcontroller that is well-known for its low power consumption and dual-core processing capabilities, which make it perfect for Internet of Things applications. Integrating both Wi-Fi and Bluetooth allows for easy communication and control across a range of projects, including wearable technology and home automation. A switch that is electrically signal-controlled is called a relay module.Relay modules serve as interface components between microcontrollers and high-power devices, allowing microcontrollers to control circuits with voltages or currents beyond their capacity. Just three modules - two for water motors and one for plant growing light are utilized, out of a four-channel relay module. Digital temperature and humidity sensor DHT11 is a simple, affordable device. The 16x2 LCD (Liquid Crystal Display) is a standard alphanumeric display module often paired with microcontrollers to provide visual feedback or data output. Buzzer modules produce audible alerts or signals and are frequently employed in alarm systems, timers, and notification devices. TDS (Total Dissolved Solids) meters measure the concentration of dissolved solids in water and are vital tools in water quality analysis in hydroponic systems.[5] To find out how much water is in the water tank, a water level sensor is employed. Additionally, when the water level is low, this model uses it to pump water to the water tanks. The hydroponic system will use water from the water tank until the rockwool is sufficiently moist. This is known by the water moisture sensor. The model consists of two water tanks: tank 1 is for plants, and tank 2 is for external tanning. When the water level in tank 1 drops, water is automatically drawn from tank 2. If tank 2 is low on water, a buzzer will sound. The outlet of the hydroponics pipe is kept to the tank2. A continuous regulation of the water will be done here. LDR sensors change their resistance based on the intensity of light falling on them. They consist of a semiconductor material whose resistance decreases and conductivity increases as the incident light intensity increases. When light rays falls on the surface of the LDR, the conductivity of the material reduces. When there is no light on the surface of the LDR then the resistance gets reduced and the conductivity increases means the plant growing light will be on.

THE DESIGN STRUCTURE OF THE HYDROPONICS SYSTEM

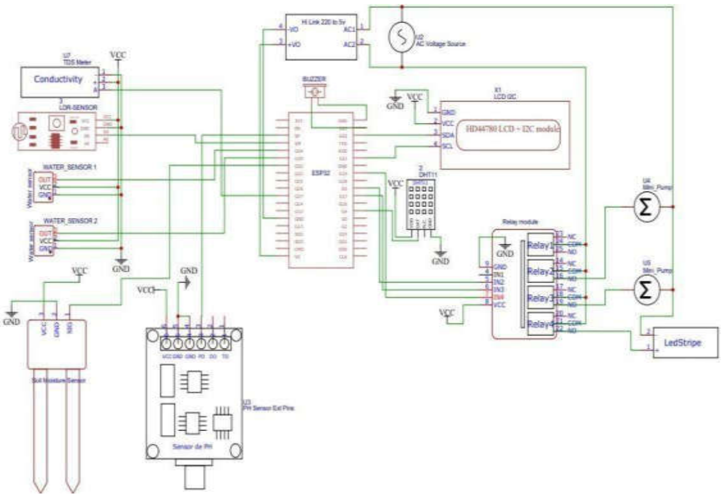

Figure.4. Schematic diagram for proposed method

- Left side of the diagram:
  AC Voltage Source: This provides power to the entire system.
  AC1 and AC2: These are likely connection points for the AC voltage source.
  Hi-Link 220V to 5V: This label indicate a adapter used to connect the AC voltage source to the system at a reduced voltage (220V to 5V).
- Center of the diagram:
  ESP32: This is the microcontroller unit (MCU) that controls the entire system. It receives signals from the sensors and sends control signals to the relays and sensors.
  DHT11: This is a temperature and humidity sensor. It sends a signal to the ESP32 with the current temperature and humidity readings.
  Water Sensor 1 and 2: These sensors detect the water level in the nutrient tanks. They send a signal to the ESP32 indicating whether the medium is wet or dry.
  Relay Module: This module contains multiple relays. A relay is a switch that is controlled by an electrical signal. When the ESP32 sends a signal to the relay module, it opens or closes a relay, which controls the flow of electricity to other components.
  Mini Pump: There are two mini pumps in the system. The ESP32 likely controls the relay module to turn on or off these pumps based on the readings from the water sensors.
  Moisture Sensor: This sensor likely measures the moisture content in the system. It sends a signal to the ESP32 with the current moisture reading.
- Right side of the diagram:
  TDS Meter: The ESP32 receives a signal from the TDS meter and that information to adjust the nutrient levels in the water supply.
  LCD 16x4 (HD44780 LCD-12C module): This is a Liquid Crystal Display (LCD) screen. The ESP32 can send signals to the LCD to display information of the sensors used.
  Buzzer: This is an audible alarm that can be used to signal that there is a problem with the system, such as a low water level in tank 2.
  Led Stripe: This is a strip of LEDs that can be used to provide lighting for the plants. The ESP32 with relay module can control the LED strip to turn it on or off and adjust the brightness.
  Ph: The ESP32 read the pH reading to adjust the pH of the water supply.

RESULT ANALYSIS

CONCLUSION

This hydroponics project integrates various sensors including temperature, humidity, water level, pH, TDS, moisture, and LDR sensors to maintain optimal growing conditions for plants. Real-time data on these parameters can be remotely monitored via ThingSpeak and an LCD display, facilitating efficient management. The system automatically adjusts water supply based on moisture levels to ensure plants receive sufficient hydration, while the LDR sensor triggers growing lights when natural sunlight is insufficient. Overall, this automated setup combines monitoring and control to create an efficient environment for sustainable and productive plant cultivation.

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