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Modern Farming

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ABSTRACT: The Internet of Things (IoT) is rapidly transforming various sectors, and agriculture is no exception. Traditional farming methods are being enhanced through IoT-based smart farming, optimizing resource utilization, reducing waste, and increasing crop yields. This paper proposes an IoT-based system for real-time monitoring of key environmental parameters in farmland, including temperature, humidity, soil moisture. The system utilizes Arduino Uno, ESP8266 Node MCU, and various sensors to collect data, which is then displayed on a web page, enabling farmers to make informed decisions and manage their crops effectively.

KEYWORDS: IoT, Smart Farming, Environment Monitoring, Precision Agriculture, Web Visualization

I. INTRODUCTION

Agriculture plays a vital role in sustaining the global population. However, traditional farming practices often face challenges such as inefficient resource management, environmental degradation, and crop losses due to unpredictable environmental conditions. IoT offers innovative solutions to address these challenges by enabling smart farming. Smart farming involves the use of interconnected devices and sensors to collect and analyze data, automate processes, and optimize resource utilization. This paper focuses on the development of an IoT-based environmental monitoring system for agricultural fields. The system aims to provide farmers with real-time data on critical environmental parameters, enabling them to make timely interventions and improve their farming practices. The system utilizes low-cost sensors and microcontrollers, making it a viable solution for small and medium-sized farms.

II. RELATED WORK

Several researchers have explored the application of IoT in agriculture. Dr. N. Sumathi. (2017) developed an IoT-based smart agriculture monitoring system. Soumil Heble et al. developed a low-power IoT network for smart agriculture. These studies demonstrate the potential of IoT to enhance agricultural practices and improve crop productivity.

III. SYSTEM DESIGN

Sensors:
- DHT11 Temperature and Humidity Sensor: Measures air temperature and humidity.
- Soil Moisture Sensor: Measures the water content in the soil.

Microcontroller:
- Arduino Uno: Processes the data from the sensors.
- ESP8266 Node MCU: Transmits the data to the web server via Wi-Fi.
  Actuator:
- Water Pump: Controls irrigation based on soil moisture levels.

Other Components:
- Breadboard: Used for prototyping the circuit.
- Jumper Wires: Used to connect the components.
- LEDs: Used for visual indication.
- Relay: Used to switch the water pump on/off.
- Power Supply: Provides power to the system.
- Web Page: Displays the sensor data and allows for remote monitoring.

IV. WORKING OF COMPONENTS

- **Arduino Uno-** The Arduino Uno acts as the central processing unit of the system, collecting data from the sensors and sending it to the ESP32 Node MCU

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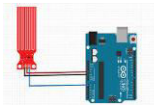
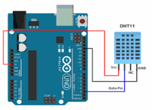
- **Power Supply-** Single power supply is used for whole components.
- **Water Level Sensor-** a water level indicator is device used to measure and display the level of water in the farm.

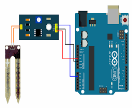


- **DHT11-** This sensor measures the temperature and humidity of the air and sends the data to the Arduino Uno.

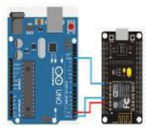


- **Water Pump-** The water pump is used to irrigate the farmland. It is controlled by the Arduino Uno based on the soil moisture data.

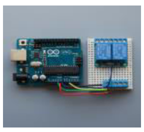
- **Soil Moisture Sensor-** This sensor measures the water content in the soil and sends the data to the Arduino Uno.



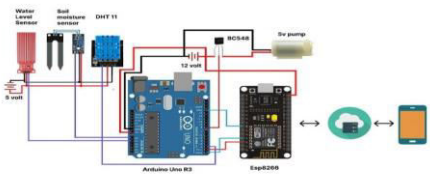
- **ESP 8266-** The ESP 8266 Node MCU is a Wi-Fi-enabled microcontroller that transmits the sensor data to a web server, making it accessible to the user through a web page.



- **BC 548 or relay-** The relay acts as a switch to control the water pump, turning it on or off as needed.



V. CIRCUIT DIAGRAM



The circuit diagram of modern farming

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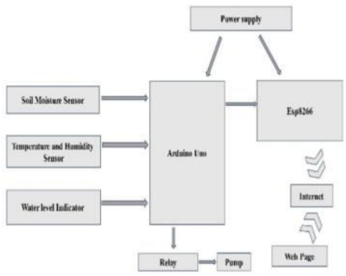
VI. BLOCK DIAGRAM



Block Diagram of Modern Farming.

VII. SYSTEM OPERATION

The system operates as follows:

- The sensors continuously collect data from the agricultural field, measuring temperature, humidity and soil moisture.
- The Arduino Uno process the data from the sensors.
- The ESP 8266 Node MCU transmits the processes data to a web server via Wi-Fi.
- The web server stores the data and makes it accessible through a user-friendly web interface.
- Farmer can access the web page to monitor the environmental condition in their fields in real time
- The system can also automate irrigation by controlling the water pump based on the soil moisture level, ensuring optimal water usage.

VIII. EXPERIMENTAL RESULTS

Initialization of Project

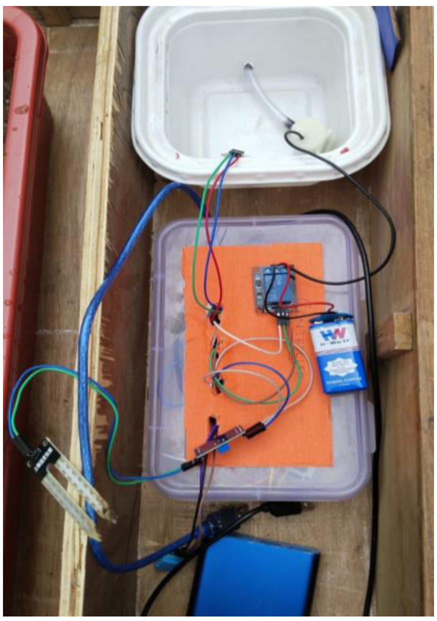


Fig. 1- Initialization of modern Farming

Detection of value using Sensors

Fig. 2- Sensor's measurement and store the data in the Esp 8266 send the data to web page via Wi-Fi.

Sensor value measure and showed on Web page.

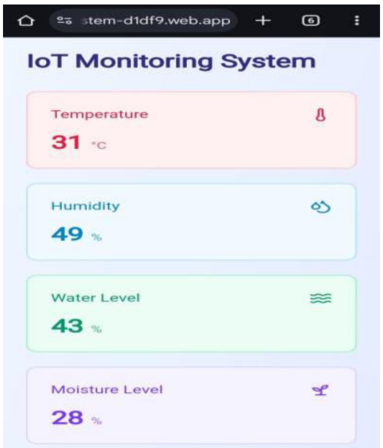


Fig. 3- Output on Web page moisture level less than 40 % motor will turn ON.

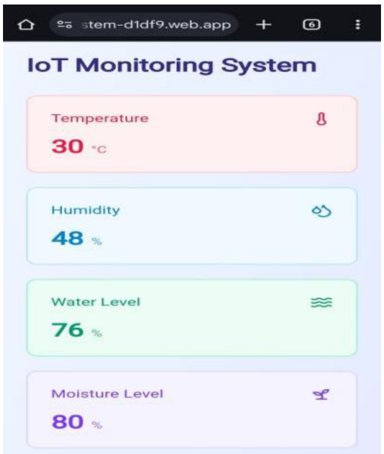


Fig. 4- Output on web page moisture level more than 60% motor will turn OFF.

Condition of Moisture level and Control: -
Pump's behavior based on the soil moisture sensor readings. Here's an in-depth explanation of how the system would control the pump with the "less than moisture level of 40%" and "more than moisture level of 60%" conditions:
Scenario: Soil Moisture Sensor and Pump Control
Soil Moisture Sensor: This sensor is the crucial input device. It constantly measures the amount of moisture in the soil and provides a numerical output representing that moisture level.
Microcontroller (Arduino/ESP32): This acts as the brain, making decisions based on the sensor's input.
Relay: This is an electrically operated switch. The microcontroller controls the relay, and the relay controls the power of water pump.
Water Pump: The device that moves water for irrigation.
Conditions and Actions:

Condition 1: Soil Moisture Reading is Less than 40%
Meaning: The soil is relatively dry. The numerical reading indicates a low level of moisture.
Microcontroller Action:
The microcontroller interprets the sensor's reading (e.g., 35, 28, 15) as "too dry."
The microcontroller sends a signal to the relay to close the circuit.
Closing the circuit allows electricity to flow to the water pump.
Relay Action: The relay receives the signal and switches to the "on" position, completing the electrical circuit.
Water Pump Action: With power supplied, the water pump turns on and begins to irrigate the land.

Condition 2: Soil Moisture Reading is 60 or More
Meaning: The soil has sufficient moisture. The reading indicates an adequate or high level of water content.
Microcontroller Action:
The microcontroller interprets the sensor's reading (e.g., 60, 65, 80) as "sufficiently moist" or "wet enough."
The microcontroller sends a signal to the relay to open the circuit.
Opening the circuit stops the flow of electricity to the pump.
Relay Action: The relay receives the signal and switches to the "off" position, interrupting the electrical circuit.
Water Pump Action: With the power supply cut off, the water pump turns off.
In Summary:
The system uses the threshold of 40% as a switch point:

- Below 40%: The pump is on (irrigation occurs).
- 60% or above: The pump is off (irrigation stops).

This precise control ensures that the crops receive the right amount of water, preventing both under-watering and over-watering.

IX. ADVANTAGES

- Reduced Human Effort: The system automates data collection and monitoring, reducing the need for manual labor.
- Real-time Monitoring: The system provides farmers with real-time data on environmental conditions, enabling them to make timely decisions.
- Increased Efficiency: The system optimizes resource utilization, such as water and fertilizers, leading to increased efficiency.
- Water Conservation: Automated irrigation based on soil moisture levels helps conserve water.
- Remote Monitoring: Farmers can monitor their fields remotely through the web interface.

X. APPLICATIONS

- Hydroponics: Monitoring and controlling environmental parameters in hydroponic systems.
- Smart Greenhouses: Automating climate control in greenhouses to optimize plant growth.
- Yield Monitoring: Collecting data to predict and optimize crop yields.
- Livestock Monitoring: Monitoring the health and well-being of livestock.

XI. CHALLENGES AND LIMITATIONS

- Initial Cost: The initial investment in sensors, microcontrollers, and communication infrastructure can be a barrier for some farmers.

- Maintenance: The system requires regular maintenance to ensure proper functioning of the sensors and other components.
- Connectivity: Reliable internet connectivity is essential for data transmission, which can be a challenge in remote areas.
- Data Security: Protecting the collected data from unauthorized access is crucial.

XII. FUTURE SCOPE

- Integration with Smart Farming Technologies: Integrating the system with other smart farming technologies, such as precision agriculture tools, drones, and robotics, to create a comprehensive agricultural management system.
- Community and Shared Farming Initiatives: Utilizing IoT to facilitate community-based farming and shared agricultural resources.
- Integration with Renewable Energy: Powering IoT devices with renewable energy sources, such as solar power, to enhance sustainability.
- AI-Powered Data Analysis: Implementing artificial intelligence (AI) algorithms to analyze the collected data and provide predictive insights to farmers.

XIII. CONCLUSION

In conclusion, this paper has presented an IoT-based environmental monitoring system that offers a robust and promising solution for modernizing agricultural practices. The system's capacity to provide farmers with real-time data on critical environmental parameters, coupled with its ability to automate irrigation processes, holds significant potential for optimizing resource utilization, minimizing waste, and ultimately enhancing crop yields. By empowering farmers with data-driven insights and automated control, this technology can contribute to more efficient and sustainable farming practices. While challenges such as initial investment, maintenance requirements, connectivity limitations, and data security considerations remain to be fully addressed, the trajectory of IoT applications in agriculture is undeniably bright. The continued development and adoption of such smart farming solutions are crucial to transform farming practices and ensure food security for a growing global population.

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