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IOT Based Automatic Plant Irrigation System

RAVI LAKSHMI SNEHITHA[1], NADIMINTI SHIRISHA[2] , SURAVARAPU NEELIMA[3], YASMEEN CHANDHINI[4],

V B K P D NAIDU[5]

[1234]Students

[5]*Assistant Professor, Department of Electronics and Communication Engineering, Sanketika Institute of Technology and Management*

Abstract

The IoT-based automatic plant irrigation system is a sustainable solution that combines solar energy and smart technology to optimize water usage and reduce manual intervention. IoT sensors monitor soil moisture levels, automating irrigation based on real-time data. Solar panels provide renewable energy, while Amazon Alexa integration enables voice-controlled operation and system monitoring. This innovative approach enhances agricultural productivity, conserves resources, and promotes eco-friendly farming practices.

Keywords: IoT, automatic irrigation, solar panels, Amazon Alexa, smart agriculture, sustainable farming, automation, renewable energy.

1. Introduction

Agriculture faces significant challenges due to water scarcity and inefficient irrigation methods. This project addresses these issues by leveraging IoT technology, solar energy, and voice-assisted control. The system automates irrigation based on soil moisture levels, ensuring precise water usage and reducing wastage. Solar panels power the system sustainably, while Alexa integration offers user-friendly control and real-time updates. This solution represents a step toward smarter and more sustainable farming practices.

2. Methodology

The system employs IoT sensors to monitor soil conditions and a microcontroller to process data. Solar panels provide renewable energy to power the water pump, which irrigates plants based on sensor readings. Alexa integration allows users to control and monitor the system through voice commands, ensuring convenience and efficiency.

3. System Design and Implementation

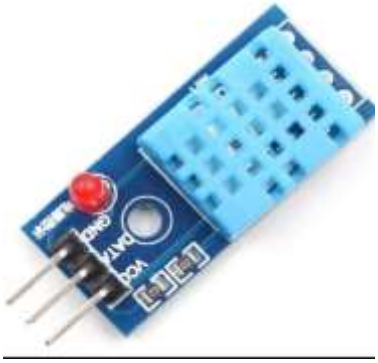
3.1 Hardware Components

Solar Panel: Supplies renewable energy to power the system.

ESP32 Microcontroller: Acts as the brain of the system, processing data from sensors and controlling the water pump.

Wi-Fi Module: Enables remote monitoring and control of the irrigation system through a mobile app or web interface.

DHT11 Sensor: Measures temperature and humidity, helping determine optimal watering conditions.



Relay: Serves as an electronic switch, controlling the water pump based on sensor readings.

Water Pump: Delivers water to the plants when needed, ensuring proper hydration.

3.2 **Software Development**

- **Mobile App:** (Flutter/React Native) for monitoring & control.
- **ESP32 Firmware**: (C/C++) for sensor-based automation.
- **Communication Protocols**:

(MQTT, HTTP API) for data exchange.

3.3 **Working Principle**

IoT sensors collect soil moisture data and send it to the microcontroller. Based on predefined thresholds, the system activates the water pump to irrigate plants. Solar panels power the components, ensuring environmental sustainability. Alexa integration allows users to interact with the system via voice commands for real-time updates and control.

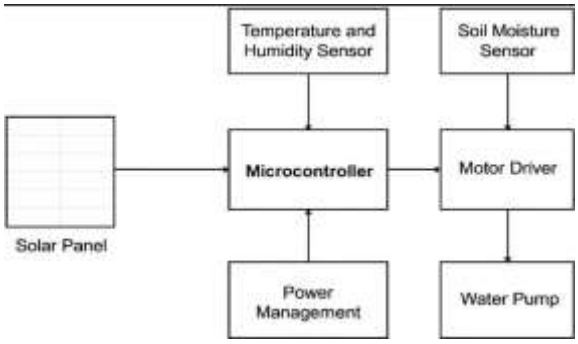
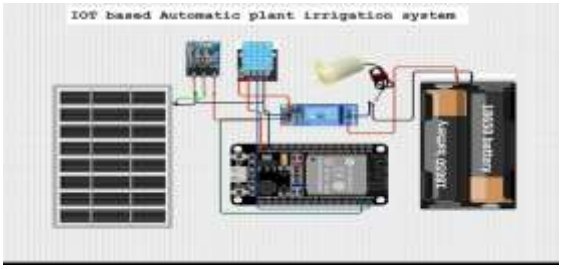


Fig 4: Block Diagram of IOT based Automatic plant Irrigation system



Schematic Diagram

4. Applications and Benefits

- **Applications:**
- **Agriculture**: Optimizes irrigation in farms and greenhouses.
- **Home Gardens**: Automates watering for residential plants.

- **Urban Green Spaces**: Maintains parks and gardens efficiently.
- **Benefits**:
- Saves water and energy.
- Reduces manual labor.
- Promotes sustainable farming practices.
- Provides user-friendly voice control and monitoring.

5. Future Enhancements

- **AI Integration:** Predictive analytics for irrigation schedules based on weather and soil conditions.
- **Advanced Sensors:** Inclusion of nutrient and temperature monitoring for comprehensive plant care.
- **Scalability:** Deployment in large-scale farming and urban green spaces.
- **Mobile App Integration:** Real-time monitoring and control through smartphones.

6. Conclusion

The IoT-based automatic irrigation system powered by solar panels and Alexa integration offers an innovative solution for modern agriculture. It minimizes resource wastage, enhances productivity, and demonstrates the potential of combining renewable energy and smart technology to address global farming challenges. This project paves the way for sustainable and intelligent agricultural practices, contributing to environmental conservation and efficient resource management.

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