

Real Time Monitoring and Control of Irrigation System Using IoT

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ABSTRACT: This paper presents an IoT-based real-time monitoring and control system for smart irrigation in agriculture. The system is developed using the ESP32 microcontroller integrated with various sensors such as soil moisture sensor, DHT11 temperature and humidity sensor, water level sensor, rain sensor, and relaycontrolled water pump. The system continuously monitors environmental and soil conditions and automatically controls irrigation based on soil moisture levels. The collected data is transmitted to a cloud platform for remote monitoring and analysis. Alerts are generated when abnormal conditions occur, such as low water level or pump failure. The proposed system minimizes water wastage, improves crop productivity, and provides a low-cost solution for precision agriculture.

KEYWORDS: IoT, ESP32, Smart Irrigation, Soil Moisture Sensor, Agriculture Automation, Water Management.

I. INTRODUCTION

Agriculture plays a vital role in the economy and food production of many developing countries. Efficient water management is one of the most important challenges in agriculture due to increasing water scarcity and climate change. Traditional irrigation methods often result in excessive water usage, uneven distribution, and reduced crop productivity.

Conventional irrigation systems mainly depend on manual operation, where farmers switch water pumps ON or OFF based on personal observation. This process is labor-intensive, timeconsuming, and inefficient because soil conditions and environmental factors continuously change. Delayed irrigation or over-irrigation may lead to crop damage, nutrient loss, and unnecessary water consumption.

The rapid development of the Internet of Things (IoT) provides advanced solutions for smart farming applications. IoT enables real-time monitoring, automated control, and remote management using interconnected sensors and cloud technologies. By integrating sensors with wireless communication modules, agricultural fields can be continuously monitored, and irrigation can be automatically controlled based on environmental conditions.

This work proposes a Real-Time Monitoring and Control of Irrigation System using the ESP32 microcontroller. The system integrates soil moisture sensing, temperature and humidity monitoring, rain detection, and water level measurement with automated pump control. Sensor data is displayed locally on an LCD and transmitted to a cloud platform for remote monitoring. Threshold-based automation ensures efficient irrigation while reducing water wastage and human intervention.

II. LITERATURE SURVEY

Recent studies highlight the importance of IoT technologies in smart agriculture and automated irrigation systems. Kumar and Singh (2019) developed an IoT-based irrigation monitoring system using soil moisture sensors and wireless communication to optimize water usage. Their system demonstrated significant reduction in water consumption.

Reddy and Kumar (2018) introduced a GSM-based irrigation control system that enabled farmers to remotely monitor and control irrigation pumps through mobile communication. Other studies focused on low-power wireless sensor networks, weather-based irrigation scheduling, and machine learning approaches for precision agriculture.

Despite these developments, many existing systems are limited to only soil moisture monitoring and lack additional features such as rain sensing, water level detection, local display systems, and cloud analytics. Some systems also lack automated alert mechanisms and real-time remote access.

The proposed system addresses these limitations by integrating multiple sensors, cloud connectivity, automated pump control, LCD visualization, and multi-modal alerts to provide a comprehensive smart irrigation solution.

III. EXISTING SYSTEM

Traditional irrigation systems rely heavily on manual labor and fixed irrigation schedules. Farmers typically operate water pumps manually without continuously monitoring soil moisture or environmental conditions. This results in excessive water usage, uneven irrigation, and increased operational costs.

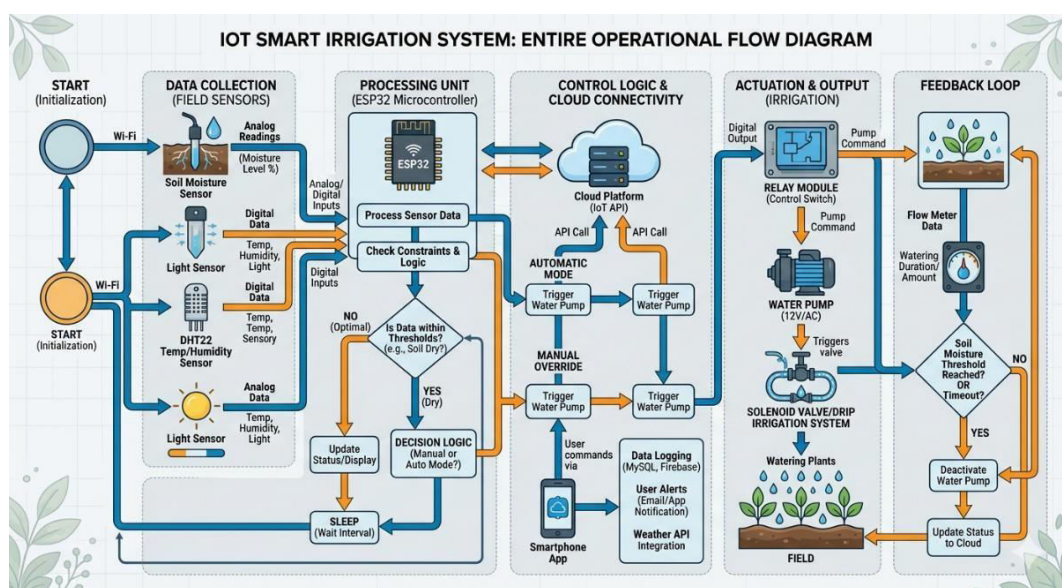
Existing irrigation systems often lack real-time monitoring, remote accessibility, and automation capabilities. In many rural areas, farmers must physically visit fields to inspect irrigation conditions, which is inefficient and time-consuming.

IV. PROPOSED SYSTEM

The proposed system uses the ESP32 microcontroller as the central processing and communication unit. It interfaces with multiple sensors to monitor environmental and irrigation-related parameters:

- **Soil Moisture Sensor:** Measures moisture content in soil
- **DHT11 Sensor:** Measures temperature and humidity
- **Rain Sensor:** Detects rainfall conditions
- **Water Level Sensor:** Monitors water availability in tank
- **Relay Module:** Controls water pump automatically
- **LCD (16×2):** Displays real-time sensor values
- **Buzzer:** Generates alerts during abnormal conditions

The ESP32 collects sensor data and transmits it to a cloud platform using Wi-Fi connectivity. Based on soil moisture values, the system automatically switches the irrigation pump ON or OFF using the relay module. The LCD displays real-time readings locally, while cloud monitoring enables remote supervision. Threshold-based decision-making improves irrigation efficiency and reduces water wastage. The system is low-cost, scalable, and suitable for smart agriculture applications.



V. SYSTEM ARCHITECTURE AND METHODOLOGY**A. Architecture Overview**

The system architecture consists of three major layers:

1. **SensingLayer:** Sensors collect soil and environmental data.
2. **ProcessingLayer:** ESP32 performs data acquisition, decision-making, automation, and cloud communication.
3. **CloudLayer:** Stores and visualizes sensor data for remote monitoring and analysis.

B. Working Principle

1. Initialize ESP32 and sensor interfaces
2. Establish Wi-Fi connection
3. Read soil moisture, temperature, humidity, rainfall, and water level data
4. Display sensor values on LCD
5. Upload data to cloud platform
6. Compare sensor values with predefined thresholds
7. If soil moisture is low → Turn ON water pump
8. If sufficient moisture is reached → Turn OFF water pump
9. Generate alerts during abnormal conditions
10. Repeat continuously in loop

C. Threshold Logic

- Soil Moisture < 30% → Turn ON Pump
- Soil Moisture > 70% → Turn OFF Pump
- Water Level Low → Alert Notification
- Rain Detected → Stop Irrigation
- Temperature > 40°C → Warning Alert

5.1 HARDWARE COMPONENTS

1. ESP32 Microcontroller
2. Soil Moisture Sensor
3. DHT11 Sensor communication with ESP32 using Arduino IDE.
4. Relay Module Water Pump
5. LCD Display
6. Power Supply

5.2 SOFTWARE REQUIREMENTS**• Arduino IDE**

Arduino IDE is used for writing, compiling, and uploading code to the ESP32 microcontroller. It supports Embedded C programming for IoT applications.

• Embedded C

Embedded C language is used for programming sensor interfaces, cloud communication, and automation logic.

• ThingSpeak Cloud Platform

ThingSpeak is used for storing, analyzing, and visualizing real-time sensor data remotely.

• ESP32 Board Package

ESP32 board package enables programming and communication with ESP32 using Arduino IDE.

• Wi-Fi Communication Protocol

Wi-Fi communication protocol is used to transmit sensor data from ESP32 to the cloud platform for remote monitoring and irrigation control.

5.3 HARDWARE REQUIREMENTS**1. ESP32 Microcontroller** Quantity: 1

Used as the main processing and control unit with built-in WiFi capability.



Figure 5.1 ESP32

2. Soil Moisture Sensor

Quantity: 1 Measures temperature and humidity inside the warehouse.

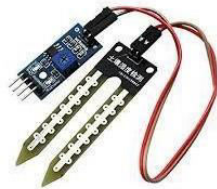


Fig 5.2 soil moisture sensor

3. DHT11 Sensor

Quantity: 1 Measures temperature and humidity inside the warehouse.

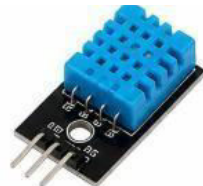


Figure 5.3. DHT11 Sensor

4. Relay Module

Quantity:1

Controls the water pump automatically based on sensor values.



Figure 5.4 Relay Module

5. Water Pump Quantity:1

Supplies water to the agricultural field during irrigation.



Figure 5.5 Water Pump

6. LCD Display Quantity:1

Displays real-time sensor readings and pump status.



Figure 5.6 LCD Display

7. Power Supply Quantity:1

Provides electrical power to the complete system.



Figure 5.7 Power Supply

VI. RESULTS & DISCUSSION

The home page of the Smart Irrigation System provides a complete overview of the agriculture monitoring process. It displays real-time values of soil moisture, temperature, humidity, pH level, and water pump status through the IoT dashboard. The page is designed using a simple and user-friendly interface so that farmers can easily monitor field conditions. Sensor data collected from the ESP8266 NodeMCU is updated continuously and displayed both on the LCD screen and the ThingSpeak cloud platform. The dashboard also shows graphical representations of environmental data for better analysis and decision-making.



Figure 6.1 Home page

The Smart Irrigation System is an IoT-based agriculture monitoring project developed using ESP8266 NodeMCU, soil moisture sensor, DHT11 sensor, pH sensor, relay module, water pump, LCD display, and ThingSpeak cloud platform. The system continuously monitors soil moisture, temperature, humidity, and soil pH level in real time. When the soil becomes dry, the relay automatically turns ON the water pump for irrigation. The DHT11 sensor measures environmental conditions, while the pH sensor checks soil acidity and alkalinity levels for healthy crop growth. All sensor values are displayed on the LCD screen and uploaded to the ThingSpeak cloud dashboard through WiFi connectivity. Farmers can monitor the data remotely using graphs and charts from anywhere through the internet. This automated system helps in reducing water wastage, minimizing manual effort, and improving efficient farming practices

Figure 6.2 Output chart

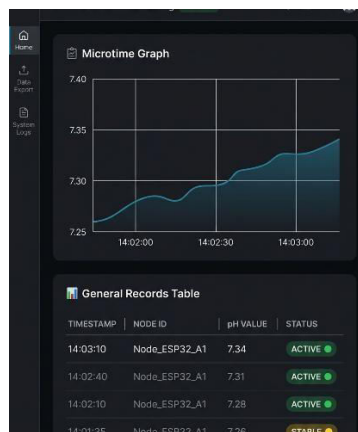
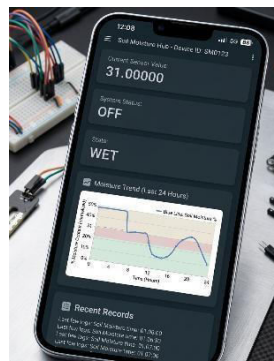


Figure 6.3 Dashboard Node Monitoring

REFERENCES

1. Al-Fuqaha, A., Guizani, M., Mohammadi, M., Aledhari, M., & Ayyash, M. (2015). Internet of Things: A Survey on Enabling Technologies, Protocols, and Applications. *IEEE Communications Surveys & Tutorials*, 17(4), 2347–2376.
2. Gubbi, J., Buyya, R., Marusic, S., & Palaniswami, M. (2013). Internet of Things (IoT): A Vision, Architectural Elements, and Future Directions. *Future Generation Computer Systems*, 29(7), 1645–1660.
3. Kumar, S., & Singh, R. (2019). IoT Based Smart Irrigation System Using Soil Moisture Sensors. *International Journal of Advanced Research in Engineering and Technology*, 10(3), 112–118.
4. Patel, M., & Shah, P. (2020). Cloud Connected Smart Irrigation System Using ESP8266. *International Journal of Innovative Technology and Exploring Engineering*, 9(4), 221–227.
5. Reddy, K., & Kumar, V. (2018). GSM Based Automatic Irrigation Control System for Smart Agriculture.

International Journal of Computer Applications, 180(12), 15–20.

6. Espressif Systems. ESP32 Technical Reference Manual. <https://www.espressif.com/en/products/socs/esp32/resources>
7. Arduino Official Documentation. <https://www.arduino.cc/en/Guide/HomePage>
8. ThingSpeak IoT Analytics Platform Documentation. <https://thingspeak.mathworks.com/>
9. Chen, L., Zhang, Z., & Li, Y. (2018). IoT Sensors and Real-Time Monitoring for Smart Agriculture. International Journal of Sensors and Applications, 8(3), 55–63.
10. Patil, R., & Suryawanshi, A. (2020). Real-Time Environmental Monitoring System for Smart Farming Using IoT. International Journal of Innovative Technology and Exploring Engineering, 9(2), 112–118.



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