

Smart Irrigation System

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Abstract

The Smart Irrigation System is an IoT-based automated irrigation solution designed to improve water management in agriculture. The system uses Arduino UNO, soil moisture sensors, relay modules, and a water pump to monitor soil conditions continuously and supply water only when required. When the soil becomes dry, the controller automatically activates the motor, and once sufficient moisture is reached, the motor turns OFF automatically. The system helps in reducing water wastage, minimizing human effort, and improving irrigation efficiency. It provides a simple, reliable, low-cost, and efficient solution for smart agriculture applications.

Keywords

IoT, Smart Irrigation System, Arduino UNO, Soil Moisture Sensor, Water Pump, Relay Module, Smart Agriculture.

Introduction

Agriculture plays an important role in daily life, and proper irrigation is necessary for healthy crop growth. Traditional irrigation methods require continuous human effort and often result in water wastage due to manual operation. To overcome these problems, a Smart Irrigation System is developed using Arduino UNO, soil moisture sensors, and IoT technology.

The system continuously monitors the moisture level present in the soil and automatically controls the water pump based on soil condition. When the soil becomes dry, the motor turns ON automatically and supplies water to the plants. Once the soil reaches sufficient moisture level, the motor turns OFF automatically. This system helps in saving water, reducing human effort, and improving irrigation efficiency, making it suitable for smart agriculture applications.

The proposed system provides an efficient and low-cost solution for automatic irrigation in agricultural fields, gardens, and greenhouses. It reduces unnecessary water usage and supports smart farming through automation and IoT technology.

Literature Review

(2024) P. Verma et al. – Proposed an automated irrigation system for water conservation using soil moisture sensors and automatic motor control. The system improved irrigation efficiency and reduced water wastage.

(2023) S. Reddy and M. Rao – Developed an Arduino-based automatic plant watering system using soil moisture sensors. Their system was low-cost, simple, and suitable for smart agriculture applications.

(2025) Raspberry Pi Foundation – Discussed IoT-based smart irrigation systems using embedded systems and cloud connectivity for remote monitoring and control of agricultural fields.

(2025) Soil Moisture Sensor Applications – Explained the importance of soil moisture sensors in smart irrigation systems for accurate water management and prevention of overwatering.

(2025) Arduino Documentation – Described Arduino UNO as an efficient and user-friendly microcontroller platform for automation and embedded system applications.

(2025) ESP8266 Wi-Fi Module Documentation – Explained the use of Wi-Fi modules in IoT-based irrigation systems for remote monitoring and smart farming applications.

(2023) Agriculture Research Institute – Highlighted the importance of automated irrigation systems in reducing water wastage and improving agricultural productivity.

Existing System

In traditional irrigation systems, farmers manually operate water pumps without checking the actual moisture level of the soil. Water is supplied continuously, which often leads to excessive water wastage and inefficient irrigation.

These systems require continuous human monitoring and consume more electricity. Overwatering and underwatering problems may also occur, which negatively affect crop growth and agricultural productivity.

Proposed System

The proposed Smart Irrigation System uses Arduino UNO, soil moisture sensors, relay modules, and a water pump to automate the irrigation process. The

system continuously monitors soil moisture and automatically controls the motor based on soil condition. It helps in saving water, reducing human

effort, and improving irrigation efficiency for smart agriculture applications.

Block Diagram

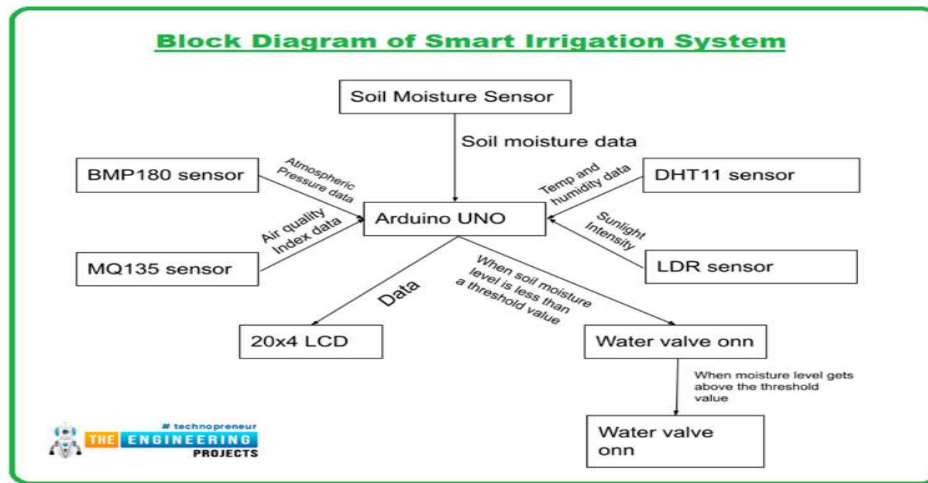


Fig 1 Block Diagram

Working Principle :

The soil moisture sensor checks the moisture content present in the soil and sends signals to the microcontroller. The controller processes the received data and decides whether watering is needed or not. If the soil becomes dry, the controller activates the relay module, which turns ON the water pump. Water is supplied to the plants

automatically. When the soil reaches sufficient moisture level, the controller turns OFF the motor. The LCD display shows the moisture condition and motor status. IoT technology can also be used for remote monitoring.

Power Supply:

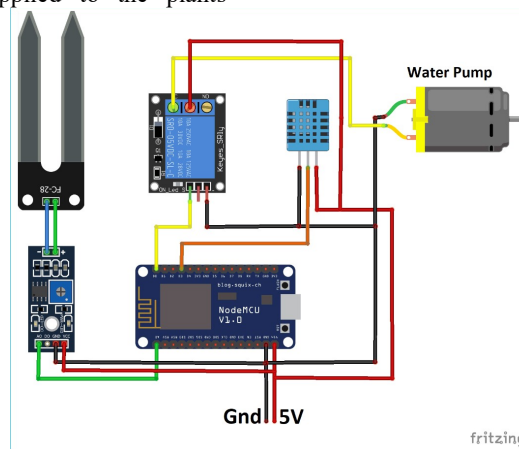


Fig 2 Power Supply

The power supply section provides electrical power to all components present in the Smart Irrigation System. Proper power supply is necessary for stable operation of the circuit. A transformer is used to step down the AC voltage, and a bridge rectifier converts AC voltage into DC voltage. The voltage regulator provides constant output voltage to the circuit components.

Bridge Rectifier:

A bridge rectifier converts AC voltage into DC voltage using four diodes connected in bridge configuration. It provides efficient rectification and smooth DC output for electronic components.

MICROCONTROLLER:

Arduino UNO is the main controlling unit of the Smart Irrigation System. It receives data from the soil moisture sensor and controls the relay module and water pump automatically based on soil condition.

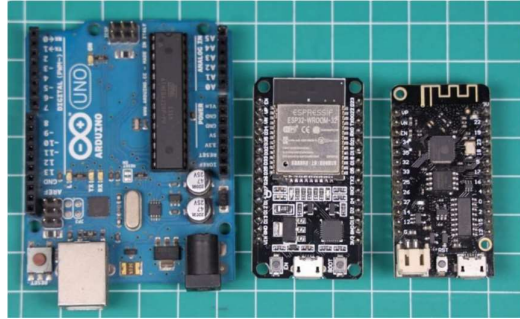


Fig 3 microcontroller

- Arduino UNO provides:
- Easy programming
- Fast processing
- Reliable operation
- Low power consumption

The soil moisture sensor is used to measure the moisture content present in the soil. The sensor continuously detects soil condition and sends signals to the Arduino UNO controller.

Wet soil conducts electricity better than dry soil. Based on this conductivity variation, the controller determines whether irrigation is required or not.

Soil Moisture Sensor



Fig 4 Soil Moisture Sensor

RELAY MODULE

The relay module acts as an electrically operated switch used to control the water pump using low-power signals from the Arduino UNO.

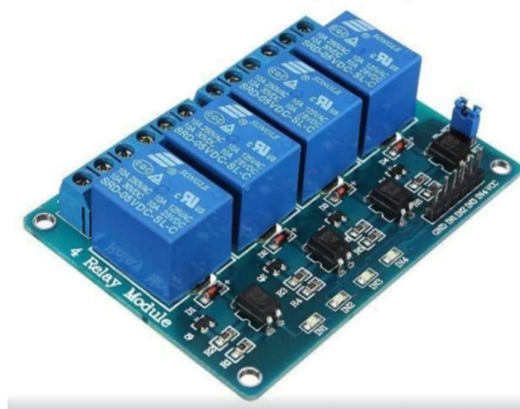


Fig 5 Relay Module

WATER PUMP

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The water pump supplies water automatically to the plants whenever the soil moisture level becomes low.

a metal object, it sends a signal to the microcontroller, which activates the buzzer alert

system and helps the operator identify the presence of danger. This sensor improves the safety and efficiency of military and bomb disposal operations by reducing direct human involvement in risky environments.



Fig 6 Water Pump

OLED DISPLAY

- The OLED display is used to show:
- Soil moisture condition
- Motor status
- Water supply condition
- OLED displays provide low power consumption and easy monitoring

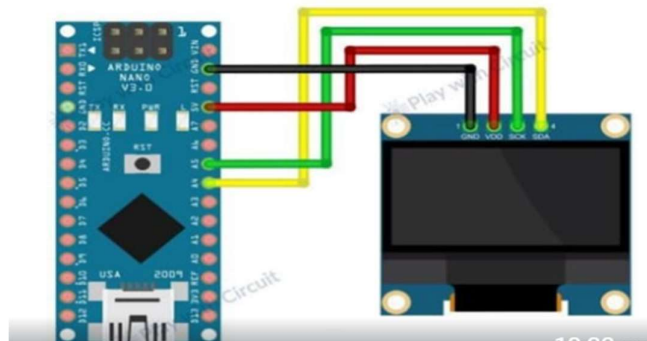
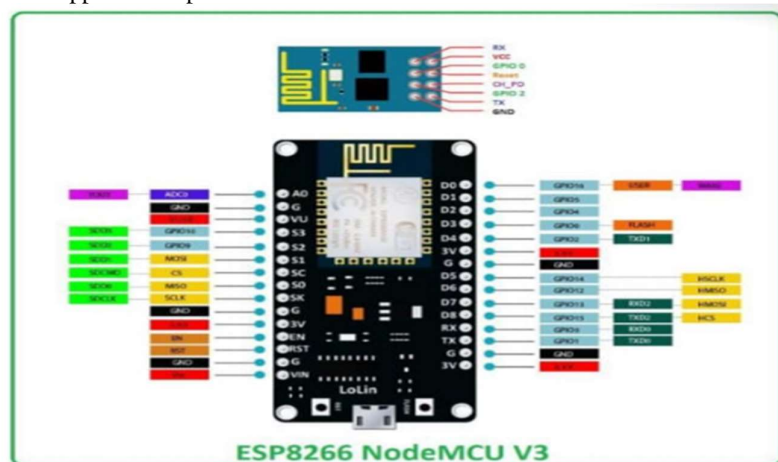


Fig 7. OLED Display

IoT / Wi-Fi Module

The IoT/Wi-Fi module enables remote monitoring and smart agriculture support. It helps users monitor

irrigation conditions using internet connectivity and cloud-based applications.



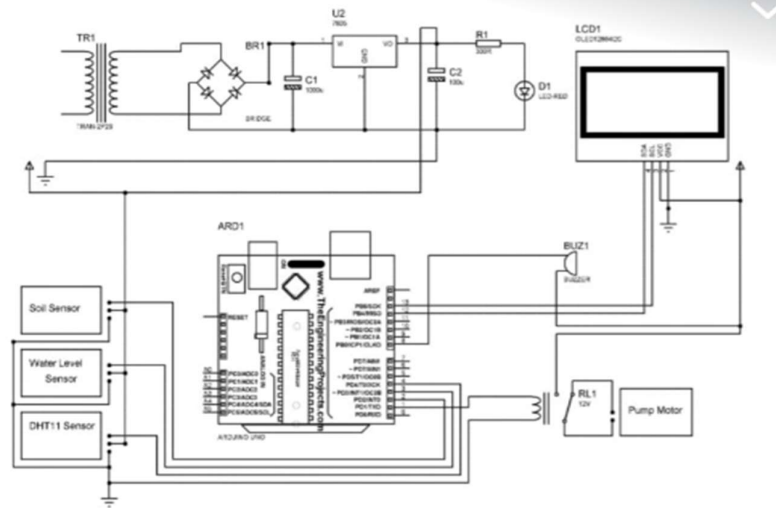


Fig 9 Circuit Diagram

RESULTS

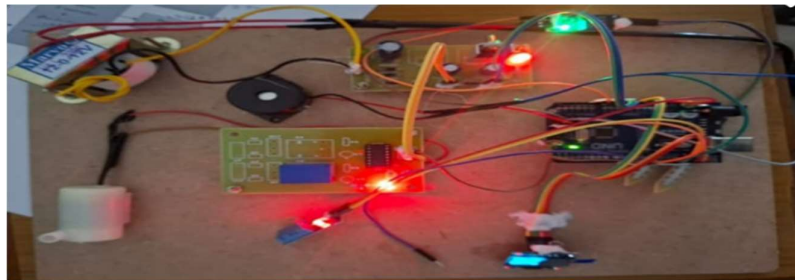


Fig:10 Hardware Kit in ON Condition



Fig 11. Output Is Display On OLED

CONCLUSION:

The IoT-based Smart Irrigation System provides an efficient and cost-effective solution for automatic irrigation and smart agriculture applications. By integrating soil moisture sensors, Arduino UNO, relay modules, water pumps, and IoT technology, the

system continuously monitors soil conditions and supplies water only when required.

The proposed system helps in reducing water wastage, minimizing human effort, improving irrigation efficiency, and increasing crop productivity. The

system operates automatically with reliable performance and low power consumption.

The Smart Irrigation System is suitable for agricultural fields, gardens, greenhouses, and smart farming applications. Overall, the project demonstrates how automation and IoT technology can improve modern agricultural practices and support sustainable water management.

FUTURE SCOPE :

Integration of IoT and cloud technology for remote monitoring and control.

Use of advanced sensors for more accurate soil moisture detection.

Development of a mobile application for smart irrigation management.

Implementation of solar-powered irrigation systems for energy efficiency.

Addition of weather forecasting systems to improve water management.

Expansion of the system for large-scale smart farming applications.

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