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SMART AGRICULTURE AUTOMATIC IRRIGATION SYSTEMS WITH ESP8266 OLED DISPLAY

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ABSTRACT

Agriculture plays a pivotal role in global food production and economic stability. With the rise of technology, integrating the Internet of Things (IoT) into agriculture has proven to be a transformative approach. Traditional irrigation systems often lead to water wastage, inefficiency, and increased labour costs. This project focuses on developing an IoT-based Smart Agriculture and Automated Irrigation System utilizing the ESP8266 in-build Wi-Fi Module along with an OLED display to enhance agricultural efficiency. The system incorporates soil moisture, temperature, and humidity sensors to monitor real-time environmental conditions. The ESP8266 microcontroller acts as the central unit, transmitting sensor data to a cloud- based platform for remote access and automation.

The project aims to optimize water usage through automatic irrigation control based on soil moisture levels, reducing human intervention and conserving resources. By integrating a Blynk or MQTT cloud platform, farmers can access live data and control the system remotely using a mobile application. The OLED display provides real-time on-site updates, making the system accessible and user-friendly. This automation ensures enhanced crop growth, increased productivity, and resource conservation, contributing to sustainable agriculture. Additionally, the implementation of data logging and predictive analytics can assist in better decision-making and planning for future crop cycles.

The significance of this project lies in its ability to reduce water wastage, lower operational costs, and improve agricultural productivity. By enabling real-time monitoring and control, the system empowers farmers with data- driven insights to make informed decisions. This IoT-enabled smart irrigation system represents a step forward in precision agriculture, making farming more efficient and sustainable. Future enhancements can include AI- based predictive analytics and machine learning for further optimization of irrigation scheduling and crop health assessment.

crimes.

INTRODUCTION

Agriculture is the backbone of human civilization, providing food, raw materials, and economic support to millions of people worldwide. With the rapid advancements in technology, the agricultural sector is embracing the Internet of Things (IoT) to enhance productivity, resource efficiency, and sustainability. Traditional farming techniques often rely on manual labour, subjective decision- making, and excessive water consumption, leading to inefficiencies and resource wastage. To address these challenges, this project aims to design and implement an IoT-based Smart Agriculture and Automated Irrigation System using the ESP8266 in-build Wi-Fi Module integrated with an OLED.display

This project focuses on optimizing water usage, monitoring environmental parameters, and automating irrigation to enhance crop yield and sustainability. By leveraging IoT, farmers can remotely access real-time data, control irrigation systems based on sensor feedback, and make informed decisions to improve productivity.

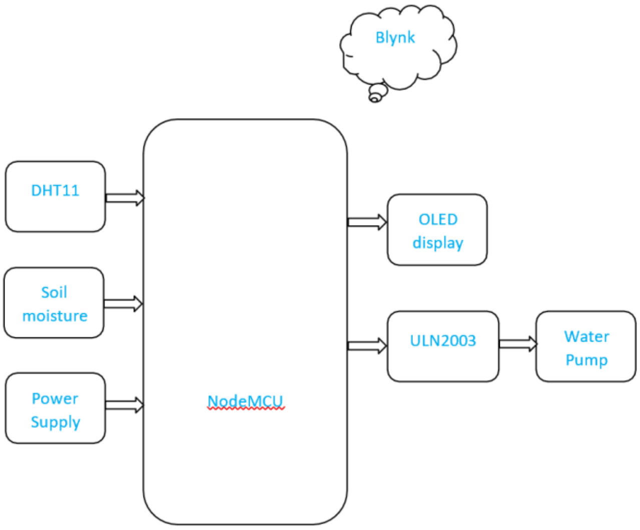

Figure.1 Block Diagram

LITERATURE SURVEY

- Mohanraj et al. (2016) developed a smart irrigation system where sensors collect data on soil moisture, temperature, and humidity. The data is analyzed using an embedded system to optimize irrigation schedules.
- Sharma et al. (2019) proposed a cloud-based precision agriculture system that integrates IoT with machine learning algorithms to predict weather patterns and soil conditions for optimal irrigation.
- Verma et al. (2021) implemented a wireless sensor network (WSN) to monitor agricultural parameters, highlighting the advantages of real-time data collection in minimizing water wastage.
- Patil et al. (2020) introduced an ESP8266-based irrigation system where real-time soil moisture data is collected, and water pumps are activated based on predefined threshold values.
- Ramesh et al. (2021) designed a cloud-integrated smart irrigation system where ESP8266 communicates sensor data to Firebase, allowing farmers to monitor and control irrigation remotely.
- Jain et al. (2022) proposed a low-cost IoT irrigation system using ESP32 and ESP8266, demonstrating how low-power Wi-Fi modules can enhance water conservation strategies.

PROPOSED SYSTEM

The NodeMCU is the central component of the system, built around the ESP8266 Wi-Fi chip. It plays a crucial role by reading data from the Soil Moisture Sensor, controlling the Water Pump through the ULN2003 relay driver, and potentially communicating with the Blynk app for remote monitoring and control. If programmed, it can also send real-time sensor data to the app for user convenience.

The Soil Moisture Sensor measures the water content in the soil and outputs an analog or digital signal corresponding to the moisture level. The NodeMCU processes this data to determine whether the soil is dry and needs watering. When watering is required, the Water Pump—typically a small submersible pump or solenoid valve—delivers water to the plants.

Since the NodeMCU operates at low voltage and current, it cannot directly drive the water pump. The ULN2003 relay driver acts as an interface, containing Darlington transistors that amplify the current, allowing the microcontroller to switch the higher current needed by the pump.

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The system may also include a DHT11 Temperature and Humidity Sensor, which, while not directly involved in irrigation, provides additional environmental data. This data can be displayed on the Blynk app and may also help in adjusting irrigation schedules based on temperature and humidity conditions.

A small OLED Display is used for local monitoring, showing real-time readings such as soil moisture levels, temperature, humidity, pump status (on/off), and possibly the Wi-Fi connection status.

The Blynk App enables remote control and monitoring of the system via the internet. It displays sensor readings, allows users to manually turn the pump on or off, and potentially set automatic irrigation schedules or moisture thresholds.

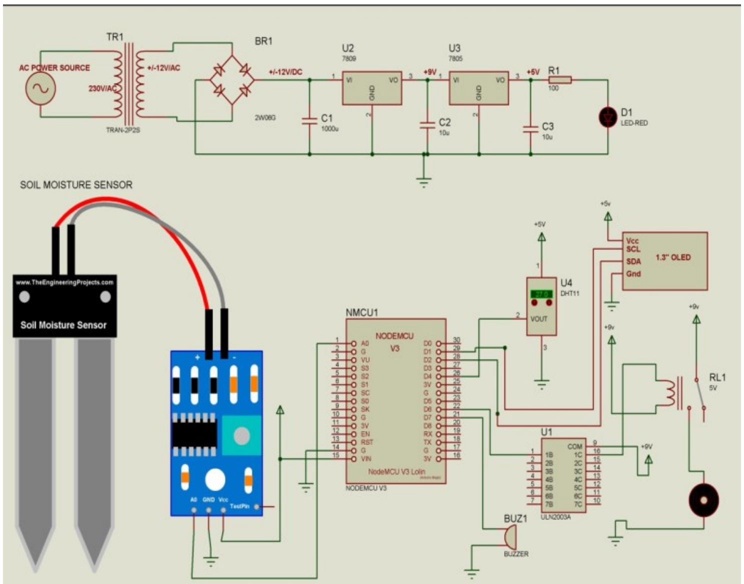

Figure.2 Schematic Diagram

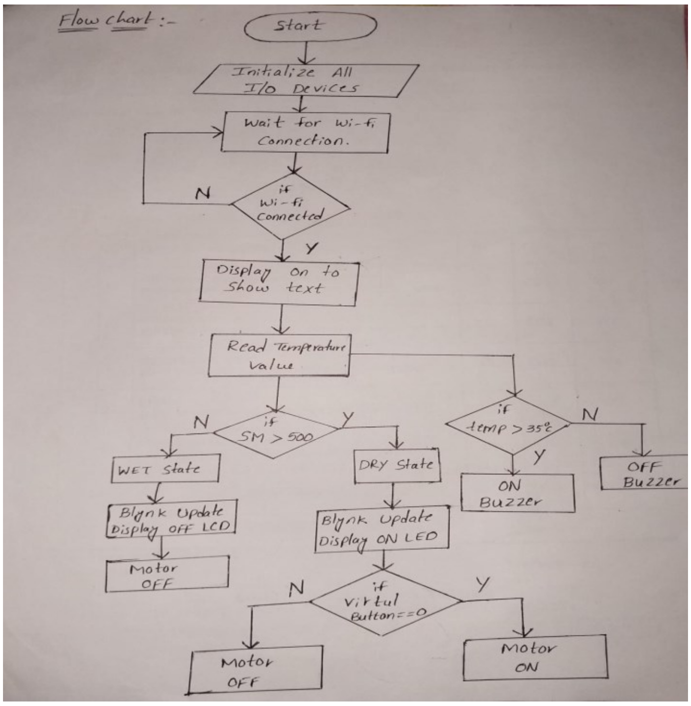

Figure.3 Flow chart

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RESULTS

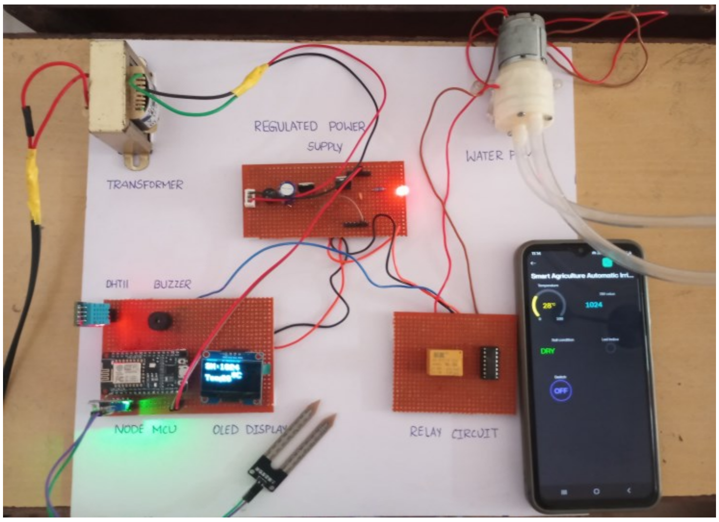

Figure.4 Dry Soil Condition

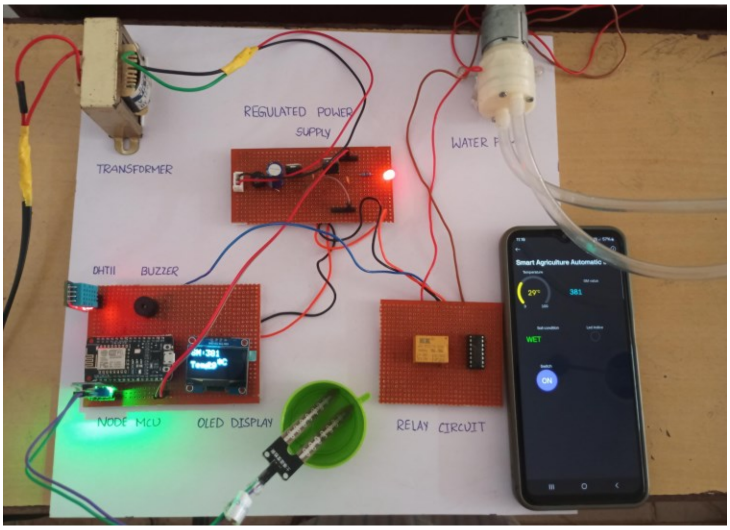

Figure.5 Wet Soil Condition

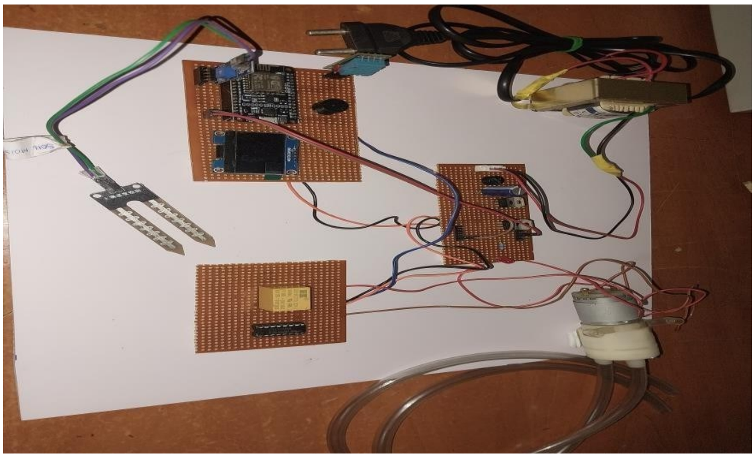

Figure.6 Working Kit

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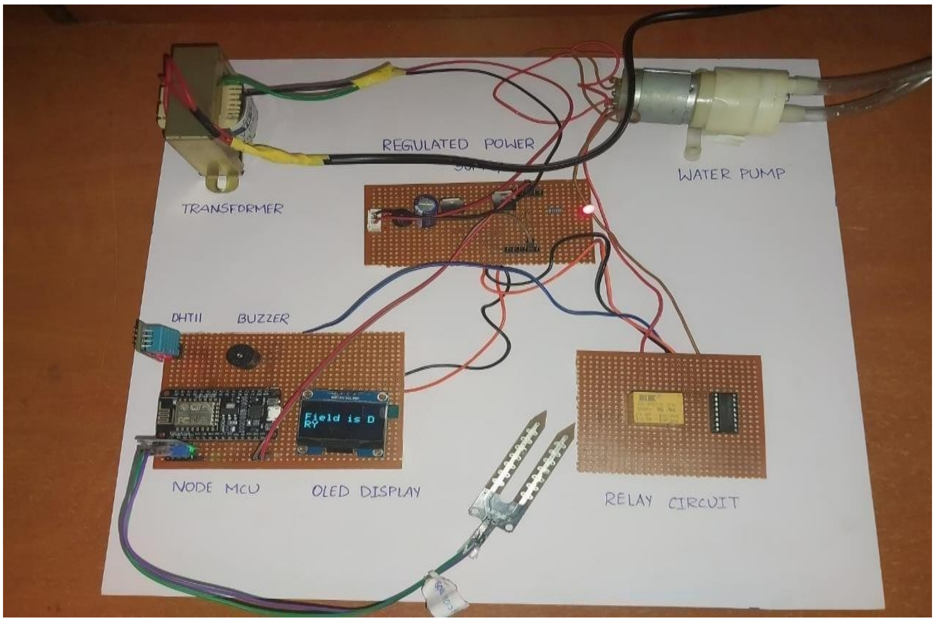

Figure.7 Dry Condition Displaying on OLED

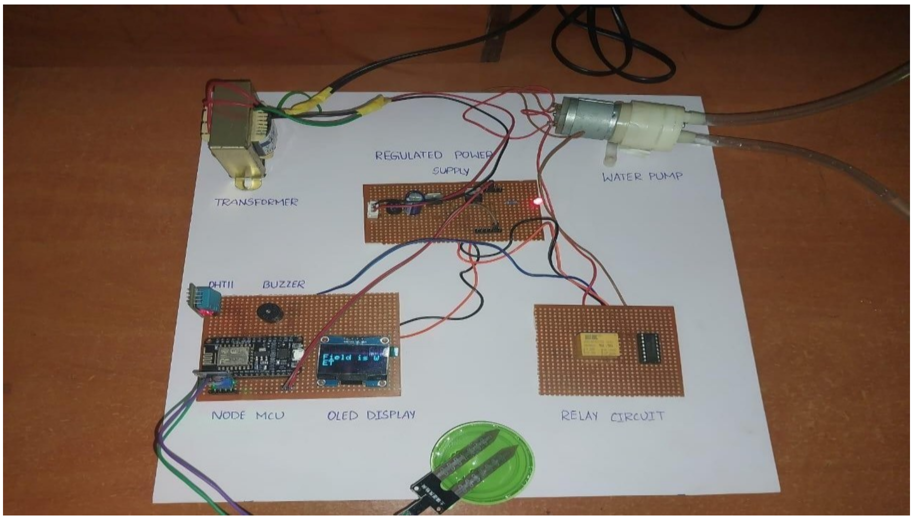

Figure.8 Wet condition Displaying On OLED

ADVANTAGES

- **Automated Irrigation –** Waters plants based on real-time soil moisture levels.
- **Remote Monitoring & Control –** Manage the system via the Blynk app from anywhere.
- **Water Conservation –** Prevents overwatering and reduces water wastage.
- **Energy Efficiency –** Uses a relay driver to optimize power consumption.
- **Real-Time Data Display –** OLED screen shows moisture, temperature, and pump status.
- **Cost-Effective –** Built with affordable and easily available components.
- **Flexible & Customizable** – Can be modified for advanced irrigation control.

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APPLICATIONS

- **Home Gardens –** Automates watering for houseplants and small gardens.
- **Agriculture & Farming** – Used for precision irrigation in fields and greenhouses.
- **Greenhouses –** Monitors and controls moisture, temperature, and humidity.
- **Smart City Projects –** Integrated into urban landscaping and vertical gardens.
- **Parks & Public Spaces –** Maintains gardens and parks with efficient water usage.
- **Hydroponics & Indoor Farming –** Provides controlled irrigation for soil-less farming.

CONCLUSION

The IoT Smart Agriculture & Automated Irrigation System using ESP8266 with OLED Display successfully demonstrates an efficient, automated, and remotely controlled irrigation solution. The system integrates soil moisture sensors, temperature & humidity sensors, an ESP8266 microcontroller, an OLED display, and a water pump, ensuring real- time monitoring and precision watering.

FUTURE SCOPE

AI and Machine Learning for Predictive Irrigation: Implementing AI-based models to analyze historical weather data, soil moisture trends, and plant growth cycles. Predict optimal irrigation schedules instead of relying on fixed thresholds.

Multi-Sensor Integration for Precision Agriculture: Adding pH sensors, NPK (Nitrogen-Phosphorus-Potassium) sensors, and rain sensors for better soil and crop analysis. Helps in precision farming by providing real-time soil fertility and nutrient levels.

Cloud Data Analytics and Historical Data Storage: Storing long-term sensor data in cloud platforms like Google Firebase, AWS IoT, or ThingSpeak. Allows trend analysis, helping farmers make data-driven decisions.

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