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IoT Based Irrigation Monitoring And Controller System

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ABSTRACT

The Internet of Things (IoT) has revolutionized agriculture by enabling smarter, more efficient farming practices. This paper presents an IoT-based irrigation monitoring and control system designed to optimize water usage and improve crop productivity. The system integrates sensors to monitor soil moisture, temperature, and humidity in realtime, providing accurate environmental data. A microcontroller processes the sensor data and communicates with a cloud-based platform, allowing remote access and control web interface. The system automatically regulates water supply based on preset thresholds or user-defined parameters, ensuring precise irrigation. By reducing water wastage and promoting sustainable agricultural practices, this IoT solution addresses challenges related to water scarcity and inefficient irrigation. The proposed system is cost-effective, easy to deploy, and scalable, making it suitable for various agricultural fields.

KEYWORDS:IOT, Irrigation system, NodeMcuESP8266, DTH 11, Moisture sensor

1. INTRODUCTION

In recent years, agriculture has evolved to leverage technology for enhanced efficiency and productivity. The Internet of Things (IoT) has emerged as a key player in this transformation, enabling smarter agricultural practices through real-time data monitoring and automation. The Internet of Things (IoT) refers to a network of physical objects integrated with embedded electronics, enabling communication and interaction with each other and their surroundings. In the near future, IoT technology is expected to revolutionize daily life by providing advanced services and transforming how individuals carry out routine activities. IoT encompasses a system of interconnected entities—ranging from computing devices and mechanical or digital machines to objects, animals, or humans—all identifiable through unique identifiers.

The primary contributions of this research include the development of a real-time IoT-enabled smart device for agricultural fields. This device is designed to monitor and evaluate soil health and environmental conditions, facilitating better crop management.

The remainder of the paper is structured as follows. Section 2 discusses the related existing works. A block diagram of smart farming is given in Section 3. The circuit diagram of smart farming is presented in Section 4. The result analysis is presented in Section 5. The paper is concluded in Section 6

2. RELATED WORKS

This section provides a brief overview of various existing works related to the topic. A wireless sensor network (WSN) using the AgriSens architecture includes components such as a water-level sensor, sensor nodes, a remote server, and an IoT gateway [1]. The adoption of WSNs is expected to address system-level

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challenges and meet end-user requirements for efficient agricultural monitoring. Comparing different WSN topologies is challenging due to the unique scenarios and specific applications of each topology [2]. The FarmFox architecture, a WSN-based conceptual model, is highlighted in [3]. It is noted for being cost-effective, user-friendly, versatile, energy-efficient, reliable, and durable. Additionally, a low-cost agro-climatic monitoring system leveraging IoT is discussed in [4]. This system consists of multiple stations located both inside and outside greenhouses, connected to an IoT platform via WSNs. Each station is equipped with various sensors to monitor parameters such as humidity, temperature, soil moisture, wind speed and direction, precipitation, pH levels, and radiation [4]. IoT technologies have also been applied in precision farming, as seen with AgriTalk, which significantly improved the quality of turmeric cultivation [5]. Another example is FarmBeats, a low-cost and accessible IoT platform for agriculture, which utilizes TV White Spaces (TVWS) for long-range communication and supports high-bandwidth sensors [6]. FarmBeats integrates an intelligent gateway and a weather-aware base station to ensure uninterrupted service, whether online or offline. Additionally, innovative path-planning algorithms have been developed to enhance the battery life of drones in agricultural applications [6].

3. BLOCK DIAGRAM OF SMART FARMING

This section outlines the design of the farming system and provides detailed descriptions of all the sensors used. The key principles guiding the development of these nodes include cost-effectiveness, energy efficiency, reliability, and durability. Three sensors have been recalibrated and integrated into the system to measure soil moisture, temperature, and humidity. The soil moisture sensors are specifically designed to monitor the volumetric water content of the soil. A detailed representation of the deployed system is illustrated in Figure 1, showcasing the block diagram of the setup.

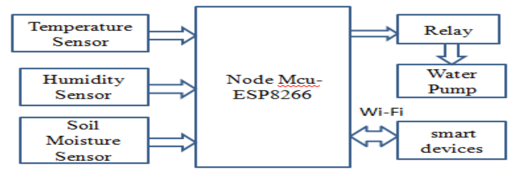
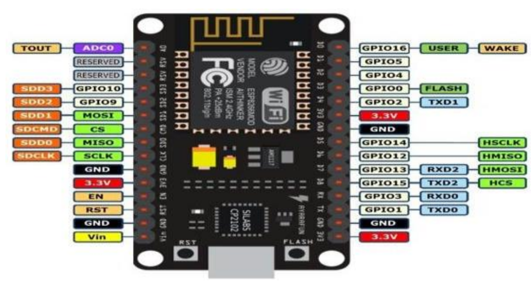


Fig. 1: Block Diagram of Smart Farming

The fundamental aspects of the various components are summarized in the following subsections.

Node Mcu ESP8266

Figure 2 illustrates the pin diagram of the NodeMCU ESP8266. NodeMCU is a low-cost, open-source IoT platform. Being open-source, its hardware design is available for editing, modification, and customization. It features firmware that operates on the ESP8266 Wi-Fi System-on-Chip (SoC) developed by Espressif Systems, with hardware based on the ESP-12 module. The firmware is programmed using the



Lua scripting language.

Figure 2: Node MCU ESP8266

Soil Moisture Sensor Module

Figure 3 depicts a Soil Moisture Sensor, a cost-effective electronic device designed to measure soil moisture levels. This sensor determines the volumetric water content within the soil. It is primarily composed of two main components: sensing probes and a sensor module.

The sensing probes enable current to flow through the soil, measuring resistance, which varies based on the soil's moisture content. The sensor module processes the data received from the probes and converts it into either a digital or analog output. As a result, the Soil Moisture Sensor provides dual output options: Digital Output (DO) and Analog Output (AO)

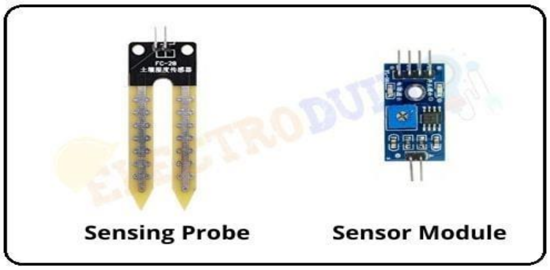


Figure 3: Soil Moisture Sensor Module

Temperature Humidity Sensor(DHT11)

Figure 4 provides the DTH11 Sensor. A humidity sensor (also known as a hygrometer) is an electronic device used to measure the amount of moisture or water vapor present in the air. It typically provides an output that indicates the relative humidity (RH), which is the percentage of moisture in the air relative to the maximum amount the air can hold at a given temperature.

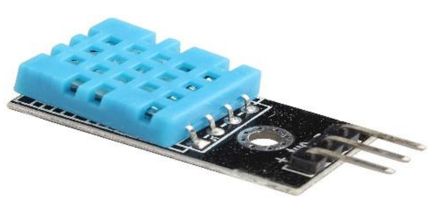


Figure 4: DTH11 Sensor

SOFTWARE USED

Blynk:

Blynk is an IoT platform designed to control hardware remotely, display sensor data, and create automation projects. It provides a user-friendly mobile app where users can monitor and control their projects in real-time. Blynk works with a wide variety of hardware, including Node MCU (ESP8266) used in this project. Key features of Blynk in this smart irrigation

project include: - Virtual Pins: Blynk allows the mapping of sensor data (humidity, temperature, soil moisture, and rain status) to virtual pins, making it easy to visualize these

parameters in the mobile app. - Cloud Connectivity: It connects the Node MCU to the internet, allowing real-time monitoring and control of the irrigation system from anywhere.

Automation and Alerts: Blynk can automate tasks such as turning the motor on/off based on conditions (e.g., soil

moisture level and rain detection). Additionally, Blynk can send notifications or emails when certain thresholds are met.

Arduino IDE:

The Arduino IDE is a widely used development

Environment for programming microcontrollers like the Node MCU. It allows developers to write, compile, and upload code to microcontroller boards. Features of the Arduino IDE in this project include: - Code Development: The Arduino IDE

provides an easy platform to write and modify the C/C++ code controlling the sensors and actuators in the irrigation system.

Libraries: In this project, libraries like

`BlynkSimpleEsp8266.h` and `DHT.h` are used, allowing integration with the Blynk platform and DHT11 sensor.

4. CIRCUIT DIAGRAM OF SMART FARMING:

The NodeMCU ESP8266 microcontroller has been utilized in this project. It enables the implementation of active sleep mode for the sensor nodes, ensuring energy efficiency. The NodeMCU ESP8266 is also a cost-effective option compared to other commercial alternatives. Figure 5 illustrates the circuit diagram of the proposed Smart Farming device, showcasing the connections between various node components and the processor.

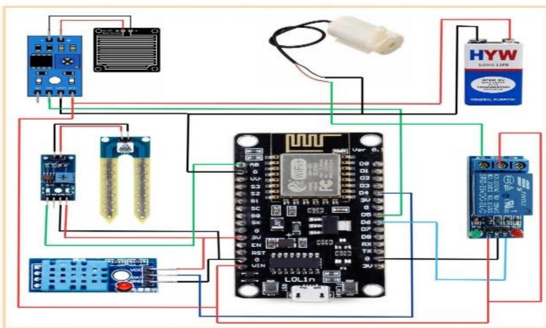


Fig. 5: Circuit Diagram of proposed Smart Farming

5. RESULT ANALYSIS :

This section presents a detailed discussion of the results obtained from the experimental setup. The snapshots included are directly captured from the implemented project.

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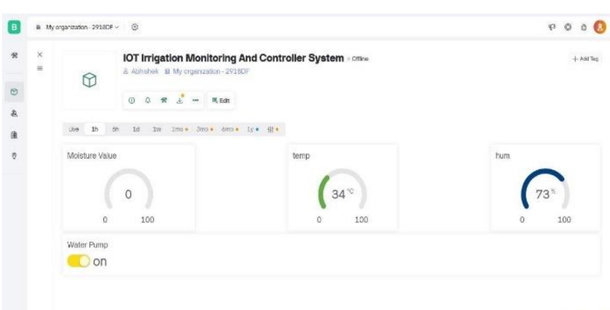

Fig. 6: Visualization of sensed data displayed on user Web application

We have collected all the data from a certain place on our campus for ten days. All the observations are shown in Table 1.

Table 1: Data collected from various sensors

Sl. No.	Time (Day)	Moisture (%)	Temperature (0C)	Humidity (%)
1	Day1	69.89	31.0	75
2	Day2	68.59	30.2	74
3	Day3	66.96	30.1	75
4	Day4	48.27	31.6	75
5	Day5	36.27	31.8	76
6	Day6	05.87	30.1	75
7	Day7	06.70	31.9	77
8	Day8	06.36	31.0	75
9	Day9	36.17	31.8	74
10	Day10	00.00	34.0	73

6. CONCLUSION:

The IoT-based irrigation monitoring and controller system demonstrates significant potential for improving agricultural productivity and resource efficiency. By integrating sensors, IoT devices, and real-time data analytics, the system automates irrigation processes, ensuring optimal water distribution based on soil moisture levels, weather conditions, and crop requirements. This approach not only reduces water wastage but also minimizes manual intervention, enhancing convenience for farmers.Moreover, the system fosters sustainability by conserving water and reducing energy consumption, contributing to environmentally responsible farming practices. It provides farmers with actionable insights through user-friendly dashboards or mobile applications, empowering data-driven decision-making.In conclusion, the implementation of IoT in irrigation systems represents a transformative step towards smart agriculture, offering economic, environmental, and operational benefits. Future advancements in IoT technology and integration with AI could further enhance the system's capabilities, paving the way for a more efficient and sustainable agricultural industry.

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