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IOT BASED AGRICULTURAL MONITORING SYSTEM USING NODE-MCU

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ABSTRACT
The IoT-Based Agricultural Monitoring System Using NodeMCU aims to modernize traditional farming methods by providing real-time monitoring of environmental conditions such as soil moisture, temperature, and humidity. The system utilizes NodeMCU as the main controller, interfacing with various sensors to collect data and transmit it to a cloud platform for remote access. Farmers can monitor field conditions via a web or mobile application and make timely decisions to optimize crop yield, conserve water, and reduce manual labor. This smart agriculture system enhances efficiency, productivity, and sustainability in farming through automation and data-driven insights.

Keywords: Smart Agriculture, NodeMCU, Soil Moisture Sensor, Temperature Monitoring, Humidity Sensor, Cloud Computing

I.INTRODUCTION

Agriculture plays a vital role in the economy of many countries, and advancements in technology have introduced smart solutions to improve productivity. Traditional farming methods often rely on manual observation, which can be inaccurate and time-consuming. With the evolution of the Internet of Things (IoT), it is now possible to
automate agricultural processes and remotely monitor field conditions. The NodeMCU-based monitoring system provides an affordable and scalable solution to collect environmental data, send it to a cloud server, and alert farmers about any critical changes. This technology-driven approach not only supports precision agriculture but also promotes resource-efficient and sustainable farming practices.

II. LITERATURE SURVEY

Kumar et al. (2020) proposed an IoT-enabled crop monitoring system that used Arduino and GSM modules for soil moisture and temperature sensing, but lacked real-time data visualization. Patel and Singh (2021) developed a smart irrigation system using Raspberry Pi and Blynk app for remote control, emphasizing automation in water management.

Reddy et al. (2022) presented an agricultural monitoring network using LoRa communication to cover large farming areas with low power consumption.

Sharma et al. (2023) introduced a cloud-based monitoring system using NodeMCU and DHT11 sensors, providing live environmental updates to farmers through ThingSpeak.

Ali et al. (2024) focused on integrating machine learning models with IoT systems to predict crop diseases based on environmental patterns. These studies highlight the growing relevance of IoT technologies in precision agriculture, yet emphasize the need for cost-effective, real-time, and user-friendly monitoring systems.

III. EXISTING SYSTEM

The existing agricultural monitoring systems rely primarily on manual inspection and traditional irrigation methods. These systems are often inefficient as they require constant human supervision, leading to water wastage, inconsistent irrigation, and inaccurate measurement of soil and environmental parameters. In some cases, semi-automated systems using basic microcontrollers like Arduino offer limited connectivity and data logging capabilities. Furthermore, many existing

models lack real-time monitoring and cloud integration, making them less effective for remote management and data-driven decision-making. As a result, there is a significant gap in providing affordable, IoT-based, automated monitoring for small and medium-scale farmers.

IV. PROPOSED SYSTEM

The proposed IoT-Based Agricultural Monitoring System employs the NodeMCU (ESP8266) as a central microcontroller that connects sensors such as the DHT11 for temperature and humidity, and the soil moisture sensor for irrigation control. The system collects real-time data and uploads it to a cloud platform like ThingSpeak or Blynk, where farmers can view the information through a web dashboard or smartphone application. Based on threshold values, the system can also automate irrigation using a relay-driven water pump. This integration of IoT with cloud technology ensures real-time feedback, efficient water management, and reduced manual intervention. The system is cost-effective, scalable, and suitable for various agricultural applications.

V. SYSTEM ARCHITECTURE

The architecture is centered around the NodeMCU (ESP8266), a low-cost microcontroller with built-in Wi-Fi, which acts as the system's brain. The architecture can be broken down into four main layers:

1. **Sensor Layer (Input):** This layer consists of various sensors that collect real-time data from the field.
2. **Processing Layer (Controller):** The NodeMCU receives data from the sensors, processes it, and makes decisions.
3. **Actuator Layer (Output):** Based on the processed data, this layer performs physical actions, such as watering the crops.
4. **Communication & Monitoring Layer (Cloud & User):** This layer uses Wi-Fi to send data to an IoT cloud platform, allowing the user to monitor and control the system remotely via a smartphone or web dashboard.

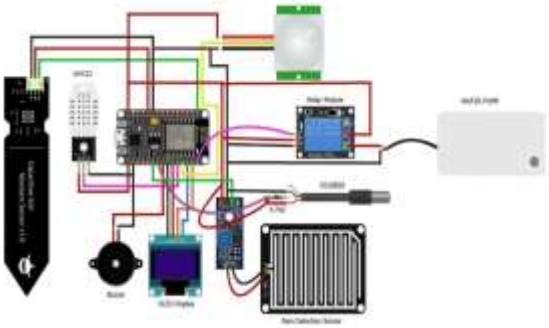

Fig.5.1: Circuit diagram for proposed model

NODE MCU:

NodeMCU is a low-cost open source IoT platform. It initially included firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which was based on the ESP-12 module. Later, support for the ESP32 32-bit MCU was added

OVERVIEW:

NodeMCU is an open source firmware for which open source prototyping board designs are available. The name "NodeMCU" combines "node" and "MCU" (micro-controller unit). The term "NodeMCU" strictly speaking refers to the firmware rather than the associated development kits.[citation needed] . Both the firmware and prototyping board designs are open source. The firmware uses the Lua scripting language. The firmware is based on the eLua project, and built on the Espressif Non-OS SDK for ESP8266. It uses many open source projects, such as lua-cjson[10] and SPIFFS.[11] Due to resource constraints, users need to select the modules relevant for their project and build a firmware tailored to their needs. Support for the 32-bit ESP32 has also been implemented.The prototyping hardware typically used is a circuit board functioning as a dual in-line package (DIP) which integrates a USB controller with a smaller surface-mounted board containing the MCU and antenna. The choice of the DIP format allows for easy prototyping on breadboards. The

design was initially was based on the ESP-12 module of the ESP8266, which is a Wi-Fi SoC integrated with a Tensilica Xtensa LX106 core, widely used in IoT applications

VI. IMPLEMENTATION

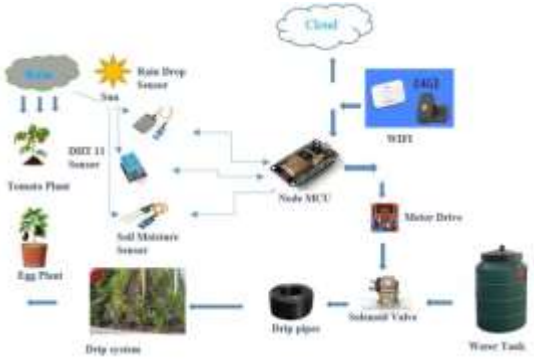

FIG. 6.1: Workflow of proposed model

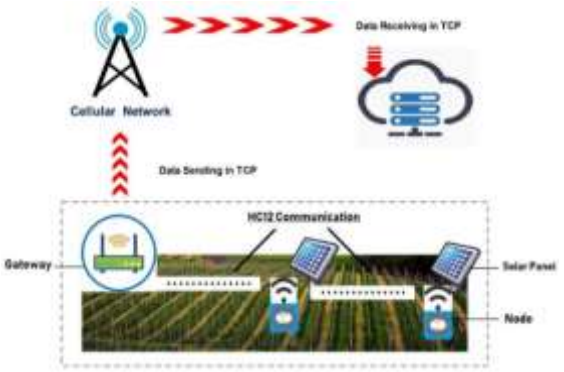

FIG. 6.2: Network implementation

The IoT-Based Agricultural Monitoring System using NodeMCU is implemented to enhance precision and efficiency in farming by enabling real-time monitoring of environmental conditions. The system employs the NodeMCU microcontroller, which serves as the core processing unit, connecting various sensors such as soil moisture, temperature, humidity, and light intensity sensors. These sensors continuously collect data from the agricultural field and transmit it to the cloud via Wi-Fi using platforms like ThingSpeak or Blynk for remote visualization and analysis. The collected data helps farmers make informed decisions about irrigation, fertilization, and crop management. Additionally, the system can trigger automated actions, such as turning on water pumps when the soil moisture level drops below a certain threshold. By integrating IoT technology, the NodeMCU-based agricultural monitoring system reduces manual labor, conserves resources, and promotes smart farming practices through efficient and data-driven crop management.

VII. CONCLUSION

The IoT-Based Agricultural Monitoring System Using NodeMCU provides an innovative and efficient approach to smart farming by integrating sensors, wireless communication, and cloud platforms. It enables real-time monitoring and automation, improving crop yield and resource utilization. By reducing manual effort and providing accurate data insights, the system supports sustainable agricultural practices and empowers farmers to make informed decisions. The proposed system can be further enhanced with predictive analytics and AI integration for future development in precision agriculture.

VIII. FUTURE SCOPE

The IoT-Based Agricultural Monitoring System Using NodeMCU can be further enhanced and expanded in several ways to increase its efficiency, intelligence, and usability. In the future, additional sensors such as pH sensors, NPK sensors, and light intensity sensors can be integrated to monitor soil fertility and optimize crop selection. The system can also be upgraded with machine learning algorithms to analyze historical data and predict irrigation schedules, crop diseases, and yield outcomes.

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