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"IOT Based on Agriculture Monitoring System"

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***Abstract*-- The Internet of Things (IoT) has emerged as a transformative technology in modern agriculture by enabling real-time monitoring, automation, and data-driven decision-making. This research presents an IoT-based agriculture monitoring system designed to continuously observe key environmental and soil parameters such as temperature, humidity, soil moisture, and light intensity. The proposed system integrates various sensors with a microcontroller and wireless communication modules to collect and transmit data to a cloud platform. Farmers can access this data through a web or mobile interface, allowing them to monitor field conditions remotely and take timely actions. The system aims to reduce manual labor, minimize water and resource wastage, and improve overall crop productivity through precise and efficient farm management.**

The collected data is analyzed to provide intelligent recommendations for irrigation scheduling and crop health management. Automated control of irrigation systems based on real-time soil moisture levels ensures optimal water usage, preventing both under-irrigation and over-irrigation. The system also supports alert mechanisms to notify farmers about abnormal conditions such as extreme temperature or low moisture levels. Experimental results demonstrate that the proposed IoT-based agriculture monitoring system enhances decision-making accuracy, improves resource utilization, and contributes to sustainable agricultural practices by increasing yield and reducing operational costs.

***Keywords*-- Smart Agriculture, Agriculture Monitoring System, Wireless Sensor Networks, Cloud Computing, Real-Time Data Monitoring.**

I. INTRODUCTION

The Internet of things (IOT) is remodeling the agriculture enabling the farmers with the wide range of techniques such as precision and sustainable agriculture to face challenges in the field. IOT technology helps in collecting information about conditions like weather, moisture, temperature and fertility of soil, Crop online monitoring enables detection of weed, level of water, pest detection, animal intrusion in to the field, crop growth, agriculture. IOT leverages farmers to get connected to his farm from anywhere and anytime. Wireless sensor networks are used for monitoring the farm conditions and micro controllers are used to control and automate the farm processes.

To view remotely the conditions in the form of image and video, wireless cameras have been used. A smart phone empowers farmer to keep updated with the ongoing conditions of his agricultural land using IOT at any time and any part of the world. IOT technology can reduce the cost and enhance the productivity of traditional farming.

A. Purpose of Research

The purpose of this research is to design and develop an IoT-based agriculture monitoring system that enables real-time observation and intelligent management of farming conditions to improve crop productivity and resource efficiency. By integrating sensors, wireless communication, and cloud-based data processing, the system aims to monitor key parameters such as soil moisture, temperature, humidity, and light intensity, and provide timely information and automated control for irrigation and crop management. This research seeks to reduce manual effort, minimize water and fertilizer wastage, enhance decision-making through data-driven insights, and promote sustainable agricultural practices.

B. Need of Automatic Irrigation

It is simple an easy to install and configure.

Saving energy and resources, so that it can be utilized in proper way and amount. Farmers would be able to smear to right amount of water at the right time by automatic irrigation. Avoiding irrigation at the wrong time of day, reduce runoff from overwatering saturated soils which will improve crop performance. Automated irrigation system uses vales to turn motor ON and OFF. Motors can be automated easily by using controllers and no need of labour to turn motor ON an OFF. It is precise method for irrigation and a valuable tool for accurate soil moisture control in highly specialized greenhouse vegetable production. It is time saving, the human error elimination in adjusting available soil moisture levels.

C. Existing System

Existing systems based on the different technologies and also focuses on generic automated irrigation system based on WSN with GSM-ZigBee for remote monitoring and controlling devices.

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The objective is to make use of wireless sensor network and communication technology such as ZigBee and GSM in industrial field to make low-cost automated irrigation system to monitor the condition of the soil and to lower the energy consumption.

The system helps the farmer to monitor and control the parameters of the soil such as air temperature, humidity, soil moisture.

At any abnormal condition, the farmer is informed and will be able to take actions remotely by using GSM. Due to its lower energy consumption and low cost, the system has the potential to be useful in semiarid or arid areas.

D. Problem Statement

1) The automation is not used for operations of the sensors and motors.
2) Monitoring is not possible in our existing system.
3) High cost for installation of the modules
4) Hard implementation.
5) Low accuracy compared to the proposed system.

E. Proposed System

The whole Arduino, Node MCU, Soil Moisture sensor, water level sensor, DHT 11 Sensor. Soil Moisture sensor measures moisture content of the soil.

The user can monitor and control parameters through webpage. This device is very much helpful to the farmers to monitor and control environmental parameters at their farms. The farmers need not to go their farms.

II. Background And Motivation

The rapid growth of population and climate variability has increased pressure on the agricultural sector to produce more food with limited resources such as water, land, and labor. Traditional farming methods often rely on manual observation and experience, which can lead to inefficient use of resources and delayed response to crop stress, pests, or environmental changes. An IoT-based agriculture monitoring system provides a smart solution by using sensors, wireless communication, and cloud platforms to continuously monitor parameters like soil moisture, temperature, humidity, and light intensity in real time. This enables farmers to make data-driven decisions, optimize irrigation and fertilizer usage, reduce crop losses, and improve overall productivity. The motivation behind this system is to promote precision agriculture that is cost-effective, sustainable, and capable of improving crop yield while conserving natural resources.

III. Objectives

The objectives behind the study carried out are:

1) To study the various agriculture monitoring systems available.
2) Understand the requirements of the IoT based agriculture monitoring system.
3) Develop framework for agriculture monitoring systems.

IV. Literature Survey

Asha, H. V., et al. presents a smart agricultural monitoring system that leverages Internet of Things (IoT) and wireless sensor networks to enable real-time environmental monitoring and automation in farming. Multiple sensors (e.g., soil moisture, temperature, humidity) are deployed across agricultural fields to collect crucial data, which is transmitted via IoT technologies to a central platform for processing and analysis. The proposed system allows remote monitoring of crop and field conditions, automated irrigation control based on sensed parameters, and actionable insights for farmers to improve resource efficiency, crop yield, and overall farm management.

Dasgupta, Ajanta, et al. This paper presents a smart irrigation monitoring system that leverages the Internet of Things (IoT) to automate and enhance irrigation practices for both small-scale and large-scale agricultural plantations. The proposed system integrates environmental sensors to continuously measure key parameters such as soil moisture, temperature, and humidity, and uses IoT connectivity to transmit real-time data for remote monitoring and analysis. By replacing traditional manual irrigation approaches with an autonomous sensor-driven framework, the system aims to optimize water usage, reduce wastage, and support decision-making for efficient irrigation scheduling.

Devan, P. Arun Mozhi, et al. presents a smart irrigation monitoring system that leverages the Internet of Things (IoT) to automate and enhance irrigation practices for both small-scale and large-scale agricultural plantations. The proposed system integrates environmental sensors to continuously measure key parameters such as soil moisture, temperature, and humidity, and uses IoT connectivity to transmit real-time data for remote monitoring and analysis. By replacing traditional manual irrigation approaches with an autonomous sensor-driven framework, the system aims to optimize water usage, reduce wastage, and support decision-making for efficient irrigation scheduling.

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Kamienski, Carlos, et al. present the smart management of freshwater for precision irrigation in agriculture is essential for increasing crop yield and decreasing costs, while contributing to environmental sustainability. The intense use of technologies offers a means for providing the exact amount of water needed by plants. The Internet of Things (IoT) is the natural choice for smart water management applications, even though the integration of different technologies required for making it work seamlessly in practice is still not fully accomplished. The SWAMP project develops an IoT-based smart water management platform for precision irrigation in agriculture with a hands-on approach based on four pilots in Brazil and Europe. This paper presents the SWAMP architecture, platform, and system deployments that highlight the replicability of the platform, and, as scalability is a major concern for IoT applications, it includes a performance analysis of FIWARE components used in the Platform.

The content reviews various research works focused on using IoT, wireless sensor networks, and automation to improve agricultural operations. Most studies emphasize low-cost, sensor-based systems using parameters such as soil moisture, temperature, and humidity to monitor field conditions in real time. Traditional manual methods used by farmers are inefficient, so automated and wireless systems are proposed to collect data from multiple locations and assist in irrigation decisions. Several works highlight smart irrigation systems, cloud computing for agricultural data management, GPS-based robotic systems for farming tasks, and image processing for crop disease detection. Overall, these technologies aim to optimize water usage, reduce manpower, improve decision-making, and increase crop productivity and profit through real-time monitoring and automated control of agricultural operations.

V. Proposed Methodology

The proposed IoT based agriculture system is designed to monitor and control agricultural field parameters in real time using sensors, microcontrollers, wireless communication, and cloud platforms. The system consists of four main layers: sensing layer, processing layer, communication layer, and application layer.

In the sensing layer, various sensors such as soil moisture sensor, temperature sensor, humidity sensor, and light intensity sensor are deployed in the agricultural field to continuously collect environmental and soil data. These sensors capture real-time conditions that directly affect crop growth.

In the processing layer, a microcontroller or development board such as Arduino or NodeMCU receives data from the sensors. The collected data is processed and compared with predefined threshold values suitable for specific crops. Based on this analysis, the controller decides whether actions such as turning ON or OFF the irrigation pump or activating alerts are required.

The communication layer uses wireless technologies such as Wi-Fi, GSM, or LoRa to transmit sensor data from the field to a cloud server or IoT platform. This allows remote monitoring and data storage for further analysis and visualization.

In the application layer, a web or mobile application displays real-time sensor values, historical data, and system status. Farmers can monitor field conditions remotely and receive notifications or alerts when parameters cross critical limits. The system also supports manual override, allowing farmers to control irrigation or devices remotely.

This methodology enables efficient use of water, reduces manpower, improves crop yield, and supports data-driven decision making, making agriculture more smart, automated, and sustainable.

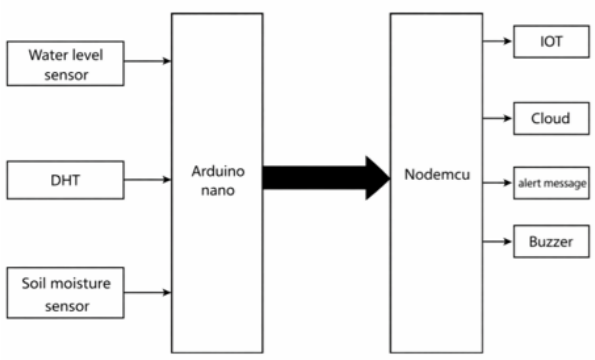

Figure 1 Block Diagram of Proposed Methodology

VI. Hardware & Software Description

The hardware of the IoT based agriculture system consists of sensors, microcontrollers, communication modules, and output devices. Soil moisture sensor is used to measure the water content in the soil. Temperature and humidity sensor (such as DHT11/DHT22) monitors atmospheric conditions. A water level sensor checks the availability of water in the tank or source. All these sensors are connected to a microcontroller like Arduino Nano, which collects and processes the sensor data.

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The software part includes programs for microcontrollers, communication protocols, cloud services, and user interface. Arduino IDE is used to write and upload programs to Arduino Nano and NodeMCU. The Arduino Nano code reads sensor values and sends them to NodeMCU using serial communication. The NodeMCU program handles Wi-Fi connection, data transmission to cloud, and receiving control commands.

Figure 2: ESP8266 Development Board

Figure 3: Arduino Uno as a microcontroller

VII. Results

The implementation of the IoT based agriculture system successfully demonstrated real-time monitoring and automatic control of farming parameters such as soil moisture, temperature, humidity, and water level. The system accurately sensed environmental conditions and transmitted data to the cloud platform, where it was displayed in graphical and numerical formats for easy understanding by farmers. Automatic irrigation was activated when soil moisture fell below the set threshold and stopped once adequate moisture was reached, which reduced water wastage and ensured optimal crop hydration.

Alert messages and buzzer notifications were generated during abnormal conditions, enabling quick response.

Overall, the results showed improved efficiency in irrigation management, reduced manual effort, better use of water resources, and increased potential for higher crop productivity.

VIII. Conclusion

The IoT based agriculture system proves to be an effective solution for modernizing traditional farming practices through automation and real-time monitoring. By integrating sensors, microcontrollers, wireless communication, and cloud platforms, the system enables accurate monitoring of soil and environmental conditions and supports automatic irrigation and alert generation. This reduces dependency on manual labor, minimizes water wastage, and improves decision making using real-time data. The system is low cost, scalable, and user friendly, making it suitable for small and large farms. Overall, it contributes to sustainable agriculture by increasing productivity, conserving resources, and enhancing farmers' ability to manage crops efficiently.

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