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IOT based Smart Plant Monitoring System and Control System

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***Abstract*-The world is now fully dependent on the internet and the Internet of Things (IoT), which is the inter-networking of physical devices embedded with electronics, sensors, software and network connectivity. IoT enables physical devices to exchange data with the manufacturer and achieve greater value and services. Agriculture is the backbone of many countries, but water scarcity is a major issue in this field. To overcome this problem, the irrigation process can be automated using IoT. By using sensors, the temperature, humidity, and light can be measured, and appropriate processing can be performed based on the outcome. This helps in reducing water wastage and improving accuracy, economic benefits, and efficiency while reducing human intervention. This paper highlights the importance of IoT in day-to-day life, its scope in the future, and its potential applications in farming methods. To demonstrate the use of IoT in agriculture, we present the Automatic Watering System, which monitors and maintains the moisture content in the soil using temperature, humidity, and moisture sensors. The Arduino UNO microcontroller is used as the control unit, regulating the appropriate amount of water to avoid over/under irrigation.**

Keywords **– Sensors, temperature, humidity, soil moisture, Arduino uno**

I. Introduction

The use of Internet of Things (IoT) technology into plant care has brought about a new era of precision agriculture and environmental management. IoT-based smart plant monitoring and control systems offer a fundamental shift in how we connect with and care for plants. These systems provide unparalleled insights into plant health, growth dynamics, and environmental conditions through the use of networked sensors, actuators, and data analytics. In this review article, we will look at the evolution, applications, problems, and future possibilities of IoT-based smart plant monitoring and control systems, with the goal of providing a thorough overview of this rapidly growing topic. The genesis of IoT-based smart plant monitoring and control systems can be traced back to the convergence of advancements in sensor technology, wireless communication, and data analytics. Early attempts at plant monitoring relied on standalone sensors and manual data collection methods, limiting their scalability and effectiveness. However, with the advent of IoT, these systems evolved into interconnected networks capable of real-time data transmission, remote technique. Arduino collects and stores all sensor data in a string format. The Raspberry Pi 3 receives the entire string from Arduino, which divides the data based on commas and stores it once more in an array. [3]

A sensor-based hydrophonics automated environmental control system.In order to create a regulated environment for crop production, ACHPA uses sensors positioned at appropriate distances and a centralized controller to control environmental parameters including temperature, humidity, and soil moisture. The controller receives pre-monitoring, and autonomous control. From simple soil moisture sensors to sophisticated multi-sensor arrays, the evolution of IoT technology has paved the way for more efficient and intelligent plant care solutions. By investigating these applications and their ramifications, this review paper hopes to emphasize the revolutionary potential of IoT-based smart plant monitoring and control systems in defining the future of agriculture and environmental stewardship.

II. Literature survey

Describe how the system is made up of a water pump, a microprocessor that manages the watering schedule, and a soil moisture sensor. The benefits of employing an automated system over manual watering, including increased plant growth and decreased water waste, are also covered in the article. All things considered, the article offers a helpful remedy for people who wish to keep their plants healthy while using the least amount of water. [1]

An automated, dependable, and user-friendly water pumping system for fields is provided by this project. Modern technology is advancing so quickly that it has taken over human life in its entirety. Even though technology plays such a significant role in our daily lives, some people lead extremely disconnected lives from this well-known concept. Therefore, it is our duty to create a few dependable systems that they can even use effectively. The project Node MCU based water pump controller at fields using relay switches was born out of this fundamental concept. The primary goal of the study is to use soil moisture to design a water management system. [2]

Explain an IOT-enabled device that uses multiclass support vector machines and image processing to classify diseases by sending real-time environment data and a plant leaf image to a database. Figure 1 outlines the model we have suggested. Plant diseases that are impacted can be identified and categorized through the use of image processing. The work in this procedure is broken down into four sections: preprocessing and picture acquisition; segmenting the affected region; extracting features; and classifying the results using a multi-class support vector machine

III. Methodology

The methodology for developing an IoT-based smart plant monitoring and control system involves defining system requirements, selecting appropriate hardware components, and establishing communication protocols. Sensor nodes are designed to capture and process environmental data, which is then transmitted and stored centrally for analysis. Control algorithms are developed based on data analysis to automate actions like watering or adjusting lighting. A user-friendly dashboard provides real-time visualization of plant conditions, and alerts

fed operating ranges for the environmental factors that need to be managed. In order to govern action, the environmental parameters obtained from the sensors are compared to the pre-fed values. [4]

Sensors suitable for wireless application in agriculture. An automatic watering system that is network-based is used to save water. A wireless sensor network that consists of temperature and soil moisture sensors is employed in the agricultural field. The Zigbee protocol was used to handle sensor data, and a microcontroller created with an algorithm based on sensor threshold values was used to manage the amount of water used for irrigation. The device, which includes a cellular internet interface and is powered by a solar panel, is used to analyze data.
A wireless camera is placed in the agricultural field to monitor the disease region using image processing techniques. Because of its low cost and lack of energy use, the technology is perfect for remote and water-scarce areas.[5]

Unbalanced fertilization of crops leads to either too much or too little fertilization, and an important yet common issue is the inability to adequately control the concentration. As a result, a sophisticated fertilization tool that can autonomously hydrate, fertilize, inject, and mix fertilizer has been developed. The research presents three control algorithms: a system priority algorithm, an injection and mixing mechanism for fertilizer, and a control algorithm for fertilizer application. It also explains the pipe system's design and system architecture. The testing results show that this system is very practical, has a stable performance, and good quality for EC and pH adjustment. [6]

An article in review Internet of Things and Node MCU [3] state that the first stage of developing an Internet of Things (IOT) product is prototyping. An Internet of Things prototype consists of a user interface, backend software, hardware components like sensors, actuators, and CPUs, and connections. An IOT development board or microcontroller unit (MCU) is used for prototyping. IOT microcontroller units (MCUs) and development boards with low-power CPUs enable several programming environments, firmware-based sensor data collecting, and raw or processed data transmission to a local or cloud server.
Based on the LUA programming language, NodeMCU is an open-source firmware for the ESP8266 Wi-fi device.[7]

notify users of critical events. Prototyping and field trials validate system performance, while data analysis guides optimization efforts based on user feedback and collected data patterns. This iterative process ensures the effective implementation and enhancement of the IoT-based smart plant monitoring and control system

IV. Conclusion

Implementing an IoT-based smart plant monitoring and control system offers users several key advantages. This technology provides real-time insights through an intuitive interface, enabling informed decision-making about plant care. Automation features simplify tasks like watering and lighting adjustments, reducing manual effort and enhancing efficiency.
Furthermore, the system promotes sustainability by optimizing resource use and minimizing environmental impact. It offers flexibility to adapt to different plant types and growing environments, making it suitable for a wide range of applications from home gardens to large-scale operations. Overall, the adoption of this technology enhances user experience, productivity, and environmental stewardship in plant cultivation

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