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Smart Plant Health Monitoring System Using AI

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Abstract

The Smart Plant Health Monitoring System utilizes IoT sensors, machine learning, and automated irrigation to monitor soil moisture, temperature, humidity, and plant diseases in real-time. It provides early detection of issues, automated alerts, and optimized water usage, helping farmers improve crop health and productivity. This system ensures efficient resource management and supports sustainable precision farming.

Keywords: Agriculture, affected plants, Soil moisture, Image processing, Diseases detection, Smart irrigation

1. Introduction

Agriculture plays a crucial role in global food production, but farmers often face challenges such as plant diseases, improper irrigation, and inefficient resource management. Traditional farming methods rely on manual observation, which can be time-consuming and inaccurate. To address these issues, we propose a Smart Plant Health Monitoring System that integrates IoT sensors, machine learning, and automated irrigation to ensure efficient crop management. This system continuously monitors soil moisture, temperature, humidity, and plant health using sensors and image processing techniques. The collected data is analyzed in real-time, enabling early disease detection, automated alerts, and optimized water usage. Farmers can access this information through a web or mobile application, allowing them to make informed decisions and take preventive measures to protect their crops.

2. Literature Survey

[1] Design and perpetration of a Smart Agriculture Monitoring System using Cloud Computing Technology with a Wi- Fi Module.

The exploration paper discusses the development of a smart husbandry monitoring system that leverages pall calculating technology and a Wi- Fi module to enhance agrarian practices. The system uses colorful detectors to collect real time data on environmental plant similar as soil humidity, temperature, moisture, and light intensity. This data is also transmitted wirelessly to a pall platform, where it's reused and anatomized. The reused data is made accessible to growers through a stoner friendly interface, enabling them to make informed opinions about irrigation, fertilization, and pest control. The system aims to ameliorate crop yield, reduce resource destruction, and promote sustainable husbandry practices by furnishing practicable perceptivity and real- time monitoring capabilities.

[2] Identification of Leaf conditions of Medicinal shops Using K- Nearest Neighbor Grounded on

Color, Texture, and Shape Features.

The exploration paper presents a system for relating splint conditions in medicinal shops using the KNearest Neighbor (KNN) algorithm. The approach involves rooting features similar as color, texture, and shape from images of plant leaves. These features are also used to train the KNN algorithm to classify the leaves as either healthy or diseased. The paper highlights the effectiveness of using these features for accurate complaint discovery and bracket. The results demonstrate that the KNN algorithm can successfully identify colorful splint conditions, furnishing a dependable tool for early discovery and operation of plant conditions in medicinal shops.

[3] Early Pest Discovery from Crop using Image Processing and Computational Intelligence.

The exploration paper discusses the development of a system for early pest discovery in crops using image processing and computational intelligence ways. The system aims to identify pests at an early stage to enable timely intervention and reduce the inordinate use of fungicides. It leverages highresolution images of crops and applies image processing algorithms to descry pest infestations. Features similar as color, texture, and shape are uprooted from the images, and machine literacy models are trained to classify the presence of pests directly. By employing computational intelligence, the system can give real- time monitoring and cautions to growers, helping them take immediate action to cover their crops and ameliorate yield.

[4] Environmental Wireless Sensor Network Using jeer Pi 3 for Greenhouse Monitoring System.

The exploration paper explores the design and perpetration of an environmental wireless detector network using raspberry Pi 3b+ to cover hothouse conditions. The system integrates colorful detectors to measure crucial environmental parameters similar as temperature, moisture, and soil humidity. The data collected by these detectors is transmitted wirelessly to the raspberry Pi 3b+, which acts as the central processing unit. The raspberry pi processes the detector data and uploads it to a pall platform for remote access and analysis. This setup allows for real- time monitoring and control of the hothouse terrain, enabling growers to optimize conditions for factory growth. The system aims to ameliorate crop yield, reduce resource destruction, and promote effective hothouse operation by furnishing practicable perceptivity grounded on accurate and timely data.

3. Existing System

IoT-based health monitoring systems utilize wearable or implantable sensors to continuously track vital signs like heart rate, temperature, and oxygen levels. This data is transmitted to healthcare providers in real time, allowing for the early detection of abnormalities. Remote patient monitoring, on the other hand, is designed for individuals requiring periodic check-ups and employs devices such as heart rate monitors and temperature sensors, with alerts sent to doctors or family members during emergencies. Additionally, the integration of blockchain technology in some systems ensures the security and privacy of patient data, preventing unauthorized access and maintaining its integrity.

4. Proposed System

The proposed smart plant health monitoring system aims to provide an automated, intelligent, and cost-effective solution for modern agriculture. By integrating IoT sensors, AI-based image processing, and machine learning algorithms, the system will enable real-time monitoring of plant health. IoT sensors will continuously collect data on temperature, humidity, soil moisture, and light intensity, ensuring optimal growing conditions. Additionally, high-resolution cameras will capture plant images, which will be analyzed using machine learning models to detect diseases at an early stage and recommend appropriate treatments. The system will also feature an automated irrigation and pesticide control mechanism, reducing manual labor and optimizing resource usage. A cloud-based data storage and analytics platform will allow farmers to access real-time insights, predictive analysis, and historical trends through a user-friendly mobile application or web interface. Unlike expensive satellite and drone-based solutions, this system will use low-cost IoT devices and AI models, making it accessible to both small and large-scale farmers. Real-time alerts via SMS, mobile apps, or email will enable farmers to take immediate action, minimizing losses and improving crop yield. By combining automation, AI-driven decision-making, and real-time analytics, the proposed system enhances agricultural productivity, promotes sustainability, and ensures a smarter approach to plant health management.

5. Advantages

The proposed smart plant health monitoring system offers several advantages that enhance agricultural productivity and efficiency. One of the key benefits is real-time monitoring, which continuously tracks essential plant health parameters such as temperature, humidity, soil moisture, and disease symptoms. This enables early disease detection through advanced image processing and machine learning techniques, reducing potential crop losses. Additionally, the system provides automated alerts and notifications, sending real-time updates to farmers via SMS or mobile applications to inform them of any potential threats.

6. Data Flow Diagram

The Smart Plant Health Monitoring System follows a structured data flow that ensures efficient monitoring, analysis, and response to plant health conditions. The process begins with the data collection phase, where various sensors deployed in the agricultural field gather real-time information on environmental parameters such as soil moisture, temperature, humidity, light intensity, and plant leaf conditions. If cameras are integrated, they capture images of leaves for disease detection. These sensors continuously monitor plant health and send data to the processing unit.

Next, in the data transmission phase, the collected data is sent to a central processing unit, such as a Raspberry Pi, Node MCU or IoT gateway, using communication technologies like Wi-Fi for remote connectivity. Machine learning algorithms analyze the data for disease detection, and a threshold analysis checks if any parameters, such as soil moisture or temperature, exceed predefined limits.

7. Use Case Diagram:

The Smart Plant Health Monitoring System operates through a structured use case that ensures efficient monitoring and management of plant health. The primary actors in this system include the farmer or user, various IoT sensors (such as temperature, humidity, soil moisture, and camera sensors), a processing unit (like Raspberry Pi or a microcontroller), a cloud database for storing data, and a mobile or web application for user interaction.

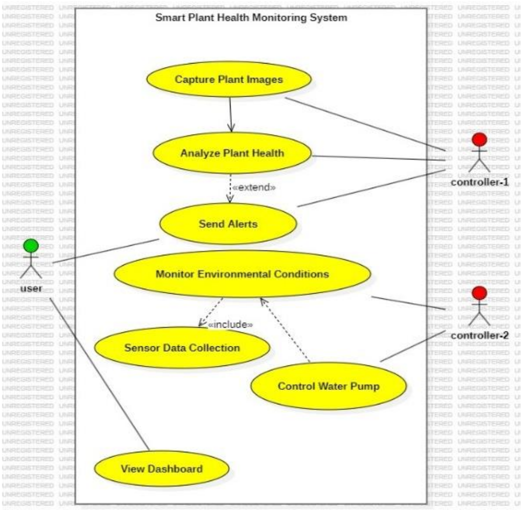

Fig:1 Use Case

Conclusion:

The Smart Plant Health Monitoring System provides an efficient, automated, and data-driven approach to modern agriculture. By integrating IoT sensors, machine learning, and automated irrigation, the system ensures real-time monitoring of soil moisture, temperature, humidity, and plant diseases. This enables early issue detection, optimized resource utilization, and improved crop health, reducing manual effort and enhancing productivity.

With features like automated alerts, remote access via a web/mobile app, and cloud-based data storage, farmers can make informed decisions to prevent crop damage and maximize yield. The system promotes sustainable farming by reducing water wastage and chemical overuse, making it a cost-effective and scalable solution for precision agriculture. Ultimately, this project contributes to smarter, more efficient, and eco-friendly farming practices, ensuring a healthier and more productive agricultural ecosystem.

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