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Plant Disease Detection using IOT

Mr. S. R. Rasal, Mr. Atharv Aade, Mr. Digambar Babar, Miss. Sanniti Koshti,
Mr. Prathmesh Gurvan, Mr. Abhinav Chougule
Department of Computer Science and Engineering
Yashwantrao Chavan Polytechnic, Ichalkaranji, India

Abstract*: Plant diseases significantly impact crop productivity, making early detection crucial. This project, plant disease detection using IoT, integrates ESP32, temperature, humidity, and soil moisture sensors to monitor plant conditions in real time. Sensor data is transmitted to the Blynk IoT platform, enabling automation by activating a roof, water pump, or fan based on environmental conditions. A machine learning model classifies plant health using images from a webcam or user uploads via a Flask-based web interface. This system enhances precision agriculture by combining IoT automation and AI-driven disease detection.*

Keywords: plant disease detection, IoT automation, machine learning, precision agriculture, smart farming

I. INTRODUCTION

Agriculture is a crucial sector that sustains human life by providing food and raw materials. however, plant diseases remain a major challenge, affecting crop yield and quality. traditionally, farmers rely on manual inspection to detect plant diseases, which is often inaccurate and time-consuming. with technological advancements, integrating smart systems can help monitor plant health more effectively and automate necessary actions to prevent crop damage.

This project, plant disease detection using iot, is designed to address these challenges by utilizing esp32 along with temperature, humidity, and soil moisture sensors. these sensors continuously collect environmental data, which is transmitted to the blynk iot platform for real-time monitoring. based on the sensor readings, automated actions are triggered, such as opening a roof when the temperature is too low, starting a water pump when soil moisture is insufficient, and activating a fan when the temperature is high. this ensures that plants receive the optimal environmental conditions needed for healthy growth.

In addition to environmental monitoring, a machine learning model is implemented to detect plant diseases. a webcam captures images of plants, or users can upload images via a flask-based web interface. the model analyzes these images to classify the plant as healthy or infected, providing early disease detection and reducing the risk of widespread infection. by combining iot-based automation with ai-driven analysis, this system enhances precision agriculture, improving crop management and reducing losses due to plant diseases.

II. LITERATURE SURVEY

IoT-based plant disease monitoring systems

Various studies have explored the integration of iot in agriculture to enhance disease detection. research by patel et al. (2021) demonstrated an iot-based framework where environmental sensors monitored real-time conditions, and data was analyzed to detect abnormalities that indicate plant diseases. the study highlighted the efficiency of remote monitoring and automation in reducing crop losses.

Machine learning approaches for plant disease classification

Recent research by sharma et al. (2020) applied convolutional neural networks (cnns) to identify plant diseases from leaf images. the study compared different deep learning models and found that pretrained models such as vgg16 and resnet achieved high accuracy in classifying plant infections. this research emphasizes the role of ai in modern agricultural disease detection.

Automation in precision agriculture using esp32
Singh et al. (2019) investigated the use of esp32 in precision agriculture for automating farming activities. their study implemented a smart irrigation system that activated water pumps based on real-time soil moisture data. this research supports the integration of esp32 for controlling environmental conditions in smart agriculture.

Blynk IoT for agricultural automation
A study by gupta et al. (2021) analyzed the efficiency of blynk iot in managing agricultural devices remotely. the research demonstrated how real-time data from temperature and humidity sensors could be visualized and controlled via a mobile application. their findings indicate that using cloud-based platforms significantly improves farm management and decision-making.

Deep learning in plant disease detection using webcam images
A study by kumar et al. (2022) developed a real-time plant disease detection system using webcam-captured images. their model processed live video feeds to classify plants as healthy or diseased using ai techniques. this research aligns with the need for continuous monitoring of crops without requiring manual intervention.

Automated climate control in greenhouses
Research by khan et al. (2020) focused on the impact of automated climate control in greenhouses. their study designed a system where fans and roof openings were controlled based on temperature and humidity variations, ensuring optimal plant growth conditions. this research is relevant to implementing automated environmental adjustments in iot-based farming.

Flask-based web applications for agricultural data visualization
Verma et al. (2021) studied the use of flask in developing web-based applications for agriculture. their research presented a system where farmers could upload images for disease detection and receive instant classification results. this study reinforces the importance of web-based interfaces in making plant disease detection accessible and user-friendly.

III. PROPOSED SYSTEM

1. Data Collection from Sensors
temperature, humidity, and soil moisture sensors are placed in the plant environment to continuously monitor the conditions. the esp32 microcontroller collects real-time data from these sensors and processes it. this data is then transmitted to the blynk iot platform, where users can visualize the readings remotely. accurate data collection ensures that any deviations from optimal conditions are detected immediately.

2. Iot-Based Automation
based on predefined threshold values, the system automates responses to maintain an ideal plant-growing environment:
if the temperature falls below the set limit, the roof mechanism opens to allow more heat into the environment.
if the soil moisture level drops below the required level, the water pump is activated to irrigate the plants.
if the temperature rises above the acceptable range, the fan turns on to regulate the heat and maintain optimal plant health. this automation reduces manual intervention and ensures efficient resource utilization.

3. Image Capturing and Uploading
the system incorporates a webcam to capture live images of plants at regular intervals. alternatively, users can manually upload images through the web interface to check for plant diseases. this allows farmers to diagnose plant health remotely without requiring a physical inspection.

4. Image Processing and Classification

once an image is captured or uploaded, it undergoes preprocessing using machine learning techniques. the image is resized, normalized, and converted into a format suitable for analysis. a deep learning model, trained on plant disease datasets, classifies the plant as either healthy or infected. the model evaluates patterns, discoloration, and texture changes to make accurate predictions.

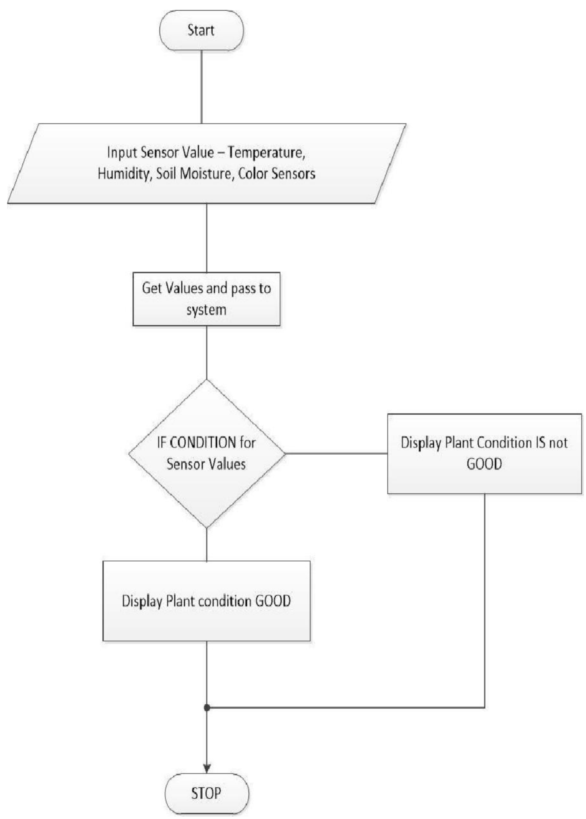
5. Displaying Results on Web Interface

after classification, the system presents the results on a user-friendly flask-based web interface. users can see whether the plant is healthy or infected, along with a confidence percentage. in case of an infected plant, additional recommendations can be provided to guide the user on the next steps.

6. Data Visualization on Blynk IoT Platform

apart from disease detection, all sensor readings (temperature, humidity, and soil moisture) are displayed on the blynk iot dashboard. this real-time visualization allows users to monitor environmental conditions remotely. alerts can also be sent to notify users if any parmeter goes beyond the safe range.

IV. DIAGRAM



V. CONCLUSION

This project successfully integrates IOT and machine learning to enhance plant disease detection and automate environmental control. by using sensors, real-time data monitoring, and an ai-based classification model, it ensures optimal plant health with minimal manual intervention. the system improves precision agriculture by providing automated responses to environmental changes and early disease detection, helping farmers make informed decisions.

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with further improvements, this technology can be scaled for larger agricultural applications to increase efficiency and reduce crop losses.

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AUTHORS

- **First Author** – Mr.S.R.Rasal, Lecturer, DKTE'S Yashwantrao Chavan Polytechnic , Ichalkaranji.
- **Second Author** – Mr.Atharv Aade, Student, DKTE'S Yashwantrao Chavan Polytechnic , Ichalkaranji.
- **Third Author** – Mr.Digambar Babar, Student, DKTE'S Yashwantrao Chavan Polytechnic , Ichalkaranji.
- **Fourth Author** – Miss.Sanniti Koshti, Student, DKTE'S Yashwantrao Chavan Polytechnic , Ichalkaranji.
- **Fifth Author** – Mr.Prathmesh Gurvan, Student, DKTE'S Yashwantrao Chavan Polytechnic , Ichalkaranji.
- **Sixth Author** – Mr.Abhinav Chougule, Student, DKTE'S Yashwantrao Chavan Polytechnic , Ichalkaranji.