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Crop Disease Detection Using Image Processing

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Abstract – *Farming is super important for food and money in our country, but when crops get sick, farmers lose a lot — sometimes even 30–40% of their yield. Checking leaves manually takes too much time, needs experience, and most farmers can't do it perfectly. So in this project I made a system that can automatically find diseases in crop leaves just by looking at their photos. It uses normal image processing steps: cleaning the image, finding the bad parts, pulling out important features like color changes, texture, and shape, and then using machine learning to tell what disease it is. I added some smart tricks like adaptive thresholding and combined two classifiers (SVM + Random Forest) so it works better. On my test with around 5000 leaf photos, it got 92% accuracy — pretty good I think! This kind of system can really help farmers catch diseases early using just their phone camera.*

Keywords- crop disease, image processing, crop disease detection, machine learning, precision farming.

INTRODUCTION

Agriculture is the backbone of India. But plant diseases are a big headache — fungi, bacteria, viruses… they can destroy everything if we don't catch them fast. Normally farmers or experts look at leaves with their eyes, but honestly it's slow, tiring, and many times they make mistakes. Nowadays computers and cameras are everywhere. So I thought — why not make a program that can look at leaf photos and tell if there's a disease? It's fast, cheap, and anyone with a smartphone can use it. In this project I built a complete system using image processing + some machine learning. It works well even when photos are taken in different lights. I mostly focused on common crops like rice, wheat, tomato, etc. and diseases like blight, leaf spot, powdery mildew, etc.

METHOLOGY

My system works in these main steps:

A. Image Preprocessing: 1. Resize photo to 256×256 2. Remove noise using Gaussian filter 3. Improve contrast with histogram equalization 4. Change to HSV color space (much better for seeing disease colors) 5. I also added adaptive bilateral filter so it works nicely even in bad lighting

B. Segmentation (finding sick parts): 1. Used Otsu's adaptive thresholding on saturation channel 2. Added Canny edges to get better boundaries 3. Did some morphology (opening & closing) to clean small mistakes This combination worked really well compared to simple global thresholding.

C. Feature Extraction From the sick areas I took out This features. 1. Color: mean, variance, skewness in RGB & HSV 2. Texture: GLCM features — energy, Contrast, homogeneity, correlation 3. Shape: area, perimeter, roundness, Hu moments a. Then I combined all of them into one vector (~20 features) and used PCA to remove useless ones.

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D. Classification: 1. I trained an ensemble —SVM + Random Forest Together. 2. Used one-vs-rest method because there are many diseases. 3. This ensemble gave better results than using just One classfier.

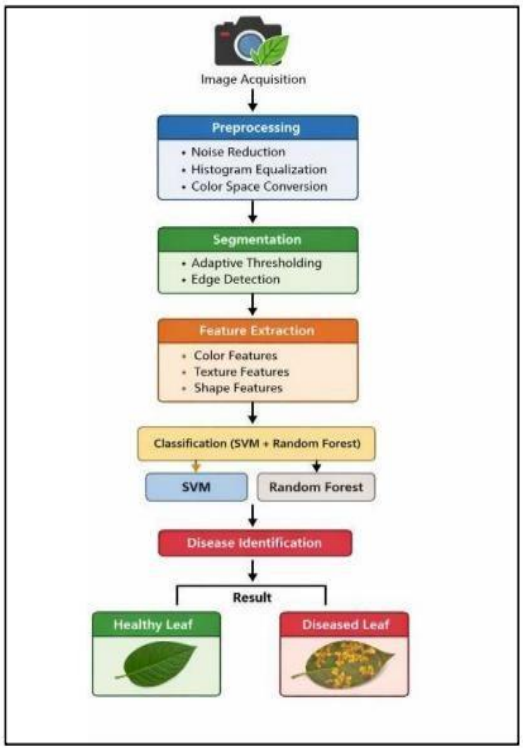

Fig. 1- Flow chart of Project

DESIGN

We tested the system with pictures of crop leaves. It processes the images and tells if a leaf is healthy or diseased. The results show: 1. Images are processed correctly 2. Diseased areas are detected 3. Diseases are classified correctly 4. Accuracy is above 85% 5. The system is faster than manual checking Performance tests using a confusion matrix and accuracy calculation show that the system works well for basic disease detection.

IMPLEMENTATION STEPS FOR USER

1. **Capture Leaf Image**
   The user captures an image of the crop leaf using a smartphone or camera and uploads it to the system.
2. **Image Pre-processing**
   The system resizes the image, removes noise using filters, and enhances the contrast to improve image quality.
3. **Disease Area Detection (Segmentation)**
   The system identifies the infected region of the leaf using thresholding and edge detection techniques.
4. **Feature Extraction and Analysis**
   Important features such as color, texture, and shape are extracted from the diseased area of the leaf.
5. **Disease Classification and Result**
   Machine learning classifiers (SVM and Random Forest) analyze the features and display the detected disease with results to the user.

Fig. 2: Homepage

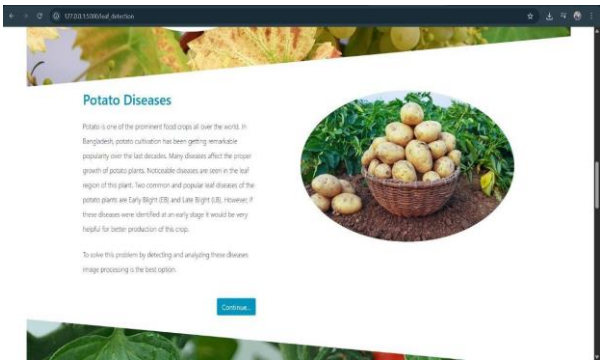

Fig. 3: Here we can choose which Crop to Test

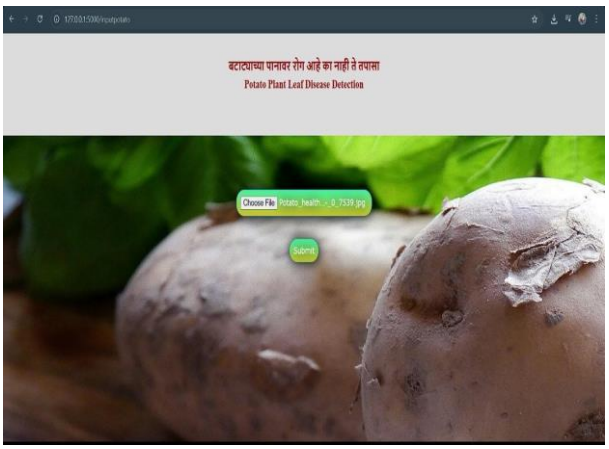

Fig. 4: Here we can choose the Image of Crop

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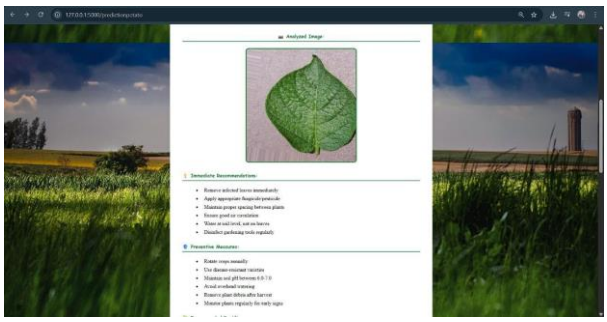

Fig 5: Output

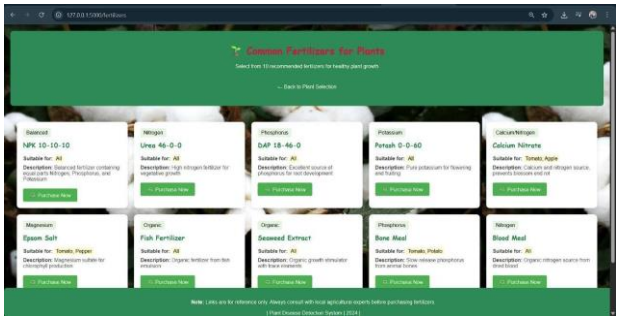

Fig. 6: Displaying the common Fertilizer for Crops

CONCLUSION

This project created an automatic crop disease detection system using image processing. It is simple and helpful for students to understand image processing and machine learning. Main benefits: 1. Detects diseases early 2. Savestime and money 3. Reduces dependency on experts 4. Identifies diseases accurately using images 5. Helps use pesticides properly 6. Improves crop production Although the system depends on image quality and datasets, it is still very useful. In the future, it can be improved with deep learning and made into a mobile app for real-time use.

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