

Plant Disease Detection using an Image Processing Technique and Machine Learning

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Abstract—Food plant cultivation and growth may be prevented in some areas by the presence of plant diseases; alternatively, food plant cultivation and growth may be possible, but plant diseases may attack the plants, destroy some or all of the plants, and reduce much of their produce, or food, before it can be harvested or consumed. The crops contract a variety of diseases as a result of diverse seasonal conditions. The plant's leaves are initially impacted by these diseases, and then contaminated the entire factory, which subsequently impacted the quality and quantity of the crop field. For classifying plant diseases, each algorithm is described along with the relevant processing techniques, such as feature extraction and image segmentation, as well as the common experimental setup. In this paper, we introduce an autonomous plant leaf disease detection and classification system that uses artificial intelligence. This system allows for rapid disease detection, classification, and application of the necessary treatments to cure the disease.

Index Terms— Artificial intelligence, Classification system, Plant diseases, Rapid disease detection.

I. INTRODUCTION

Depending on the type of soil, local climate, and economic value, the rancher selects the best yield. The majority of the time, farmers commit suicide as a result of production loss because they are unable to repay the bank loan they have taken out for farming. Plant diseases have a detrimental effect on agricultural production. Plants with a disease typically have noticeable stains or lesions on their leaves, stems, flowers, or fruits. The majority of diseases and pest conditions exhibit a distinct visual pattern that can be utilized to specifically identify irregularities. Most disease signs may first develop on the leaves of plants, which are typically the main source for identifying plant illnesses.

II. DETECTION SYSTEM FOR PLANT DISEASES

By looking at the plant's leaves, stem, and roots, one can detect plant illnesses. The shape and color of the damaged area, as well as diseased leaves, stems, fruits, and flowers, can all be detected using digital image processing.

The general procedures used in various image-processing methods are as follows:

1. Image Acquisition
2. Image Preprocessing
3. Image Segmentation
4. Image Feature Extraction
5. Image-based Disease Identification

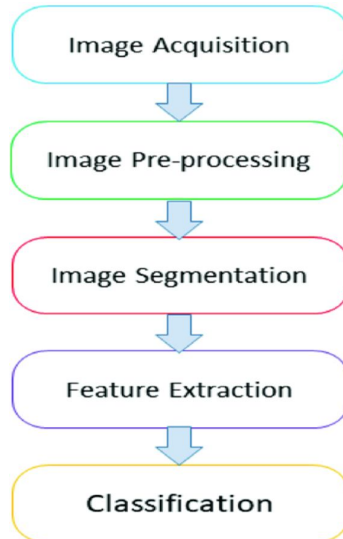


Fig.1 Image-Processing Methodology

- ❖ **Image acquisition:** Image acquisition is the process of creating a precisely encoded representation of an object's visual characteristics, such as its internal structure or a physical scene.
- ❖ **Image Preprocessing:** Images that have been acquired will be used in pre-processing phases to enhance some picture attributes necessary for additional processing. To divide the plant image into distinct fragments, segmentation is used. This can be used to remove unhealthy tissue from the background of a plant's leaf, stem, or root.
- ❖ **Image Segmentation:** Picture segmentation is a technique used in digital image processing and computer vision to separate an advanced image into several pieces. The goal of division is to make a picture simpler and transform its structure into something that is gradually meaningful and easier to understand.
- ❖ **Image Feature Extraction:** Using grey level co-occurrence matrix (GLCM), blend vision, and artificial intelligence, among other methods, it is possible to extract the color, shape, and texture characteristics of the diseased area of the plant.
- ❖ **Image-based Disease Identification:** This step entails successfully predicting and classifying plant diseases using various machine-learning algorithms.

III. DIAGNOSIS OF DISEASES

The following objectives are achieved using image analysis:

1. Spotting illnesses on the fruit, stems, and leaves.
2. Calculate the impacted area.
3. Determine the cause of the affected area.
4. Ascertain the hue of the impacted region.
5. Establish the fruits' size and shape.

• **Symptoms of Fungal Disease:** Fungi, such as Late blight, cause plant leaf diseases. It first appears on lower, aged leaves that are wet or have areas of grey-green color. These spots turn dark as the parasite condition progresses, which encourages the growth of fungus.

• **Symptoms of a Viral Disease:** Of all the plant illnesses, those brought on by infections are the most difficult to diagnose. There are no history indications that are constantly observable and mistaken for damage or nutrient deficits. Aphids, Whiteflies, cucumber creepy crawlies, and leafhoppers are frequent carriers of this disease.



Fig. 2 Fungal Disease



Fig. 3 Viral Disease

- **Symptoms of Bacterial Disease:** Pathogenic bacteria can seriously afflict crops. They must enter through wounds or plant holes since they cannot simply permeate plant tissue. Bugs, various infections, and farming equipment used during various chores, such as trimming and plucking, can cause wounds on plants.



Fig. 4 Bacterial Disease

IV. MODEL STRUCTURE USING MACHINE LEARNING

The vanishing gradients problem, one of the well-known puzzles, is solved by the ResNets Architecture. In ResNets, instead of using a traditional neural network where each layer feeds into the next layer and directly into the layers two to three hops away, we use a network with residual blocks to prevent over-fitting (a condition where validation loss stops decreasing at a point and then keeps increasing while training loss still decreases).

STEPS:

1. Users can load photos in jpeg,png,jpg format and use RGB (red, green, and blue) format.
2. After that, the system creates segment pictures, which may involve converting RGB images to grayscale or grayscale to binary image formats.
3. The user then decides on relevant classification methods (k-means cluster algorithm).

4. Following that, users can obtain classification outcomes and quickly identify leaf illness.

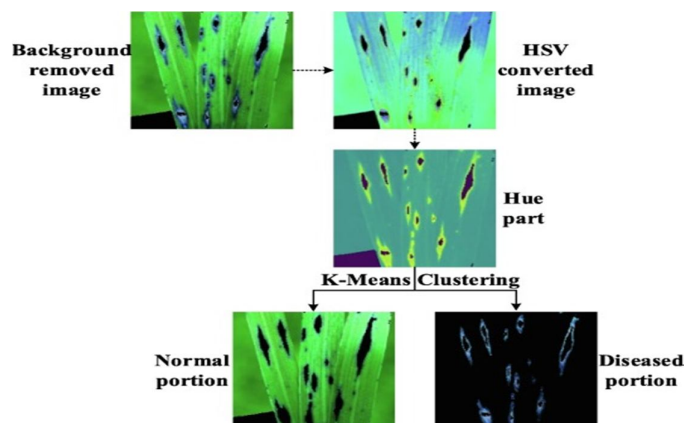


Fig. 5 Gray scale image using K-Means Clustering

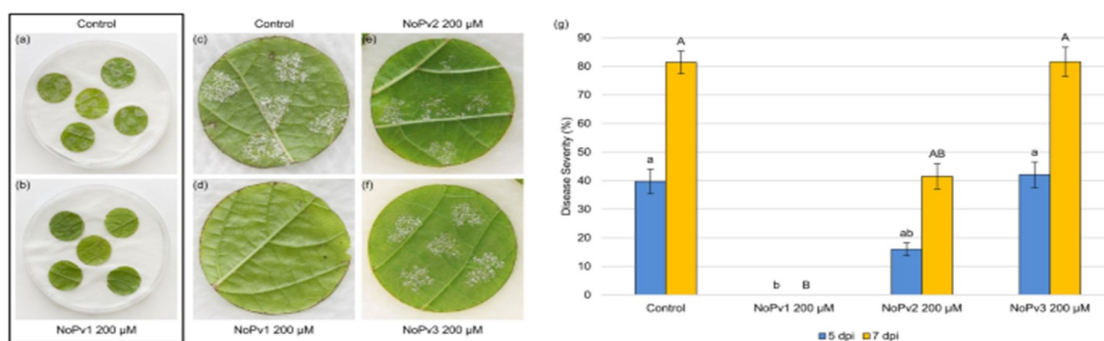


Fig. 6 Diseases Detection

V. CONCLUSION

The approaches for automatic computerized disease detection in plants that can be carried out utilizing picture segmentation and classification techniques are presented in this research. The creation of automatic detection systems using cutting-edge technology, such as image processing, helps farmers identify diseases at an early or initial stage and provide useful data for their management. The ResNet algorithm produced highly accurate results and was able to identify more illnesses from different harvests. ResNets produce a significantly better classification for images.

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