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Crop Leaves Disease Identification Using KERAS

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Abstract: In recent times, drastic climate changes and lack of immunity in crops has caused substantial increase in growth of crop diseases. This causes large scale demolition of crops, decreases cultivation and eventually leads to financial loss of farmers. Due to rapid growth in variety of diseases and adequate knowledge of farmer, identification and treatment of the disease has become a major challenge. This paper proposes Artificial Intelligence (AI) system classifies and identifies the leaf diseases early using K-Means clustering algorithm and Support Vector Machine (SVM) classifier. The model serves its objective by classifying images of leaves into diseased category based on the pattern of defect.

Keywords: Leaf disease, Image processing, Artificial Intelligence, Keras.

I. INTRODUCTION

With the help of these contemporary technology, human society is now able to generate enough food to satisfy the needs of almost 7 billion people. The decline of pollinators (Report of the Plenary of the Intergovernmental Science-Policy Platform on Biodiversity Ecosystem and Services on the work of its fourth session, 2016), climate change (Tai et al., 2014), plant diseases (Strange and Scott, 2005), and other factors continue to pose a threat to food security. In addition to posing a threat to global food security, plant diseases can have catastrophic effects on smallholder farmers whose livelihoods depend on robust crops. More than 80% of agricultural production in the developing countries is produced by smallholder farmers (UNEP, 2013), and reports of yield losses of more than 50% due to pests and illnesses are frequent (Harvey et al., 2014). Furthermore, according to Sanchez and Swaminathan (2005), smallholder farming households account for 50% of all hungry people, making them particularly vulnerable to disruptions in the food supply caused by pathogens. This study's main goal is to find and categorise leaf diseases in diverse crops. It is done following a four-step process.

Step 1: Gathering all of the database's pictures that are available. Various file formats are used to store images.. (.png, .bmp, .gif, .jpg)

Step 2: Using K-means clustering method, segmenting the images into clusters.

Step 3: From the segmented clusters, extracting all the available texture features using Gray-Level Co-occurrence Matrix.

Step 4: The SVM classifier is used to identify and categorise various leaf diseases affecting various crops after extracting all of the textural information.

The advantages and disadvantages of various methods used in the identification of various plant diseases utilising different computer vision and machine learning algorithms that have already been implemented and tested are further discussed in the literature review section of this research.

II. METHOD TO DETECT AND IDENTIFY DISEASE

A. Direct Method

Table 1 compares the available direct detection methods for plant pathogens based on their limit of detection, advantages and limitations.

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Techniques	Limit of Detection (CFU/m L) [12]	Advantages	Limitations
PCR	103-104	Mature and common technology, portable, easy to operate.	Effectiveness issubjected to DNA extraction, inhibitors, polymerase activity, concentrationof PCR buffer and deoxy nucleoside triphosphate.
FISH	103	High sensitivity	Autofluorescence, photobleaching
ELISA	105-106	Low cost, visual color change can be used for detection.	Low sensitivity for bacteria
IF	103	High sensitivity, target distribution can be visualized.	Photobleaching

Table 1: Comparison of the current methods for detecting plant diseases resulting from bacterial pathogens.

(PCR: polymerase chain reaction; FISH: fluorescence in- situ hybridization; ELISA: enzyme-linked immunosorbent assay; IF: immunofluorescence; FCM: flow cytometry; CFU: colony forming unit.)

B. Indirect Method

This method uses image processing to discover and classify illness symptoms in various crop types.
Automation of the cultivation process, early disease detection, and the need for specific pesticides due to specific diseases are all results of the development of computer technologies in agriculture. Plant diseases can be detected using machine learning, computer vision, and IOT (Internet of Things) techniques. A database contains a variety of agricultural information. These data are used by a machine learning system, which reveals hidden links and previously unknown patterns. These methods utilise all available data (text, photos), process it using algorithms, and then assist farmers in taking additional steps based on relevant recommendations. There is a great style guide for science writers called.

III. LITERATURE REVIEW

After Every nation has a criterion to verify the calibre of agricultural goods, such as vegetables, that it purchases from a farm or an individual. The main goal of quality inspections is to find any diseases that might be present in agricultural products like fruits and vegetables and impact consumers if consumed. Consequently, plant diseases are decreased, and a higher-quality product is produced. Precision agriculture and smart systems are now possible because to advances in artificial intelligence (AI) systems, which will improve product and quality control. One of the most effective methods for detecting plant diseases utilised in many AI-based applications is image processing.

There are already a number of strategies that use image processing to identify diseases. According to Ghaiwat and Arora's research, there are four steps involved in classifying diseases using images. The first step is taking RGB (Red, Green, and Blue) photos of leaves and developing a colour transformation framework. In the second step, green pixels are masked and eliminated using a threshold value. Utilizing the segmentation method and texture statistics, the third phase creates meaningful segments. Finally, classifier techniques are used to categorise the disease using the retrieved feature. This approach is effective at identifying and classifying the condition with a 94% accuracy rate.

Plant diseases are identified in Naikwadi and Amoda's research utilising histogram matching based on the methods of edge detection and colour feature. In the colour feature technique, the layers of the gathered photos are separated into RGB layers throughout the training process. The edges of layered images are found using edge detection techniques, and then texture is examined using a statistical technique called the Gray level spatial dependence matrix/Gray level co-occurrence histogram, which describes texture based on frequent pairings of pixels with particular values and corresponding image relationships. They failed to assess the system's accuracy rate and used a short dataset for training.

Both the Simple Threshold and Triangle Threshold approaches are combined by Patil and Bodhe. These techniques are used for segmentation and lesion region detection. Estimating the leaf area and lesion region results in the disease classification.

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In Sladojevic et al study's a deep level CNN (convolutional Neural Network) model was created for categorising 13 distinct leaf diseases of tomato and apple plants. This model foresaw the sickness and distinguished between sick and healthy leaves. This technique involves several steps, including image collecting, pre-processing for training and validation, image augmentation, and eventually fine-tuning the deep CNN model. This experimental model's results showed an average 96% accuracy. The only plants whose diseases this model can detect are tomato and apple plants.

Sardogan et al. suggested a tomato leaf disease detector based on CNN (Convolutional Neural Network) and Learning Vector optimization (LVQ) method. Several other studies were also conducted utilising neural networks with improved accuracy. Their system generated 90% accuracy, which is good. One drawback of this approach is that because the detector is not deployed on the ICPS, it cannot be implemented effectively on the Smart Edge (Industrial Cyber-Physical System).
For getting close to edge devices, computations are performed. Despite experimental results indicating improved performance in terms of accuracy and interference time, it is nearly difficult to execute compression techniques on microcontrollers due to the minimal RAM and Flash availability.

IV. PROPOSED SYSTEM

A. Types of Leaf Disease

Crop diseases occur primarily on leaves, but some may also occur on stems and/or fruit. Leaf diseases are the most common diseases of most plants. They are usually controlled with fungicides, bactericides and resistant varieties. Leaf diseases are described under several different symptom types.

(a) Leaf spots (other names: anthracnose, scab, leaf blotch, shot hole): are typically quite distinct spots that come in a variety of sizes, shapes, and hues. There is almost always a recognizable margin. Sometimes a golden halo surrounds the area, which may be brought on by bacteria or fungi. If caused by a fungus, the area almost always has some form of fungus development, especially in damp weather. This fungus development can take the form of mouldy spore growth or tiny pimple-like formations that are frequently black in appearance. To see these structures, it is frequently required to use a hand lens or a microscope. Diseased spots may merge together to produce uneven regions known as "blotches" if they are numerous or close together .The common names of leaf spot diseases may be general, such as bacterial leaf spot; descriptive, such as frog-eye leaf spot; or named after the fungus, such as Septoria leaf spot.

(b) Leaf blights: are more erratic in shape and typically larger sick areas than leaf spots. Sometimes a large number of tiny spots combine to give leaves a "blighting" appearance. Common names frequently contain the term "blight," for example, Southern corn leaf blight or early blight.

(c) Rusts: create "pustules," which resemble leaf spots but are different. Bright yellow, orange-red, reddish-brown, or black rust pustules are the most common colours. The pustules are typically elevated above the surface of the leaf, and when they are wiped with a white cloth, a coloured deposit that matches the colour of the pustule is usually visible on the fabric. In extreme circumstances, the leaf quickly withers and dies. Some rust varieties can also develop on stems. Grains and grass frequently rust.

(d) Powdery mildew: is a superficial, white to light greyish, powdery to mealy growth on leaves, but may also occur on stems and flowers. Affected leaves usually turn yellow, wither and die rapidly. The problem is common on cucurbit-type vegetables and on small grains.

(e) Downy mildew: Light grey to purplish mouldy development on the underside of the leaf and pale yellow green to yellow patches on the upper leaf surface are symptoms. A downy mildew condition is blue mould of tobacco. Downy mildew, such as the sorghum downy mildew of corn or grain sorghum, can cause deformed plant development (a "crazy top").

(f) Mosaic Virus: It is a viral illness that causes white, yellow, and green (light or dark) spots to form on the affected plant leaves.

(g) Yellow Leaves: Due to moisture stress brought on by inadequate or excessive watering, leaves turn yellow.
(h) Leaf Curl: This disease is characterized by color change, distort and curling of leaves. It is caused by both virus and fungus.

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B. Methodology

In this research we are focussing on identification and classification of diseases in corn. Proposed system consists of five different phases, Image Acquisition, Image Pre- processing, Image segmentation, Feature Extraction and Feature Classification.

(a) Image Acquisition: Dataset which includes healthy and diseased images of crop leaves are collected and stored in a file as a part of Image Acquisition Phase.
Type of File: JPG File.
Dimensions: 256 * 256.
Width: 256 Pixels.
Height: 256 Pixels.
Horizontal Resolution: 96 dpi.
Vertical Resolution: 96 dpi.
Bit Depth: 24.

(b) Data Preprocessing: After importing the information, we provide a unique value for training purposes to each label or class of each plant disease. The data set will be divided with a 0.2 split ratio.

(c) Data Augmentation: In order to diversity our dataset, we had to increase the number of photographs in it and conduct a number of operations, including zoom, shift, and rotation.

(d) USE Of CNN: KERAS library has been used for this purpose where method of deep learning has been used, in which we have created a 2D Convolution layer with 32 filter of 3x3 kernel. The we perform batch normalization, next was the two blocks of 2D Convolutional layer with
64 filter and rectified linear followed by pooling and dropout layer, then we repeat the last set of fully connected layers with 128 filters.

(e) Training and optimization have been performed in the last stage to get a goof accuracy. We have used Adam optimizer technique to have a better minimum convergence as compared to other optimization techniques.

V.RESULT

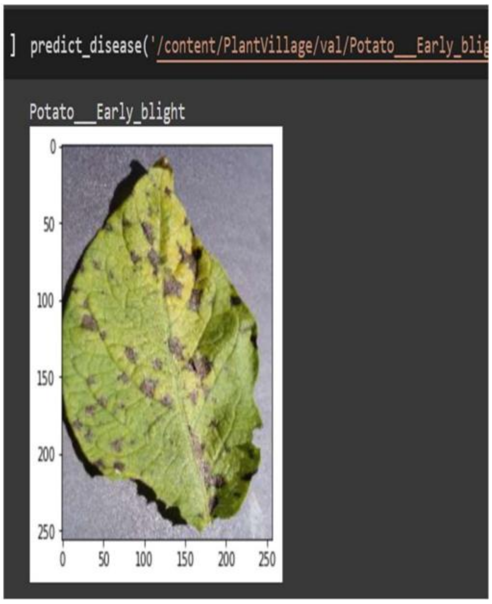

Figure 1: Result one detected

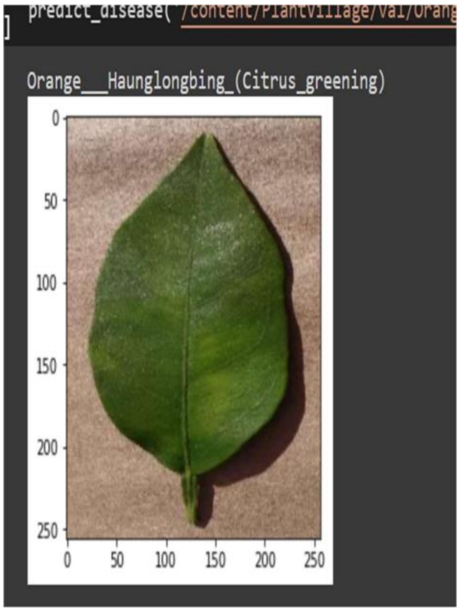

Figure 2: Result two detected

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VI.CONCLUSION

Above research has identified all the existing gaps and use a Subtractive clustering algorithm and KERAS to identify a disease which is more efficient and can scale up based on new requirements. The current proposed model was tested on Google Colab but due to the unavailability of system requirements, the model was not tested with a small dataset but in future, with proper system requirements in hand, this model can be tested on a much larger dataset. Also, the current proposed system is focused on the data acquired about leaves. In future, the aspects of this model could be broadened by the datasets of soil, weather, and techniques which incubate the use of appropriate pesticides and fertilizers. Predictive analysis would be implemented to alert a user or a farmer when there is a disease outbreak near their location. Future proposed work has significant potential since it would be multidimensional where several methods would be considered and implemented.

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