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Fruit Disease Detection Using CNN

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ABSTRACT

India's largest industry is the fruit industry. The fruit disease causes large losses in productivity, quality, and quantity due to lack of care and improper human inspection. The manual examination is a time-consuming and arduous operation. Using multiple color, texture, and shape feature combinations, an image processing strategy is given for apple fruit disease identification and categorization. Image segmentation, feature extraction (color, texture, and shape), feature combining, and finally, Fruit Disease Detection using Conventional Neural Network (CNN) where Fruits are classified into diseased or normal classes, These are the basic steps of the suggested approach. Our proposed method was tested and validated in the lab. The accuracy level achieved by using this proposed technique is 97 %.Keywords: CNN, Deep Learning, Classification, Identification, Categorization, Visual Imagery.

I. INTRODUCTION

Agriculture is essential to the harvesting of any culture. Agriculture is, in fact, critical to human civilization. Field prevalence and water management in the soil must be maintained on a regular basis in order to achieve the goal of good production. Fruit disease has a significant impact on product quality and quantity. The most significant impediment in this area is fruit disease. This research looks at illnesses that affect fruit yield. In order to analyze the degradation of fruit crops, image processing techniques are applied. The proposed system is tasked with identifying the flaws in the fruit photos. Normal Smartphone Cameras can be used to obtain the dataset.

Early identification of fruit diseases is critical for economic reasons. Deep Learning can detect and classify illnesses early, limiting disease spread and improving cure rates. Powdery mildew, rust, and black rot are common symptoms of powdery mildew, rust, and black rot in apples and cherries, among other fruits. Manual inspection is sluggish, prone to errors, and requires a lot of personnel and time. Artificial intelligence can be used to extract data on fruit color, shape, and texture, which can help in virus diagnosis. As a result, there are more mistakes made when grading fruits for export. To avoid the flaws during manual classification, researchers have presented an image detection approach to classify infected fruits from healthy fruits to enhance accuracy.

This work is divided into five sections, section 1, is the brief introduction to the topic at hand. Section 2, contains literature surveys on the subject. In section 3, the Proposed Methodology is as outlined, and section 4, deals with results. At last in section 5, we come to the conclusion.

II. LITERATURE SURVEY

According to Malathy, S et al. [1], farmed fruits should be disease and pest free so that people can contribute a significant amount to the global economy and enable farmers and agriculturalists to live a nice, affluent, and healthy life. With the help of image processing and the proposed technique, these things are possible. The use of CNN algorithms facilitates the detection of the disease on fruits and aids in the classification of diseased versus healthy fruits. Utilizing image processing techniques, this approach may quickly detect and classify the fruits using these approaches and algorithms. Our project's main goal is to increase the value of fruit disease diagnosis.

Devi, P. K. [2] concluded that the correlation chart of the Probability Ratio of the Support Vector Machine (SVM) algorithm, Existing-K-Means Neighbor technique, and the E-K-Means Clustering algorithm exhibit distinct properties. In the x hub, there is no data, and in the y hub, there is the Probability Ratio. The E-K-Means Clustering algorithm beats out the other two. The esteem of the Support Vector Machine algorithm ranges from 40.6 to 66.9, that of the Existing-K-Means Neighbor approach from 49.6 to 77.5, and that of the E-K-Means clustering strategy from 55 to 86. The E-K-Means clustering technique consistently produces astonishing results.

Wang, H et al. [3] present an enhanced Mask R-CNN target detection technique in which he used the following fruits: apple, orange, peach, and pear as the research object.

1) Improve Mask R-CNN for multi-scale feature fusion: To the initial feature pyramid structure, add a bottom-up horizontal connection path. The effect of multi-scale feature fusion is improved, and large-scale targets in the lesion detection process are effectively solved. It is not the best value to have poor positioning and network detection accuracy.

2) The algorithm's mAP value in detecting the target fruit surface lesions is above 95%, and the average detection speed is 2.6 frames per second when using GPU, according to the test results.

3) Despite the excellent detection accuracy of the proposed detection model in the paper, the detection speed is slightly slower. The next step will be to investigate how to increase detection speed while maintaining model detection accuracy.

Behera, S.K et al. [4] stated that "We effectively classified the different types of disease with 90% accuracy and computed the disease severity of four types of infected oranges using Machine Learning and Fuzzy Logic." This study may be extended to include soft computing approaches to improve accuracy and validate with additional samples.

Zhao, J [5] suggested a detection approach for common tomato fruit physiological illnesses based on the YOLOv2, a convolutional neural network. Several pretreatment procedures were applied to datasets to reduce the risk of overfitting and improve detection accuracy. To improve network detection, a k-means clustering algorithm was utilized. The suggested detection approach performed well for both healthy tomato fruits and tomato fruits with prevalent physiological disorders. The YOLOv2 tomato fruit identification network had a mAP (mean Average Precision) of 97.24 percent. In addition, comparison trials revealed that training the network using RGB images was effective.

With 10 hidden layers, Abirami, S [6] determined that classification of fruit diseases can be done quickly using Feed forward-back PNN, with an accuracy of 92 % for bacterial disease and 86 % for fungal disease. The number of hidden layers is changed, and the network's performance is evaluated. The proportion of accuracy decreases as the number of concealed units decreases. The classification can be done in the future using Advanced neural network classifiers to enhance efficiency.

According to Nikitha, M et al. [7], The system is intended to find how efficiently the fruit is impacted and recognize the fruit from the given image. This function is extremely beneficial to farmers and can be used for various purposes. The Inception v3 model and Transfer Learning are utilized to improve results in the categorization and identification of fruit illnesses. We may also add some more features to the model such that the integration of image processing and deep neural networks is effective for detecting diseases in vegetables and fruits, as well as in the agricultural industry.

Dharmasiri, S. B. D. H [8] explained that the support vector machine technique was used to create the models, which were created according to passion fruit diseases and stages. The diseases of passion fruit may be identified with an average accuracy of 79 %, and the stage with an average accuracy of 66 %.

III. PROPOSED METHODOLOGY

For more effective fruit disease identification, precise image segmentation is required. Otherwise, the non-infected region's traits dominate the infected region's characteristics. CNN-based image processing is recommended in this proposed method to determine the specific region that is solely affected.

After the processing step was completed, specific features were extracted from the processed image. Finally, the method's training and classification processes are carried out, and the precise result is supplied. The flow of the system and mechanism used to extract features is given in Fig 1.

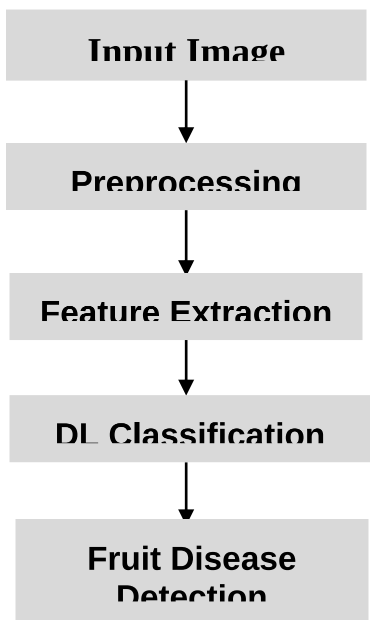

Fig 1. Block diagram of the proposed DL

A. *Input Image*

This is the initial stage. The collecting of sample photos was done here, and the acquired images were utilized to train the classifier model and develop the classifier model. Pictures of healthy and diseased fruits were recorded with readily available mobile phone cameras and utilized as the training set and test set images for the classification algorithm.

Images were taken from diverse perspectives, in varied situations, and under varying lighting conditions. We commonly store these photographs in the "JPG" format. For this classifier method, we'll require test and training sets of data from agricultural fields in various regions.

B. *Dataset Preprocessing*

Following the acquisition of sufficient datasets, we subject these datasets to the Preprocessing stage to improve the image quality. All of the original fruit photographs were saved in a single folder. We can save these photos under any name we like. Images are taken in a variety of sizes and angles. For example, if a picture is acquired horizontally, it must be rotated 90 degrees and enlarged to a dimension of 200 by 300 pixels, as we consider the following size to be typical for every dataset used. And, if the acquired images' height and breadth were also varied, those images would need to be scaled to 250 x 250 pixels. If the image is large, then there will be a delay in processing. After the image scaling procedure is completed, an image restoration approach is performed to decrease noise and improve the image's sharpness. It improves the overall image quality. All such photographs are saved in the same folder after this process is completed.

C. *Segmentation of Datasets*

Image segmentation is the third phase of this disease detection technique. The initial step is to convert all pre-processed photos to L*a*b, HSV, and Gray color models before saving them in RGB format. This method also identifies the best color-modeled image to use in the pre-processing procedure. Following this, we alter the format of the pre-processed image to binary format, which is known as image conversion. The formatting values are clustered using the CNN method. All of this is done while keeping the picture segmentation algorithm in mind.

D. *Applying Training Set*

The algorithm is then trained on a set of photos that have already been processed by the preceding rounds. Feature extraction was used to generate the output. We have a trained model that has to be validated and tested. Diseases Detection and Classification Procedure:

Input: fruit image.

Output: Classified fruit disease.

Algorithm:

1. A bulk of input dataset is given for training
2. A set of Test Dataset is given to test the accuracy of the training model.
3. Perform feature extraction using colour features.
4. Perform feature-level fusion using colour and texture features.
5. Apply Convolution neural network classifier on the segmented image.
6. If the fruit is infected by any disease then go to step 7, otherwise, go to step 8.
7. Apply K-means clustering for image segmentation.
8. Print “Given fruit is Healthy”.
9. Print the result with classified fruit disease.
10. Fetch the Proposed Remedy for the problem from the database.

Advantages of Proposed System:

1. Accuracy is high and it is Applicable for both low and high pixel images.
2. Enhancing the value of fruit disease detection also takes only a few seconds to provide an exact result.
3. The name of the disease is also found by highlighting the affected places.

IV. RESULTS

Fruit disease detection utilizing a universal filter, Clustering algorithm, and Convolution Neural Network (CNN) Algorithm is an effective way of detecting diseases at an early stage, allowing us to avoid problems that would otherwise be fatal to humans. The approach of detecting any anomalous type of information in the photos, which is regarded as a fault in the fruit, is suggested in this literature. It's an approach for identifying and removing noisy data and presenting noise-free data for further analysis.

The proposed method begins with the input of an image of any fruit. It could be a healthy or unhealthy fruit. The disease-affected areas are highlighted after the Image is supplied. Following the analysis, the disease's name is displayed.The image of the fruits, which are used for giving input for detecting the diseases was taken from the image repository named Kaggle.com.

Step 1: At the first step of the proposed method, the image of the fruit is given as input(either fresh or diseased). The image which is given as the input will be displayed first as shown in Fig 2.

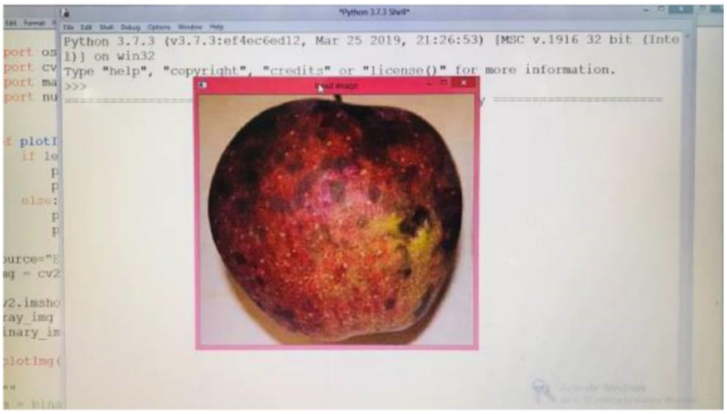

Fig 2. Display of Input Image in Python Shell

Step 2: After displaying the input image, the disease-affected areas will be highlighted in the second step as given in Fig 3.

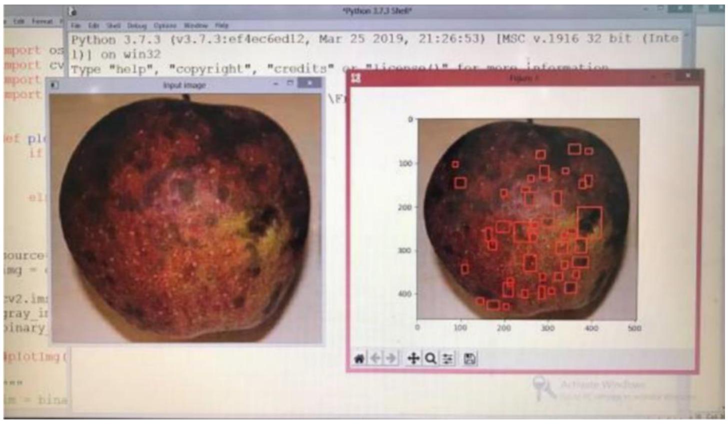

Fig 3. Disease-affected areas are highlighted

Step 3: After highlighting the disease-affected areas of the fruit, if we close that tab, then the name of the disease will be shown in the python shell along with the disease highlighted image as shown in Fig 4., Fig 5., Fig 6.

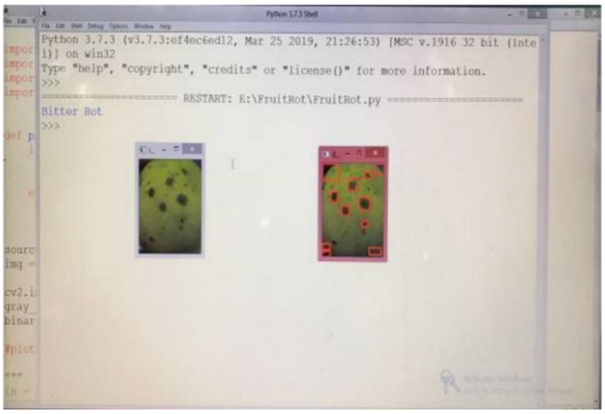

Fig. 4. Bitter Rot

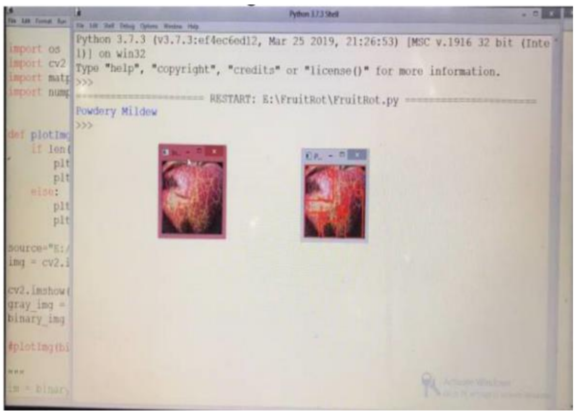

Fig. 5. Powdery Mildew

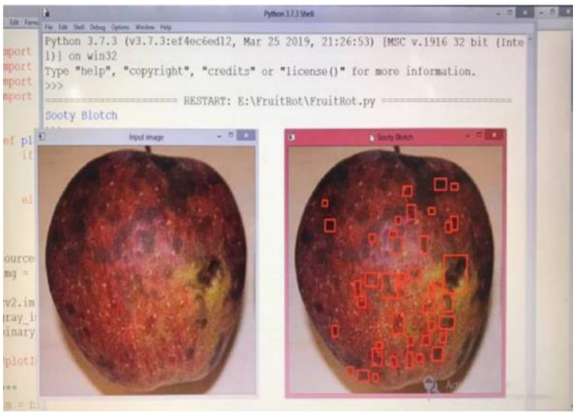

Fig. 6. Sooty Blotch

Step 4: If we give a fresh fruit as an input, then the output will say that the given input image is the “Fresh Fruit”.

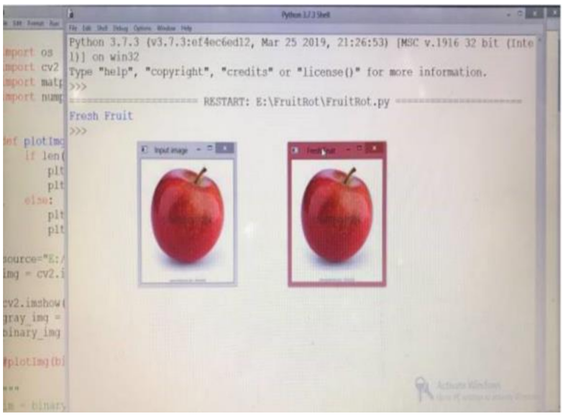

Fig 7. If we give a fresh fruit as an input, then the output will say that the given input image is the "Fresh Fruit".

V. CONCLUSION

A universal filter is used in the pre-processing stage of the suggested technique. The pre-processing stage is crucial because it is when the image's clarity is improved. The image clarity determines the accuracy of the final result. The next step is to extract the features. Information is extracted using textured and colored properties. The data is segmented using the k-means clustering approach. The main purpose of this strategy is to distinguish between critical and non-critical image parts. The data is classified using convolutional neural networks. Convolution neural networks offer the greatest results in terms of classification accuracy.

Real-time datasets can be tested against the suggested system in the future. A prompted random forest approach can also help to improve the convergence rate.

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