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# An Efficient Computer Aided Diagnosis Model for Citrus Disease Detection

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***ABSTRACT***

The citrus industry is a consequential part of Florida’s agricultural economy. Citrus fruits, including oranges, grapefruit, tangelos, lemons, tangerines, and other specialty fruits, are the state’s largest agricultural commodities. The economic effect on the citrus sector the state of Florida's overall economy is huge. The citrus industry is also one of the leading producers of jobs for people in Therefore Florida have tremendous potential for the overall economic balance of the economy. These facts show the value of citrus beyond doubt. In the states trade business, As such, some substantial options concerning good practices for citrus production and processing in the recent past, fruits have been made. One of the main concerns is proper disease control. Every year, huge quantities of chemicals are used as fungicides to prevent various citrus crop diseases, Therefore, evoking significant concern from environmentalists regarding worsening. In addition, farmers are also worried about the immense costs involved in these operations and substantial loss of profit. Various alternatives to eliminate the use of these toxic chemicals are being pursued to address this situation. Multiple core technologies the integration of image recognition and artificial intelligence principles. In order to resolve this condition, different researchers have evolved in the past. The focus of these applications was to classify the disease in the early stages of the disease so that other innovations such as robots and automated vehicles could be used to selectively apply the chemicals in the groves.

**Keywords:** citrus, image recognition, diseases identification, image segmentation

## I. INTRODUCTION

Citrus plants are widely grown fruits worldwide, such as limes, mandarins, bananas, tangerines, grapefruits, and limes. Each year, citrus-producing businesses produce a significant amount of waste where 50 percent of citrus peel is wasted each year due to various plant diseases. One of the major problems that directly decreases the efficiency of agricultural production is plant diseases. Proper disease control measures must be undertaken so that,

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crop yield losses may be minimized and excessive application of fungicides may be avoided which is a major contributor to Pollution of the atmosphere and a large source of spending. Many key enabling technologies have been developed to enable automated recognition of disease symptoms using image processing and computer vision principles to be accomplished.

In agricultural applications, computer vision techniques are used, such as weed detection in a field, fruit sorting on a conveyor belt in the fruit processing industry, etc. Using a digital camera, digital images are collected from the world surrounding the sensor. The basic procedure that any vision-based detection is the first phase is the image acquisition phase. In this stage, in the second phase, an analog CCD camera interfaced with a computer containing a frame grabber board is used to take images of the various leaves that are to be classified. The images obtained from the first step are usually not ideal for classification purposes because of various factors, such as noise, lighting changes, etc. In the third phase, edge detection is completed to discover the actual leaf boundary in the image. Later, feature extraction is finished based on specific properties between pixels in the image or their texture.

Plant diseases are largely responsible for the decline in productivity in the agricultural sector, causing national economic losses. Throughout the planet, citrus is a significant source of nutrients such as vitamin C. However, citrus diseases have had a big influence on the production and quality of citrus fruits.

## II. RELATED WORKS

In agriculture, plant diseases are mainly responsible for reducing productivity that causes economic losses. As an essential source of nutrients in the world, such as vitamin C, citrus is used in plants. Citrus diseases, however, are badly affected by the processing and quality of citrus fruits. In the last decade, computer vision and image recognition approach for recognizing and classifying diseases in plants have been commonly used. It proposes a hybrid technique to identify and classify diseases in citrus plants. There are two key phases of the proposed system: (a) identification of lesion spots on citrus leaves and stems; (b) evaluation of citrus diseases. The citrus lesion spots are extracted by an optimized weighted segmentation process, which is conducted on an improved input image. Then color, texture, and geometric characteristics are fused in a codebook. Also, the best characteristics are selected by implementing a hybrid feature selection process consisting of a PCA ranking, entropy, and skewness-based covariance vector. The quarantined characteristics are transferred for the final relegation of citrus disease to the Multi-Class Support Vector Machine (M-SVM).

To detect and identify tomato seedlings and weeds plants in a commercial agricultural sector, Tian et al. (2000) developed a machine vision systemImages acquired in agricultural tomato fields under natural lighting were studied extensively and an environmentally sensitive segmentation algorithm has been developed that could adjust to changes in the illumination of natural light. Four semantic form characteristics were used by the method to

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distinguish tomato cotyledons from tomato leaves and a syntactic algorithm of the entire plant was used to predict the stem position of the entire plant. Accuracies of 65 percent for the identification of tomato plants were reported using these techniques. Methods based on shape matching were occlusion, inadequate definition of leaves with variable leaf serrations and aggregate limits of multiple leaves. For the use of robotic harvesting of fruit [6] .

To detect apples ready for harvest, Kataoka et al. (2001) developed an automatic detection system. The main discriminating factor was the color of apples in this process. The color of apples suitable for harvesting and those picked earlier than harvest time were measured using a spectrophotometer and compared these both displayed some variations in color[5] .

A catalog of texture descriptions in the literature of computer vision has been compiled by Coggins (1982). Some examples are listed as follows. 1) "the texture to be what constitutes a macroscopic region." Its arrangement is simply due to the repeated patterns in which, according to a placement law, elements or primitives are arranged. (2) A region in an image has a constant texture if the local statistics or other local properties of the image function are constant, steadily varying, or roughly regularly collected[7].

Xavier P. Burgos- Artizzu proposed a method of image processing which comprise image segmentation of soil, crop, and weed. Weed pressure calculated based on the percentage of soil, crop, and weed. Computational methods such as classification, reduction, and weed extraction are used in evolutionary algorithms for weed extraction, resulting in a precision of up to 96 percent[8].

E R Davies studied different machine vision techniques for inspection of fruit and vegetables to grains which includes color image processing, infrared imaging, etc. He also investigated techniques for Ham to cheese inspection and animals from pigs to fish. Image processing techniques such as image segmentation, shape analysis and morphology, texture analysis, noise reduction, 3D vision, invariance, pattern recognition, and image modality are used to grade these categories [31]. Abraham Gastélum-Barrios devised the method for evaluation of tomato quality by image processing. Features viz. Color, shape, size, firmness was considered for invasive, noninvasive methods. IP techniques like pattern recognition, 22 grayscale images, image segmentation, and excess green were discussed [9].

Majid Rashidi compared the two techniques of volume measurement using water displacement and image processing. The cantaloupe volume grading scheme, which uses thresholding techniques and the Bland-Altman approach, was used to measure the cantaloupe volume. Volume measured by IP had a marginal difference with the water displacement method [10].

## III. PROPOSED WORK

In the farming sector, the diseases affected by plants are largely responsible for the reduced profit that results in financial losses. Citrus is used globally as the key nutrient option, namely vitamin C, in the case of plants. Yet citrus diseases have a significant effect on both production and quality. Computer vision and image processing methods for the identification and classification of plant diseases have been widely used in recent days. This paper describes the novel deep learning (DL) based citrus disease detection and classification model.

The proposed approach is evaluated on the dataset of the Citrus Disease Picture Gallery, the combined dataset (Infested with Scale Plant Village and Database of Citrus Images), and our own database of images collected. We used these datasets, namely black spot, canker, scab, greening, for the identification and classification of citrus diseases.

Pre-processing takes place first to maximize the image's consistency. Then to segment the images, the Otsu method is applied. Next as a function extractor, the Alex-Net model is added. Finally, to distinguish the various types of citrus diseases, a random forest (RF) classifier is used. Besides, to improve the contrast of the applied citrus images, the adaptive gamma correction (AGC) model is applied. On the Citrus Disease Picture Gallery Dataset, systematic experimentation takes place.

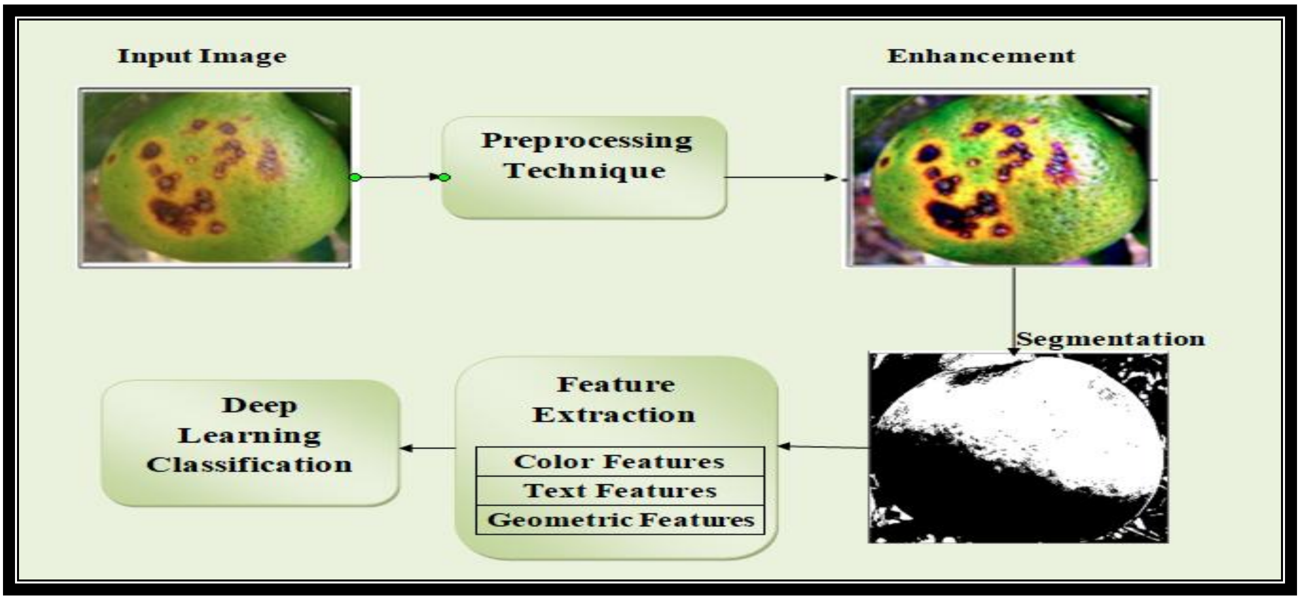


*FIG 1.SYSTEM ARCHITECTURE*

## IV. MODULE DESCRIPTION

### 1. PREPROCESSING

Preprocessing is used to improve the input image's visual consistency. It eliminates many issues due to poor contrast, such as brightness effects, lighting, and problems. In the field of image processing, the preprocessing phase plays a critical role because poor contrast images affect the precision of lesion segmentation. A hybrid contrast stretching approach is used, which is based on a Gaussian function and a Top-hat filter. The Top-hat filter is initially performed on an input image, and later on, by inserting the Top-hat filter image and the difference-Gaussian image, the lesion contrast is enhanced.

### 2. ENHANCEMENT

The process of enhancing the quality and information content of original data before processing is image enhancement.

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Popular practices include improvement of contrast, spatial filtering, slicing of density, and FCC.Common practices include contrast enhancement, spatial filtering, density slicing, and FCC.

1) Contrast enhancement or stretching is done by extending the original grey level range by a linear transformation.
2) Spatial filtering enhances the linear characteristics that exist naturally such as a fault, shear zones, and lineaments.
3) Density slicing transforms the continuous grey tone range to reflect various characteristics in a sequence of density intervals identified by a separate color or symbol.
4) FCC is commonly used in remote sensing compared to true colors because of the absence of a purely blue color band because further scattering is dominant in the blue wavelength. The FCC is standardized since it contains the maximum amount of similar Earth object data and satisfies all users.

## 3. SEGMENTATION

In order to simplify or alter the representation of an image into something more meaningful and simpler to analyze, the method of partitioning a digital image into several segments (sets of pixels).

### 3.1 Weighted Segmentation

The weighted segmentation results and HDCT-based saliency segmentation are optimized. The main purpose of optimization is to further increase the precision of segmentation. The fused segmented and salient image is therefore based on a new limit rule that includes common pixels.

### 3.2Saliency Map

A map of saliency is an image that shows the unique quality of each pixel. The purpose of a protrusion map is to simplify and/or modify an image's representation into something that is more significant and easier to analyze.

## 4. FEATURE EXTRACTION

In the field of computer vision and pattern recognition for the depiction of an image, feature extraction plays a vital role. There are many uses for feature extraction, such as video monitoring, agriculture, medical, and robotics. Efficient feature extraction and selection for precise classification of infected regions is the main problem in this section.

### 4.1Color feature

The color features are extracted from enhanced images. For the classification of the infected area in the picture, the color features are more important since each lesion spot has a different color. By using various types of color spaces and parameters, these features are obtained.

### 4.2 Geometric feature

In many applications, such as robotics, vision systems, and agriculture, the geometric function often plays an important role in defining their geometric feature. To find global details and local information such as lesion shape, size, and location, these features are extracted from the segmented spot lesions.

### 4.3Texture feature

In the segmented image, the texture characteristics are extracted. The extraction of the texture function aims to observe the combination of image intensities at different locations, to

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calculate the irregularity level, the midpoint, the smallest interval between the disease-ridden pixels, and the shape of the spots of the disease that are relative to each other in the image.

### 5. CLASSIFICATION

Classification is the process in which assign data into a certain number of groups. Identifying the category/class to which new data would fall is the primary objective of a classification issue. Classification of images analyzes the numerical properties of different features of images and organizes data into groups.

## V. EXPERIMENT AND RESULT

The performance of the Deep Learning-based model can be enhanced by using feature weights which reduce or increase the influence of the features based on the method. It can be concluded the statistical classification It is evident for models 2B and 3B, the classification accuracies for some classes of leaves were inconsistent. Mahalanobis distance method determines the similarity of a set of values from an unknown sample (test data) to a set of values measured from a collection of known samples (training data). For models 2B and 3B, it may be the case that the spectrums for training and test were dissimilar for the particular choice of texture features in those models. Since the classification was predominantly based on the Mahalanobis distance, even a slight off bound may significantly affect the test accuracies. Therefore, the choice of the method, model, and hence the texture features selected, significantly affect the classification results. The confusion matrix is created by the method presented. The matrix of the uncertainty in Fig. In the form of the 5*5 matrix, 2 is clearly represented. The table value indicates that a set of 18 images under blackspot, 77 images under cancer, 16 images under greening, 22 images under safe, and 15 images under scab form are clearly identified by the presented model. The values are manipulated in terms of TP, TN, FP and FN to determine the classification performance.

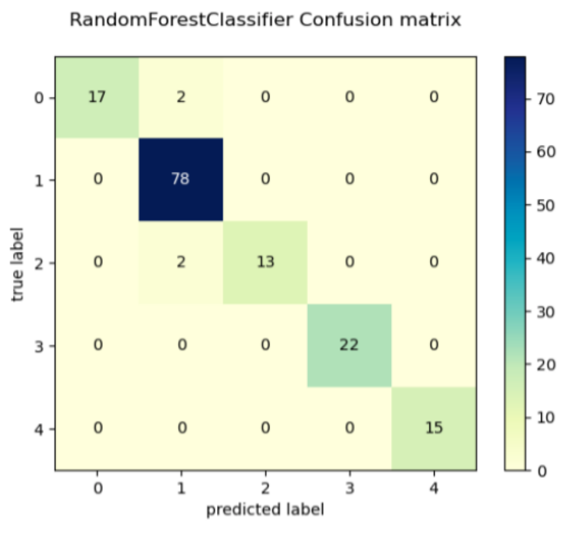


**Fig 2: Random Forestclassfier Confusion Matrix**

## VI. CONCLUSIONS AND FUTURE SCOPE

There are a lot of avenues for improving the classification, especially using the Feature Weighted method. A comparative study of the different classification methods can be used as a valuable tool in deducing the ideal methods for the disease classification in the leaves. Feature Weights can be concatenated to obtain better results, especially in the presence of noise. The performance variation and accuracy in the presence of noise and missing features can be conducted to determine the robustness of the classifiers along with different feature reducing techniques such as linear discriminate analysis.

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