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INVESTIGATIONS ON COCONUT TREE DISEASE SEGMENTATION USING INTELLIGENT TECHNIQUES

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Abstract - *Coconut is one of India's most flexible plantation crops. It plays a unique role in Indian culture and heritage. Every portion of the coconut plant can be used for a variety of purposes. Using image processing techniques, this research focuses on detecting problems in coconut trees such as stem bleeding, leaf blight disease, and pest invasion by the red palm weevil. The segmentation of diseased regions provides advance warning of the disease and increases coconut production. K-Means Clustering and Fuzzy clustering segmentation methods are employed in this paper and clustering are used to compute the affected area.*

***Key Words*: Stem bleeding, Leaf Blight, Segmentation, K-Means, Fuzzy C-Means.**

1. INTRODUCTION

Coconut tree (Coco's nucifera) is the only extant species of the genus Coco's and belongs to the palm family (Arecaceae). The name "coconut" can refer to the entire coconut palm, the seed, or the fruit, which is a drupe, not a nut, according to botanical classification. After the three indentations on the coconut shell that mimic facial features, the name comes from the Old Portuguese word coco, which means "head" or "skull." They are a cultural emblem of the tropics and can be found in coastal tropical regions.

1.1.1 Plant

Coco's nucifera is a palm that may reach a height of 30 meters (100 feet) and has pinnate leaves that are 60-90 cm (2-3 feet) long. A tall coconut palm tree can produce up to 75 fruits per year in fertile soil, although it usually produces less than 30. Coconut palms produce their first fruit in six to ten years with correct care and growing circumstances, requiring 15 to 20 years to reach optimum production.

1.1.2 Fruit

The coconut fruit is a drupe, not a real nut, according to botany. It has three layers, same as other fruits: exocarp, mesocarp, and endocarp. The glossy outer skin of the exocarp is yellow-green to yellow-brown in color. The mesocarp is made up of a fibre known as coir, which has a variety of traditional and commercial applications. The coconut's "husk" is made up of the exocarp and mesocarp, while the hard "shell" is made up of the endocarp.

1.2 Major diseases affecting coconut tree

- Ganoderma – Basal Stem Rot
- But Rot
- Leaf Blight
- Stem Bleeding
- Root(Wilt)Disease
- Leaf Rot

1.2.1 Leaf Blight

The emergence of yellowish brown small dots on the leaflet is one of the disease's early signs. These spots expand and become grey with time. The spot's periphery turns a dark brown color. During wet seasons, bacterial leaf blight is a devastating disease that affects coconuts.

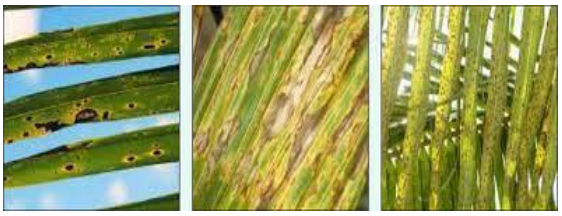


Fig.1: Leaf Blight

1.2.2 Stem Bleeding

The exudation of a dark reddish brown liquid from longitudinal fissures in the bark and wounds on the stem, which trickles down for several inches to several feet, is known as stem bleeding. As the disease advances, the lesions spread higher.

Exudation of reddish-brown liquid through cracks on a coconut trunk

Fig.2: Stem Bleeding

1.2.3 Red palm weevil

Tunneling in the stem or base of the fronds, leaves with straight edges rather than pointed tips, frass at tunnel entrances, withering and death of the leaves, particularly at the crown.

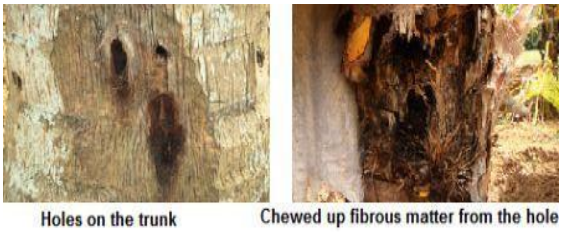


Fig.3: Red palm weevil

2. PROPOSED METHODOLOGY

Calculate the segmentation of the affected region of the coconut tree illness from the disease image. By calculating the afflicted area, the stage of the disease can be determined quickly.

2.1 Dataset

The images for this project were taken from the TNAU database, which is open to the public. A total of 60 images were chosen for the proposed method's implementation.

2.2 Pre-processing

The input images are converted as a suitable format for the further processing.

2.2.1. Image Enhancement

The contrast of the input images is increased by adjusting them. Because the input coconut images were taken on a sunny day, increasing the contrast is necessary for further processing. Lab color space was applied to the RGB images. The same information is converted to a lightness component L* and two color components a* and b* in lab. Lightness was created to mimic human vision, which is highly sensitive to green but not so much to blue. Because green color is prevalent in coconut images, the lightening technique makes the green color sensitive.

2.3 Image Segmentation

Image segmentation is a technique for breaking down a digital image into subgroups in order to reduce the image's complexity and make future processing or analysis of the image easier. In simple terms, segmentation is the process of assigning labels to pixels. The focus of this research was on K-Means clustering and the Fuzzy C-Means Clustering method.

2.3.1 K-Means Clustering

The K-means algorithm is an unsupervised method for separating the interest area from the background. Based on the K-centroids, it clusters or partitions the given data into K-clusters or sections. When you have unlabeled data, the algorithm is used (i.e. data without defined categories or groups). The purpose is to locate specific groups based on some form of data similarity, with K representing the number of groups. The goal of K-Means clustering is to reduce the sum of squared distances between all points and the cluster centre to the smallest possible value.

2.3.1.1 Steps in K-Means Algorithm

1. Determine the number of clusters to be K.
2. Choose the centroids at random among K locations.
3. Assign each data point to the centroids that are closest to it, forming K clusters.
4. Calculate and position each cluster's new centroids.
5. Assign each data point to the new centroids that are closest to it.

Figure 4 shows the flow diagram for K-Means Clustering segmentation.

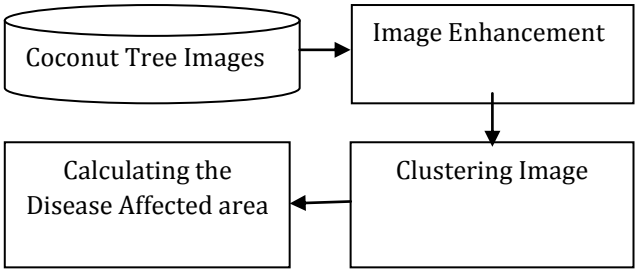


Fig.4: Flow Diagram of K-Means Clustering

2.3.2 Fuzzy C Means Segmentation

The data must be handled in Fuzzy C-Mean by assigning a partial membership value to each pixel in the image. The fuzzy set's membership value is in the range of 0 to 1. A member of one fuzzy set can also be a member of other fuzzy sets in the same image in fuzzy clustering. When a member function is used to characterise something, it has three basic characteristics. The fuzzy set's core is the full member, Support is the set's non-membership value, and Boundary is the partial membership with a value between 0 and 1. In general, determining whether a pixel belongs to a region is difficult. This is owing to the region's unsharp transitions.

2.3.2.1 Fuzzy c-mean Algorithm steps

1. Calculate the prototype clusters (means).
2. Calculate the distances between the points.
3. Make changes to the partition matrix.

Figure 5 shows the flow diagram for Fuzzy C-Means Clustering segmentation.

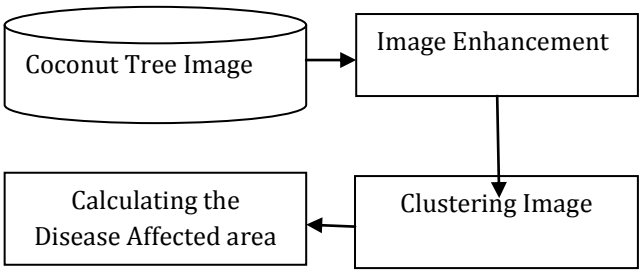


Fig.5: Flow Diagram of Fuzzy C-Means Clustering

3. Result

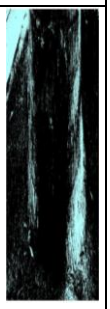
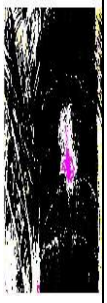
Compare the K-Means clustering and the Fuzzy C-Means (FCM) clustering Methods in order to improve the accuracy of the segmentation process. The results of these algorithms were implemented and evaluated with sample images.

Terms	K-Means Accuracy	Fuzzy C-Means Accuracy
Leaf Blight	87.5%	90%
Stem Bleeding	85%	88%
Red Palm Weevil	90%	92%
Affected Area Calculation	80%	85%

3.1. K-Means Segmentation Outputs

	Original	Contrast Enhance	Object Cluster1	Object Cluster2	Object Cluster3
Healthy					
Leaf blight					
Stem bleeding					
Redpalm weevil					

3.2 Fuzzy C-Means Segmentation outputs

	Original	Contrast Enhance	Object Cluster1	Object Cluster2	Object Cluster3
Healthy images					
Leaf blight					
Stem bleeding					
Red Palm weevil					

4. Conclusion

The disease of the coconut tree, such as stem bleeding, leaf blight disease, and pest infection by the Red palm weevil, were segmented in this study. For testing, a total of roughly 60 images were taken from the publically available TNAU, both normal and disease-affected images. The disease-affected area regions were segmented from the total image using the K-Means segmentation technique. The disease-affected area is also computed using K-means. To improve the segmentation outcome, Fuzzy C Means segmentation was employed to increase the number of iterations and clusters. MATLAB 2018a was used to produce the above segmentation. The disease-affected region was also segmented and the disease-affected area was estimated using these segmentations.

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