COCONUT TREE DISEASE SEGMENTATION USING FUZZY ROUGH C-MEANSCLUSTERING ALGORITHM

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ABSTRACT

The occurrence of plant diseases has a negative impact on agricultural production. If plant diseases are not observed in time, it will lead huge lose for farmers. Early detection is the basis for effective prevention and control of plant diseases, and they play a vital role in the management and decision making of agricultural production. Coconut palms are affected by a number of diseases, some of which are dangerous and the disease gradually reduces the strength of thepalm causing severe loss in the yield. Coconut trees are also attacked by a number of fungi, bacteria, viruses and nematodes leading to significant quantitative and qualitative loss. In this paper, Fuzzy Rough C-Means (FRCM) segmentation algorithm is proposed to detect the Coconut tree diseases. The effectiveness of the proposed segmentation algorithm is verified by comparing its results with that of the OTSU segmentation algorithm.

Key words: Segmentation, image processing, Fuzzy, Rough C Means and Disease.
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INTRODUCTION

Image processing is a method to convert an image into digital form and perform some operations on it, in order to getan enhanced image or to extract some useful information from it. Image pre-processing techniques are used to improve the quality of an image before processing into an application [1]. This uses a small neighborhood of a pixel in an input image to get a new brightness value in the output image. These pre-processing techniques are also called filtration and resolution enhancement. Most of the imaging techniques are degraded by noise. In order to preserve the edges and contour information of the Agricultural plant images, the efficient denoising and an improved enhancement technique is required. Gaussian,

Median and Wiener filters are used for image de - noising.

Image segmentation is a daunting task in automatic image processing analysis [2]. It occupies vital position in many image processing applications, and it consists of sub-dividing the image into its constituent parts. Also, it extracts the Region of Interest (ROI) that should be homogeneous as for a few attributes. Image segmentation algorithms are developed based on two basic properties of intensity values: a)Similarity –Based b)Discontinuity-Based. In similarity- based approach, segmentation is done based on grouping of pixels based on some features. In discontinuity-based approach the partition is done based on some abrupt changes in gray level intensity of the image. a)Detection of Isolated Points b)Detection of Lines c)Edge Detection [3]. The agriculture sector can be considered as the backbone for any developing economy. To obtain the maximum yield from the crops, it is required that farmers should be provided with the best technologies and methodologies.

Coconut is a palm plantation vital for its various uses from its fruit to trunk. India is the third-largest producer of coconut and its by-products in the world [4]. The southern states of India contribute a majority of the production in the country. Any disease affecting the yield of the coconut plantation eventually affects the related industries and the livelihood of the families who depend on the coconut economy [5].

P. Balamurugan and R. Rajesh (2012) [6] deals with the classification of coconut tree leaves which are affected by one of the diseases named as 'leaf rot'. They used Neural Network Based System for the Classification of Leaf Rot Disease in Cocos Nucifera Tree Leaves. Abraham Chandy (2019) [7] proposed a precision agriculture technique to detect various pests in coconut trees with the help of NVIDIA Tegra System on Chip (SoC) along with a camera interfaced drone. The drone flies across the coconut farm and captures the images and processes the data using deep learning algorithm to identify the unhealthy and pest affected trees. The deep learning algorithm uses a set of sample pest database.

Dirami, Ahmed, et al (2013) [8] employed the Thresholding segmentation (THS), techniques to segment the images before going for the classification process. Alshawwa et.al., (2019) [9] proposed the expert System which was produced to help farmers in diagnosing many of the coconut diseases such as: Bud Rot, Leaf Rot, Stem Bleeding, Tanjore wilt and Root (wilt). In this paper, section 1 discusses about the introduction of the proposed work. The major

diseases and pests which are affecting coconut tree are discussed in section 3 and 4 respectively. Section4 elaborates the implementation of Fuzzy rough C Means algorithm (FRCM) for segmentation of coconut tree images. The results and discussion of the proposed work is discussed in section 5. Section 6 gives the conclusion of the proposed work.

2. MAJOR DISEASES AFFECTING COCONUT TREES

a) Ganoderma – basal stem rot (BSR)

Basal stem rot (BSR) caused by the species of Ganoderma is one of the most devastating diseases of numerous perennial, coniferous and palmaceous hosts. The disease is also referred to as Thanjavur wilt, bole rot, Ganoderma disease and Anabe.

Fig.1. Ganoderma – basal stem rot

Fig.2. Root Wilt Disease

b) Root Wilt Disease (RWD)

Root (wilt) disease (RWD) caused by phytoplasma is one of the most devasting diseases of coconut palms. The major symptoms of the disease in leaves are wilting and drooping and flaccidity; ribbing, paling/yellowing and necrosis of leaflets are typical symptoms of foliar diseases.

c) Bud rot

Fig.3. Bud rot

Bud rot is a fatal disease of coconut palm, characterized by the rotting of the terminal bud and surrounding tissues.Even though it affects the palms of all ages, young palms in low lying and moist situations are more susceptible to the disease. Fungus perpetuates on the host debris, in crevices and natural openings of the dead tissue.

Fig.4.Leaf Blight

d) Leaf Blight

Bacterial leaf blight is a serious disease of coconuts during wet seasons. The drying up of the leaves from the tip downwards, the progress of infection being from the older leaves to the younger. The worst affected palms present the appearance of severe drought-affected trees.

e) Stem bleeding disease

A reddish-brown liquid oozes from cracks and holes in the stem. It seeps out and runs down the stem, turning black and staining the stem as it dries. The disease is caused by Chalara paradoxa, a mainly soil borne plant-pathogenic fungus that infects wounds and openings in the coconut stem.

Fig.5. Stem bleeding disease

f) Leaf rot

The first symptom is the appearance of water-soaked brown lesions in the spear leaves of root-wilt affected palms. Gradually these spots enlarge and coalesce resulting in extensive rotting.

Fig.6. Leaf rot

a) Rhinoceros beetle

Pest population occurs round the year but population maximum during June – September coinciding with the onset of monsoon

b) Red palm weevil

It is the most destructive pest of young coconut palms. Unlike the Rhinoceros beetle, the adult

3. PESTS AFFECTING COCONUT TREES

weevil is incapable of causing any direct damage to the tree; on the other hand, the early stages of the weevil are passed on the palm and the damage caused to the tree by the weevil larvae is often fatal.

Fig.7.Rhinoceros beetle

Fig.8. Red palm weevil

c) Black-headed caterpillar

The leaf eating black headed caterpillar, Opisina arenosella is a serious pest of coconut palm causing significant yield loss in all the coconut growing tracts of India. It infests coconut of all age groups and is a prolific feeder of coconut leaves.

d) Coconut Eriophyid Mite and Termite

Termites are likely to cause damage to transplanted seedlings particularly in the earlier stage (wilting of seedlings).

Fig.9.Black-headed caterpillar

Fig,10,Coconut Eriophyid Mite and Termite

In this paper, required data set is collected to detect the symptoms of the coconut plant diseases and pest infections. To remove the unwanted noise present in the captured image, median filter is used. Fuzzy rough C-means clustering technique is used to segment the infected region in the image.

4. FUZZY ROUGH C-MEANS (FRCM) CLUSTERING ALGORITHM

Fuzzy Rough C-Means (FRCM) clustering algorithm is a hybrid clustering algorithm, termed as the FRCM It is developed by integrating the merits of both rough sets and fuzzy sets. The RFCM adds the concept of fuzzy membership of fuzzy sets, and lower and upper approximations of rough sets into *c*-means algorithm. While the membership of fuzzy sets enables efficient handling of overlapping partitions, the rough sets deal with uncertainty, vagueness, and incompleteness in class definition. The RFCM algorithm partitions a set $X = (x_1 \dots . . , x_i \dots \dots . x_n)$ of n objects into c clusters by minimizing the following objective function

$$J = \sum_{i=1}^{c} J_i$$

5. RESULTS AND DISCUSSION

The sample images shown in Figs 11(a), 12(a), 13(a) and 14(a) namely leaf blight, stem bleeding and healthy images are given as input to wiener filter. The pre processed outputs are presented in Figs. 11(b),12(b),13(b) and 14(b). The pre processed outputs are given as input to the segmentation algorithms like FRCM and OTSU**.** The segmentation results of the image processing algorithm are shown in Fig.11(c,d), 12 (c,d), 13(c,d) and 14(c,d). The results indicate that the FRCM

segmentation algorithm performed better than OTSU method for segmenting the regions. OTSU does a good job in segmenting the portion of the leaf blight; however, in other categories, it did not perform very well. Furthermore, OTSU fails to segment the portion of the stem bleeding. On the other hand, FRCM segmentation carries out its function to segment relevant regions in every category without problems. For example, stem bled regions and sections with holes are properly segmented.

Fig.11(a) Sample Image 1 (Leaf Blight)

Fig.11(b) Pre processed output

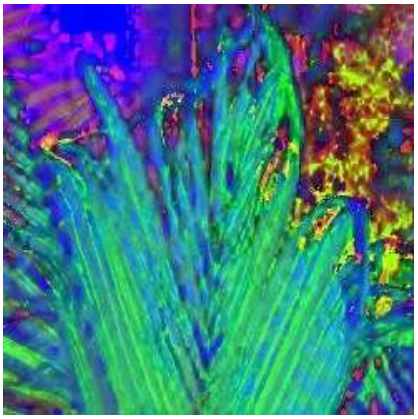

Fig.11(c) Segmented output using FRCM

Fig.11(d) Segmented output using OTSU

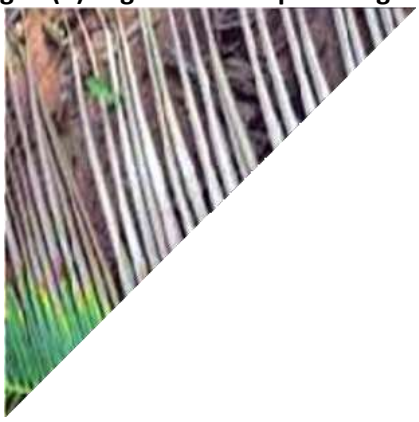

Fig.12 (a) Sample Image 2 (Leaf Blight)

Fig.12(b) Pre processed output

Fig.13(a) Sample Image 3 (Stem Bleeding)

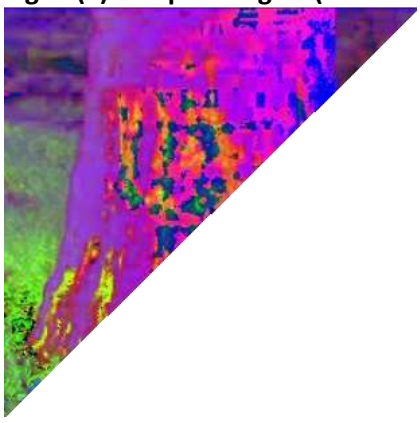

Fig.13(b) Pre processed output

Fig.13(c) Segmented output using FRCM

Fig.13(d) Segmented output using OTSU

6. CONCLUSION

In this paper, coconut tree diseases and pests affecting coconut trees were discussed. The coconut tree data set were collected, pre processed and segmented. Pre processing part has been carried by implementing wiener filter and segmentation part has been carried out by incorporating Fuzzy Rough C Means and OTSU thresholding algorithms. The performance of the proposed FRCM segmentation algorithm is validated by comparing its result with that of OTSU segmentation algorithm. FRCM segmentation algorithm performed better than OTSU method for segmenting the regions. OTSU does a good job in segmenting the portion of the leaf blight; however, in other categories, it did not perform very well. Furthermore, OTSU fails to segment the portion of the stem bleeding. On the other hand, FRCM segmentation carries out its function to segment relevant regions in every category without problems.

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