RICE PLANT DISEASE DETECTION USING MULTILAYER SPARSE CONVOLUTION NEURAL NETWORK

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Abstract

Diagnosis of the plant disease has become crucial in agriculture sector due to its importance and application. Disease on any particular region of the plant will expand and propagate on entire regions of the plant. Plant pathology has to be utilized to analyse the plant disease. In order to diagnosis plant diseases using plant pathology, image segmentation techniques have been widely applied. Automatic image segmentation such as watershed method, region based method and thresholding method has been employed in existing by mapping or grouping the continuous and discontinuous features of the plant disease effected regions. Its characteristic of region has been computed using grey level, texture and colour component. Segmented region of the image is employed for feature selector using simulated annealing. For precise plant classification on leaf disease, image segmentation faces several challenges in object detection. To tackle these challenges, an object change detection using deep learning architectures has to be carried out. In this article, a new plant disease diagnosis method has been proposed as multilayer sparse deep convolution neural network for enhanced plant disease classification. Convolution Neural Network is considered as Deep learning architecture and it is optimized by hyperparameter on its each layer processing to extract the sparse feature on the non continuous and continuous region characteristics for diverse plant disease classes. Experimental results of the proposed model have been carried out on plant village dataset to prove its efficiency and accuracy on comparing performance with traditional state of art approaches on plant disease classification. It is validated on 5 fold cross validation using covariance matrix of the dataset samples.

Keywords: Rice Plant Disease, Image Segmentation, Convolution Neural Network, Shape and Texture Analysis, Simulated Annealing, Deep learning.

I INTRODUCTION

Rice plant leaf disease recognition and prediction are the primary importance for precise agriculture [1]. Complexity of the image background acquired and multiple disease symptoms of the rice plant in the acquired image are complex to identify and represent into classes [2]. Machine learning techniques employed for Rice plant leaf disease classification and prediction model lead to classification error [3]. Disease affected region of the plant is extracted on basis of shape, colour and texture features have an ability to discriminate on basis of disease classes. Extracted features have been processed on the deep learning technique to classify the feature into classes on stage of the disease of the plant [4].

In order to increase the performance of the classifier, image segmentation technique such as thresholding based method, watershed based methods, region detection based segmentation methods, edge detection based segmentation methods and clustering based segmentation methods [5] have an ability to change the representation of the disease region. Further image segmentation method for effective representation leads to difficulties on intensity variation on shape and color aspects of the disease region and irregularities of boundary detected on its origin with texture process. To handle those difficulties, a novel technique

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named as multilayer sparse Convolution Neural Network was modelled in this article with respect to edge based feature abstraction and pixel based feature correlation on the evolving features of the image pixel.

Rest of the article has Sectionalized into various parts which are as follows. The related literatures of the rice plant disease prediction using machine learning is discussed in the Section 2 which is provided with introduction of the deep learning and description of the proposed methodology for disease recognition has been provided in the section 3. Section 4 provides experimental analysis and performance analysis of proposed mechanism against various performance evaluations metrics. Finally conclusion of the proposed work has been provided with suggestion for future work in section 5.

II RELATED WORK

In this section, various machine learning techniques have been employed for image segmentation of rice plant leaf disease images was analysed against different objects strategies, object constraints and object characteristics.

2.1. Analysis of Genetic Algorithm for segmentation of Rice Plant leaf disease image

In particular literature, image segmentation of the pre-processed image has been carried out using genetic algorithms as it is subjected to the group of evolutionary algorithms to identify discriminative features. Genetic algorithm generates object partitions on the pre-processed image using fitness function for object selection [6]. However object sectioned its classes on basis of cross over and mutation on the available population. In addition, Genetic algorithm generates object for classification using population (partitions) of the input rice place disease image on the functional process of the populations selection, partitions cross over, population mutation and partitions offspring. Population containing features has been categorized into several classes on fitness value.

2.2. Region growing method for image segmentation of Rice Plant leaf Disease

In this literature, the region growing method for image segmentation of the rice plant disease image has been employed with objective function to identify nearby pixels of the closest image pixel of the pre-processed image and it determines probability of grouping the adjacent pixel to the certain input partition. It uses some disease specific criterions for segmentation through Input pixel selection. Finally region grouping function of the expanding pixel on the disease region is developed with several growing criteria's to segments the related image pixel of the particular region through on region membership.

III PROPOSED MODEL

In this section, the detailed architecture of the proposed methodology to recognize rice plant disease has been defined on various aspects.

3.1.Image Pre-processing - Noise Reduction and Background Subtraction

Plant Village dataset containing various plant disease is exposed various issues such as images noises, , low contrast and irregular brightness of the image on various regions and illumination changes on various origins have to be eliminated in the image pre-processing. The image pre-processing employed using median filter for noise filtering, grab-cut technique and z-score normalization to eliminate the color differentiation and image normalization for noisy image [7]. The color difference on every pixel in the input image has to be segmented and it has to be enhanced by implementing the color differentiation technique. Illumination changes on the input image have been enhanced using z score image normalization. Finally the image contrast is improved on various value ranges on pixel intensity is done by contrast stretching.

3.2. Shape and texture analysis

In this model, feature of the image has been extracted on image textures and image shapes analysis of the pre-processed image. On employing those analyses, the important visual elements of the features concerning the disease and health region of plant have been partitioned on basis of its characteristics. Shape analysis of the image computes the geometric information of the specified region such as edges and boundaries on varied intensity of the image [8]. Further it identifies the location and object orientation of the region shape as disease image changes frequently.

Image texture analysis of the pre-processed image is to distinguish the spatial distribution of image pixel intensity of the edges and boundaries of the regions. Texture is considered as a repeating pattern of pixel value with same image intensity and its local variations of image intensity on its neighbouring pixel. Point cannot be considered as texture. Texel is considered as texture primitives or texture elements. The figure 1 depicts the proposed architecture of the rice plant disease specific image segmentation model.

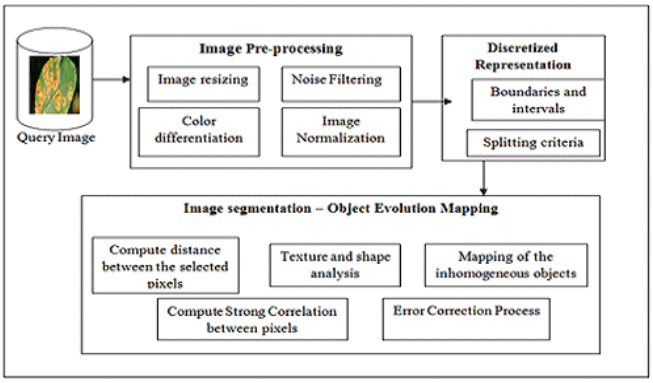

Figure 1: Proposed Architecture of the Rice Plant Disease specific image segmentation Technique

Plant disease image is computed automatically using texture segmentation to determine the boundaries between texture regions [9]. Texture segmentation is employed either as primitive's texture analysis or element texture analysis. Varying texture regions has been computed on its changes in the boundaries.

- Properties of the pixel in terms of fine coarse, grained and smooth have been described and determined using texture analysis as it refers to tone and structure.

- Pixel Intensity properties of the image is represented as tone of the texture and spatial relationship of the partitioned pixel value is considered as structure of the texture.

The image texture analysis can be classified as

- Structural analysis: Intensity variation of the pixel of the specified region is carried out on aspect of color pixel relationship on its arrangement.

- Statistical analysis: Distribution of the pixel based on texture is represented in form of feature vector containing pixel intensity of specific region [10].

IV EXPERIMENTAL ANALYSIS

In this section, experimental analysis of the proposed methodology has been computed against accuracy and effectiveness which is considered as performance measures. The experimental results are obtained in java platform using plant village dataset. The plant village dataset was employed for experimental analysis is been expressed in detail along its attribute description of performance metrics.

4.1. Dataset description

Plant village dataset composed of rice plant disease towards segmentation of the images has been considered in experimental analysis of the proposed model. Dataset contain 54000 images representing various classes of diseases of the crops under various temperature and climatic conditions.

4.2. Performance analysis

In performance analysis, crop containing rice plant disease has been extracted and segmented into various

disease classes on basis of texture and shape analysis of feature regions. The proposed segmentation accuracy has been computed as 97.89%. Table 1 depicts the performance value of the proposed and existing method on basis of rice plant disease specific image segmentation methods in the plant village dataset

Technique	Accuracy	Computation Time
Multilayer Sparse CNN Proposed	98.84	26.58ms
POS based Region Growing Method	96.73	34.59ms
Disease based Genetic Algorithm	94.89	42.17ms

Table 1: Performance analysis of the Rice Plant disease specific Image Segmentation Technique

Performance Accuracy of the proposed rice plant disease specific image segmentation technique is derived on aspect of changes detection in the disease specific region representation and Intensity coincide interval (CI) of the region has been represented on the span of Intensity changes on one particular color pixel in the particular region. The figure 2 represents performance evaluation of proposed rice plant specific image segmentation technique with respect to accuracy.

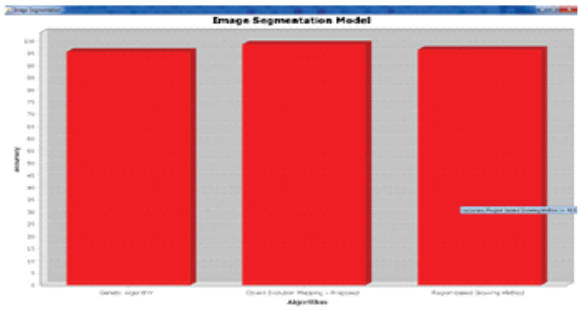

Figure 2: Performance Evaluation of the disease specific region segmentation Accuracy Execution Time

Performance analysis with respect to execution time is considered as viability of a time taken to execute the image segmentation method on the increasing propagation of the pixel. It depicts the efficiency of the multilayer sparse convolution neural network on disease classification. Figure 3 represents the execution time of segmentation results for disease classification of rice plant.

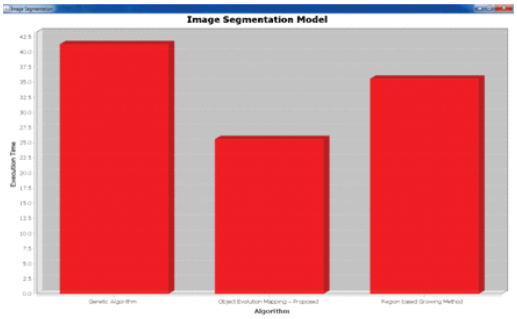

Figure 3: Evaluation of the Execution Time

V CONCLUSION

The Multilayer Sparse Convolution Neural Network based proposed segmentation methodology was designed and implemented to the rice plant leaf disease images and its results has been analysed in this work on accuracy and robustness. Proposed image segmentation in the deep learning process correlates the disease region pixel along its neighbour object using features extracted after preprocessing. The experimental results of the proposed technique on classification of plant diseases on basis of the feature segmented have been evaluated on change detection of the features. The proposed deep learning based segmentation technique generates the higher accuracy on the disease segmented objects of the images.

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