Empirical Study on Rice Plant Disease Detection Using Machine Learning Architectures

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Abstract— Rice is deliberate as a major source of food among the rural population and also it is considered and the second most cereal crop cultivated over the world. Over the past decades, rice crops are crucially admitted as one of the powerful energy streams for the production of resources. Rice plant diseases are considered as a raising factor behind the agricultural, economic and communal loss in the upcoming development of the agricultural field. Identifying disease from the images of the plant is one of the interesting research areas in computer and agriculture field. This paper presents a survey of various image processing techniques using machine-learning approaches to identify region and classes of rice plant diseases based on images of diseases affected rice plants. Especially those techniques identify Leaf blast, Brown spot, sheath blight and bacterial blight disease of the plant on basis of the leaf characteristics. Further it analyses the noise reduction and segmentation algorithm to reduce the interference of complex background with the detection of target blade in the image by charactering it on basis of texture, color and shape. Feature identified on basis of the supervised and unsupervised learning algorithms to screen the seedling on the feature identified but it has some limitation. Towards effective identification, deep learning architecture based Convolution Neural Network has been outlined which can be effectively employed to determine the different sizes of the dataset on rice plant diseases.

Keywords: Rice Plant Disease, Image Processing, Machine Learning, Deep Learning, Disease Identification

I. INTRODUCTION

As one of world's major food crops, rice is stable in production, which is related to agricultural security, social stability and national development. Nevertheless, rice diseases have occurred frequently in recent years, causing serious losses in rice production. Rice diseases are mainly the rice blast, bacterial blight, sheath blight, and symptoms characterized by texture, the color and the shape, which are typical of rapid occurrence and easy infection. At present, the identification of rice diseases is mainly through artificial identification on querying rice diseases maps and automated detection[1].

Conventional manual identification is inefficient, time-consuming and costly. The operation of the diseases identification to some disease of rice plant is simple on employment of the machine learning paradigms with high accuracy. The existing machine learning detection of rice diseases is leads to misclassification on evolving diseases characteristics. Considering the large environmental impact, slow detection speed, and low accuracy, machine learning model has not been widely applied to disease prediction. In this case, it is of great significance to make rapid and accurate judgments on rice diseases on employment of deep learning architectures [2].

Deep learning architectures are used to perform lesion image segmentation, extract the feature image, and then normalize and select the hidden features of the rice disease on leaf. By applying the deep pattern recognition method [3] and soft computing techniques[4], clustering of the disease region in the plant is identified with high accuracy for various diseased rice plants to screen seedling with rickets in a non-destructive manner by feature selection and model parameters. In addition, in order to prevent the model from overfitting and improving its generalization performance, two data enhancement strategies of randomly discarding one band image and random panning average spectral image brightness were also proposed in the literature.

The remainder of this paper is organized as follows: We discuss the review of literature in Section 2 and presents machine learning technique for plant disease mining models in Section 3. Section 4 provides objective of the work and section 5 outlines the proposed methodology. Section 5 provides conclusion of the work.

II. RELATED WORK

In this section, various existing model applied to diagnosis of the plant disease on rice plant by utilizing deep learning model has been detailed as follows

A. Wavelet Based Feature Extraction for Rice Plant Disease Detection and Classification

In this method, detection and classification of rice plant diseases using simple image processing approach based on wavelet transform has been analysed [5]. In this approach uses the multi-resolution analysis, Discrete Wavelet Transform (DWT) to perform decomposition of the input image into horizontal, vertical, diagonal sub-bands. Different color and texture features are extracted from horizontal, vertical, diagonal sub-bands of the input image up to 2 levels and considered as features. Classification has been done by using an Ensemble of Linear Classifier adopting the Random Subspace Method (RSM).

1) Drawbacks of the model

- Discovering the texture relationships is complex and difficult due to the limited access to sub bands of the image.

B. Rice Disease Detection using Intensity Moments and Random Forest

In this method, automated method for recognizing and categorizing various plant diseases on evolving disease has been done using intensity moments and random forest. This model has capability to detect the main three types of rice leaf diseases (Bacterial leaf blight, Leaf blast, and Brown spot) by the Random Forest decision tree classifier. It splits the sharp

contrast on disease discrimination[6]. Intensity moments are needed here for extracting features properly on the tuning parameter on the permutation function on the structure of the feature represented through ensemble learner.

- *Drawbacks of the model*

– It is restricted to selected features on base estimators of the random forest. It is tough to be interpreting the target variable of the disease.

C. Diagnosis Rice Plant Diseases Using the Fuzzy System

In this method, early detection method using fuzzy system to the rice plant disease is analysed on characteristics that appear in rice plants. Fuzzy systems use ten inputs. This input is the result of the extraction of rice plant images, i.e. contrast, correlation, energy, homogeneity, average, variance, kurtosis, entropy, standard deviation, and skewness. The fuzzification process is carried out using the Gauss membership function, the fuzzy inference is done using the Sugeno method, and the defuzzification process uses the weight average method[7]. Output variables are classified into three sets, i.e. Bacterial leaf blight, Brown spot, and Leaf smut. Graphical user interface was used to improve the user experience in using fuzzy system.

- *Drawbacks of the Model*

– Diseases identified are perceived based on assumption, so it may not be widely accepted.

D. Vegetation indices based segmentation for automatic classification of Rice plant Disease

In this method, automatic identification of plant diseases is to extract the infected region from the normal portion of the plant has been analysed. Studding the infected leaves it has been observed that the greenness of the infected portion of the leaves changes significantly with respect to the normal leaves. Vegetation indices (VI) are some metric used for the remote sensing images to measure the greenness[8]. Thus VIs are computed from the acquired images of the infected plant. These VI are then used to extract the infected portion from the acquired visual images. Among the available VI Normalized Difference Vegetation Index (NDVI), Green Normalized Difference Vegetation Index (GNDVI), Enhanced Vegetation Indices (EVI), and Soil Adjusted Vegetation Index (SAVI) are used in the proposed work. Images of the rice leave infected by leaf blast (caused by pathogen Magnaporthe grisea) and brown spot (caused by pathogen Bipolaris oryzae) diseases are acquired using the digital cameras. Then above mentioned vegetative indices are computed to get efficient segmentation. Otsu's method has been applied on the VI images to extract the infected portions. Then five different texture features namely Homogeneity, Correlation, Contrast, Energy and Entropy of the infected regions are computed. These feature values are then used for classifying the diseases using 15 different classifiers (such as: naïve Bayes, SVM, Part, J48 classifiers, etc.)

- *Disadvantage of the Model*

– It produces the major difference on temperature of the single leaves.

E. Rice Plant Leaf Disease Detection and Severity Estimation using Semantic Segmentation

In this method, semantic segmentation has been analysed as it detect crop diseases in Rice plant of affected area and calculating the affected area and estimate the severity on basis of characterization of texture, the color and the shape. Finally support vector machine (SVM) is used for classification of the leaf diseases[9].

- *Drawbacks of the model*

– Feature extracted produces large representation which will lead to misclassification error on determining the diseased segment.

III. Overview of Deep Learning Architecture for Plant Disease Detection

The plant disease detection can be effectively carried out on analysis of Plant pathology[10] which provides kinds of plant diseases, and their causes along processing procedures for controlling and managing. In this primary objective is to analyse the rice pant leaf and to recognize and classify the disease on basis of deep learning architectures[11] on following primary steps highlighted below

– Step 1: Input the entire picture of rice diseases into deep learning architecture to obtain a feature map for processing it
– Step 2: The feature is input to the objective function to acquire the feature information of the candidate frame of interest
– Step 3: Identify the characteristics of rice diseases extracted from the candidate box, and use a classifier to determine whether it belongs to a specific disease category;
– Step 4: For the candidate frame belonging to a certain disease feature, the position of the disease is further adjusted by a regression process.

On employing these steps, the effective disease region and its type can be computed effectively with high accuracy. Figure 1 represents the general architecture of the plant disease recognition model. It can be seen that the algorithm has better recognition effect and higher recognition rate.

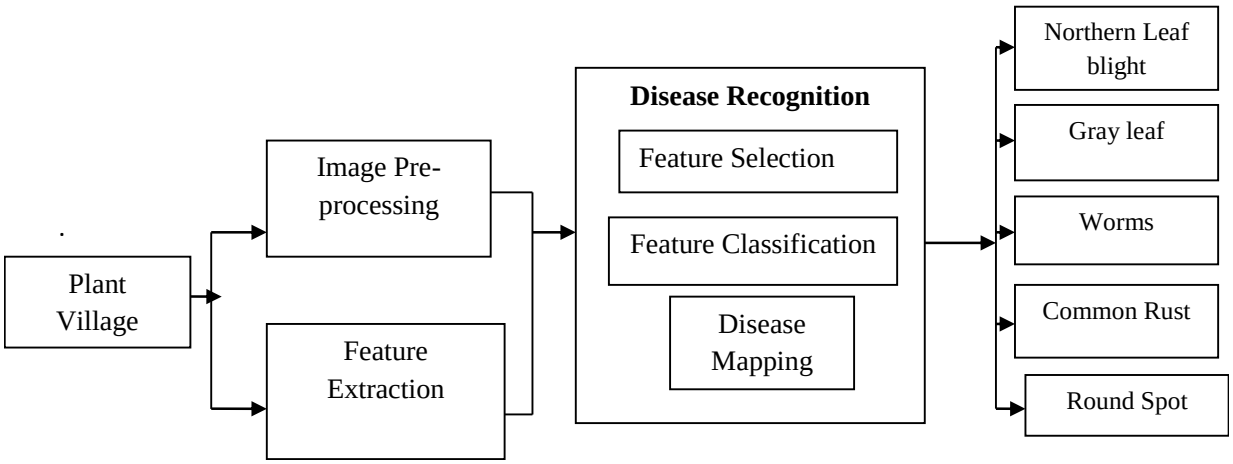

Fig. 1: Architecture of the Disease Recognition model

A large majority of the machine learning methods of disease detection are focused on the detection of collected pictures. Therefore, in the proposed investigation shall be conducted to apply the deep learning to the dynamic detection of large-scale rice planting detection and disease.

IV. CONCLUSION

In this paper, an empirical analysis of the machine learning technique to diagnosis of rice plant disease has been presented in detail. It has been analysed on various processing step of the machine learning paradigms on basis of image preprocessing, feature extraction, feature selection and feature classification against characteristic of rice plant leaves. However disease prediction model deals with classifying the disease region accurately on the underlying extracted features. These analyses help to model a new methodology as framework for disease identification and interventions on various characteristics of the plant leaves to numerous kinds of diseases along the identification of mineral deficiency in the plant.

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