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Paddy plant leaf diseases identification using machine learning approach

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***Abstract*---**Agriculture is the most important sector in the Indian Economy and gives contribution in the form of agricultural productivity. To increase the agricultural productivity, precise and on-time detection of crop diseases and pest is needed. Most of the times, farmers fail to take the necessary steps even if they may have been able to identify the problem. Moreover, in some rural areas farmers cannot get rid of these problems because they do not have proper knowledge or education on how to do so. Most of the cases involve leaf diseases which are not recognized properly, and farmers end up using insecticides which may not be suitable for that particular disease. This paper provide new techniques of image pre- processing and a new combination of feature set from the processed images to make a trained model that will show how accurate our methodology is to detect diseases accurately. In this work, Machine learning algorithms namely KNN and SVM are implemented which can detect leaf diseases accurately. Among various plant leaf diseases, Rice leaf disease is one of them. This work is based on three Rice leaf diseases, they are - Bacterial leaf blight, Leaf smut, Brown spot. These diseases are common Rice leaf diseases in India. The method proposes consists of four main phases which are: image pre- processing, segmentation, feature extraction and classification. Proposed algorithms are compared with existing algorithms and results are very promising.

***Keywords*---**Bacterial leaf blight, Leaf smut, Brown spot, KNN, SVM.

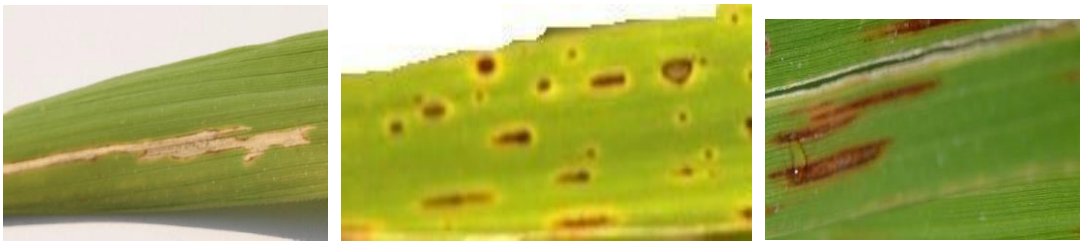
Introduction

Crop diseases have become risk to food security. As the population is increasing, to fulfill the requirement of food, crop production should also be increased. In contrast, the improper use of pesticides is causing an adverse effect on the soil and food quality. Proper and precise diagnosis of plant diseases is one of the important features of precision agriculture. If proper care is not taken of the diseases and pests, then it may result in the reduction of quality and quantity of

the crop. As a result, farmers face several problems in controlling the diseases on crops and often have to face a massive loss in terms of production. Sometimes, it is also very difficult to identify a disease as symptoms of many leaf diseases are quite similar. This research proposes four main phases which are: image pre-processing, segmentation, feature extraction and classification. This paper focuses mainly on image segmentation and feature extraction techniques.

Images are collected from publicly available Plant Village database. It contains about 54,306 images ofdiseased as well as healthy leaves crops. Fig 1 shows some sample images of Rice leaf from the dataset. Here images of Rice crop leaf are analyzed which have following class labels:

- Bacterial leaf blight affected Rice leaf.
- Leaf Smut Rice leaf.
- Brown spot affected Rice leaf.



Bacterial leaf blight Brown spot Leaf smut

Fig.1: Three classes of Rice leaf disease

Literature Review

In paper [1], neural network is used to detect the disease. If leaf is infected, further processing is done to identify the disease. Genetic algorithm is used along with SVM to optimize loss and identify the type of disease. This paper states method for optimization of loss function using genetic algorithm, which is similar to theory of natural selection where only strong parameters survive. The texture features are extracted using GLCM method, and given to the artificial neural network.

In [2] authors provide Deep learning models for plant disease detection and diagnosis. In this work, specific CNN architectures were trained and assessed, to form an automated plant disease detection and diagnosis system, based on simple images of leaves of healthy and diseased plants. The available dataset contained images captured in both experimental (laboratory) setups and real cultivation conditions in the field. The proposed deep learning approach may find more general solutions than shallow approaches, which learn with less data but are specific to few crops. The next section presents the basic principles of the tested models, the datasets used for training and testing, and the experimentations that were designed for the investigation of the factors that affect the performance and

robustness of the developed system. Section 3 presents the results of the application of the proposed models for plant disease detection and diagnosis, while the paper closes with some concluding remarks and directions for future research towards the evolution and enhancement of the developed system. Omkar Kulkarni in his research work has used color features like mean, standard deviation, skewness and kurtosis are made on the pixel values of the leaves. He has consolidated features coming through grey level co-occurrence matrix (GLCM) functions which identify the texture of an image. It generates a GLCM that produce statistical measures by calculating how frequently pairs of pixel with specific values and in a specified spatial relation occur in an image [3]. Research in Paper [4] based on SVM Classifier Based Grape Leaf Disease Detection. This paper is intended to aid in the detection and classification leaf diseases of grape using SVM classification technique. First the diseased region is found using segmentation by K-means clustering, then both color and texture features are extracted. Finally classification technique is used to detect the type of leaf disease. In the paper [5] authors provide system of Crop Diseases and Pests Detection Using Convolutional Neural Network. Deep learning approach can be used to detect the diseases and pest more accurately on leaves and other parts of the crop. The proposed method is helpful in detecting crop diseases as well as pests. In this paper, the deep learning techniques related to diseases and pest detection has been reviewed and the deep learning model for automatic diagnosis of crop diseases and pests is proposed. Shahir Mahdee et al. [6], represent techniques for detecting infected parts of plant leaves. Images are pre-processed with the help of RGB to HSV conversion technique. Cluster based method background subtraction is used for segmentation. Correlation, energy, homogeneity etc. features are also used. For image classification, support vector machine (SVM) technique is used [8].

Proposed Work Flow

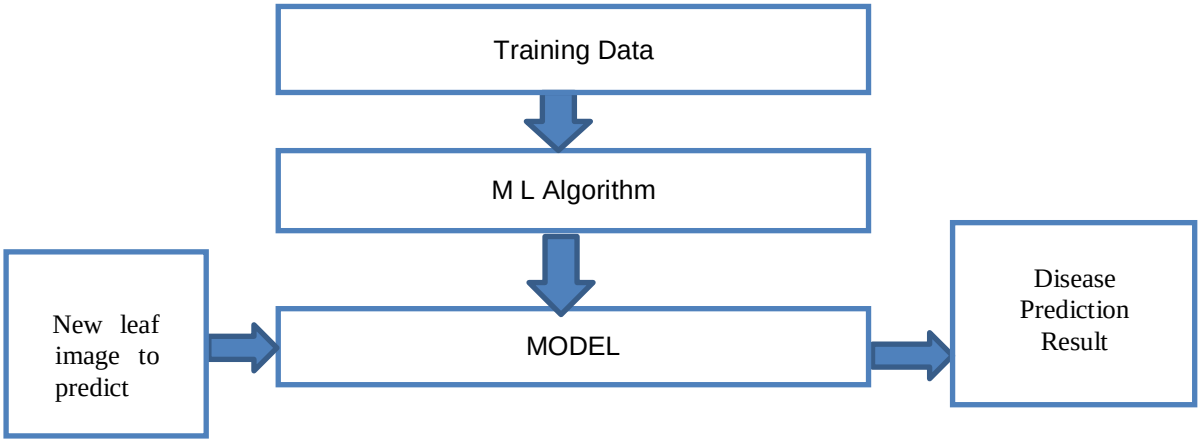


Fig. 2: System Framework

Image pre-processing is important step to remove noise from input image. In pre-processing two operation is use to remove noise. First operation is gray conversion and second one is convert input

image into binarized image. A grayscale image is simply one in which the only colors are shaded of gray. The reason for differentiating such images from any other sort of color image is that less information needs to be provided for each pixel. While binary image is very faster to processing any operation because binary image is one that can have exactly two colors i.e. white and black. In Fig 3 there are three buttons (input image, pre-processing, clear all). Three axes where image is display when button is press.

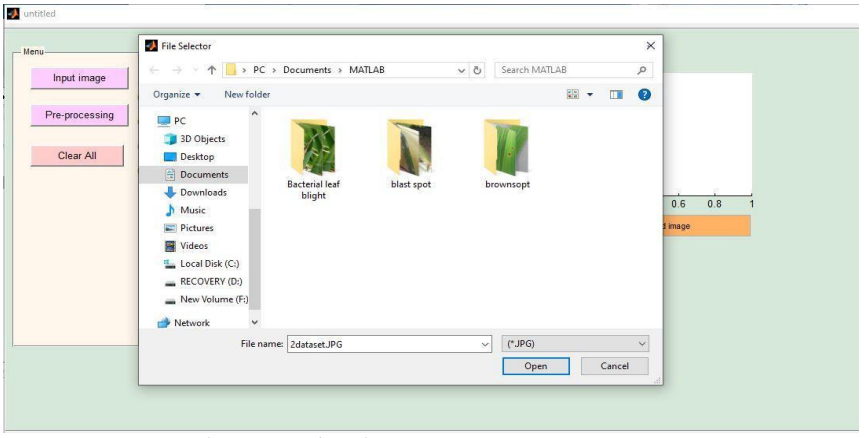


Fig. 3: Selecting Image From Dataset

After click on input image button this window is open. In the window three folders is shown this three folders is our leaf disease class. Select one image from this folder. After click on pre-processing button two operation is performed (gray conversion and binary conversion). In second axes grayscale image is shown and in third axes binarized image is shown.

Fig. 4: Pre-processing Image

Classifiers Implemented

Two classifiers mentioned below are implemented using Python and results of leaf disease detection is given in the below table1.

a. KNN Classifier: K nearest neighbor classifier calculates the distance of test data from each instance stores in database and finds K minimum distances. K will be input to algorithm. K nearest neighbor corresponding to test data will be selected. In our research if K = 1 is 96.2%. If K increases accuracy decreases.

b. SVM: Support Vector Machine is an algorithm of machine learning. The SVM follows the concept of separating the features from one another. The same types of features come on one plane, and another feature comes on another plane. The classifier is using the concept of the planes, lines, and hyper planes to separate the features. The classifier line for one-dimensional, plane for two- dimensional, and hyper planes for three-dimensional data. Accuracy using SVM is 98.56%.

Table 1
Accuracy of ML algorithm on training and testing data

ML algorithms	Accuracy on training dataset	Accuracy on testing dataset
Regression[7]	75.463 %	70.8333 %
Naive Bayes[7]	58.7963 %	50%
Decision Tree (j48) [7]	94.9074 %	97.9167%
KNN [Proposed]	95%	96.2%
SVM[Proposed]	98%	98.56%

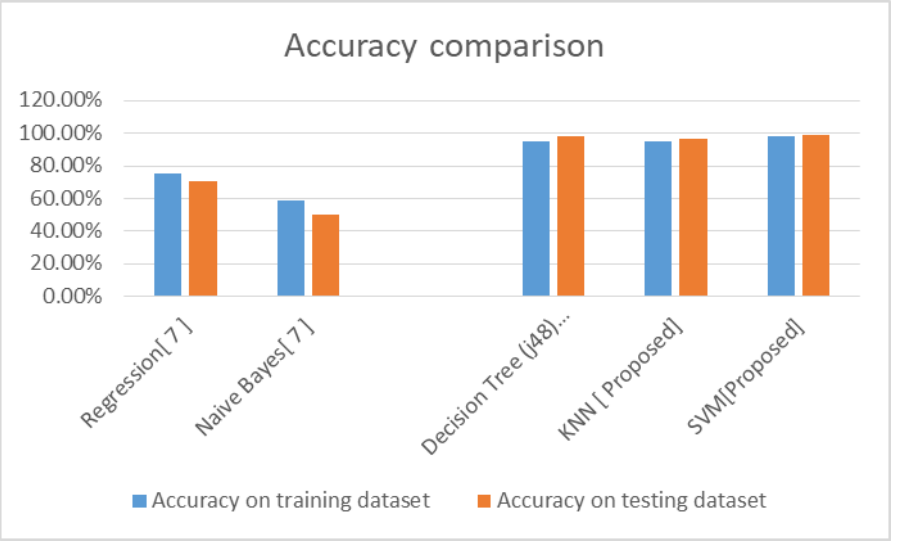


Fig 5: Accuracy Comparison of Existing and Proposed Algorithm

Conclusion

Proposed work is determining accuracy of machine learning algorithm for identifying leaf disease in rice plant. This paper considers three diseases namely Bacterial leaf blight, Leaf Smut Rice leaf, and Brown spot affected Rice leaf. Here we have implemented KNN and SVM for identifying rice leaf disease and accuracy is compared with existing algorithms. Proposed work can be extended for recommendation system of treatment for corresponding disease. Also other diseases can be included for identification.

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