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Determination of Blast Disease Using SVM And ANN Classifiers

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Abstract— This paper is mainly industrialized to find the blast disease and reduce the crop defeat and hence increase the paddy cultivation production in an effective manner. In modern farming field, pest and disease identification is a major role of paddy cultivation. Image classification by the use of deep convolutional neural networks of training and methodology used the facilitate a quick and easy system implementation. Pests and diseases are a threat to paddy production, especially in India, but identification remains to be a challenge in massive scale and automatically. The results show that we can effectively detect and recognize the paddy diseases and pests including healthy plant class using classifiers, with the best accuracy of 91%. The significantly high success rate makes the model a really useful advisory or early warning tool, and an approach that would be further expanded to support an unified paddy plant disease identification system to work in real cultivation conditions.

Key words : Pest, Disease, Image classification, ANN,SVM, Image Net.

I. INTRODUCTION

In this paper, a mechanism to detect the blast disease that occurs in the leaves of paddy crop from its leaf images is presented. Totally, eight features relevant to the disease are extracted in the stage of feature extraction and two classifiers namely SVM and ANN algorithms are used in this work for the purpose of classification. The paddy images are collected from the farm field of Moovanallur, Paravakottai in the district of Tiruvarur, Tamilnadu, India.
In India, farmers produce unindustrialized products and there is increased consumption of agriculture products due to the high population growth. In south India, rice is the main ingredient in all the food items settled on a daily basis. Hence, it is cultivated in more agricultural field, than other crops[1]. The yield of the rice crop is mostly affected by the various diseases caused by different agents. Huge loss in rice cultivation is earned due to diseases than the other chance meeting like environmental conditions and pests[2] any stage of rice crop, like the nursery stage and main field stage, the crop may be disease-ridden by either fungal or bacterial based diseases. Brown spots, sheath blight, Bacterial leaf blight, sheath rot, tungro, and blast are known as the several fungal and bacterial vectors based diseases [3]. Among those diseases, the blast disease creates grain losses in paddy cultivation, nearly 70% to 80%, according to the report of Tamilnadu Agriculture University (TNAU). At the nursery stage of paddy leaf, the blast disease can affect a very small part of the leaf and it would spread to the entire rice crop, thus creating, major turnover loss. This paper is focused to provide a deep learning technique to find the blast disease by using the SVM and ANN classifiers. Ultimately, an appropriate confusion matrix is laboring to analyze the performance of both classifiers.

II. RELATED WORK

2.1 Overview of Classifiers

This section provides an overview of the two classifiers used in this research work namely, ANN and SVM classifiers.
(i) SVM Classifier: Support Vector Machines (SVMs) is a supervised machine learning technique. There are a number of examples of where it has been used in the agricultural domain. This methods is applied for reduction of rainfall for climate change scenarios.

(i) To minimize the oversimplification error bound and to achieve generalized performance. It is used to forecast the demand and supply of pulp wood [4].It is also applied to provide insights into crop comeback patterns related to climate conditions by providing the features involvement analysis for agricultural yield prediction .The Sequential

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Minimal Optimization (SMO) classifier has been applied on the current dataset.

(ii) ANN Classifier: An artificial neural network (ANN) is known as a computational model which works according to the functions and structure of biological neural networks. The relationship between[5] the outputs and inputs are modelled with the help of non-linear statistical data modelling tools that exist in the ANN. ANN Classification is considered as a Supervised Learning method. The concert of the system is indicated by the known class labels. ANN classifier is required to differentiate the various cases present in the system.

(iii)Data Sets: In this research work, 353 images are used to train the classifier, in which, 148 images consist of the normal paddy leaf images, whilst, 205 images consist of the blast affected paddy leaves[7]. In the 104 images, employed for testing, the number of blast affected paddy leaf images are 57, and, normal images are 47. The details of data set images are shown in Table 1.

Table 1: Data Sets

Type of image	No of images in Training Phase	No of images in Testing Phase
Normal	148	47
Blast Affected	205	57
Total	353	104

2.2 Determination Of Blast Disease By Using Both Svm And Ann Classifiers

The flow diagram shown in Fig.1 indicates the process steps used for Blast disease recognition using SVM and ANN classifier[8] algorithms. This process consists of five various stages such as Image Acquisition, Image pre-processing, Image Segmentation, Feature Extraction and Classification.

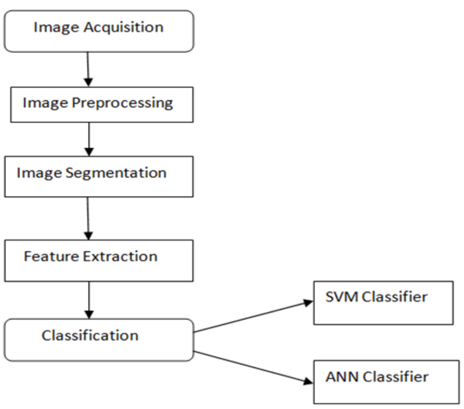

Fig.1 Flow Diagram of Proposed Method

In the image acquisition step, the digital camera is employed to capture the image512×512 pixels of rice leaf. The pixel of images is reduced to 256×256 pixels for increasing the accuracy. The gray scale image is created from there sized colour image for carrying out subsequent process[9]. The HSV image is extracted from the RGB image during the phase of image pre-processing. The normal and the blast affected images which are used in the processing steps are shown in Fig.2 (a) and (b).

After the pre-processing of paddy leaf images, k-means clustering is employed for various k values for Image segmentation. Fig. 3 exhibits the sample result of the k-Means clustering implemented images affected by blast disease.

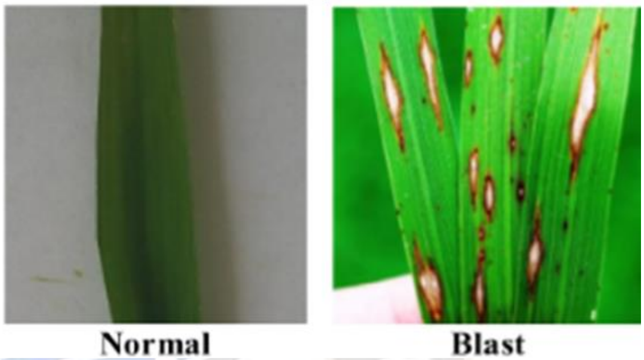

Fig. 2: (a) Normal image (b) Blast affected image

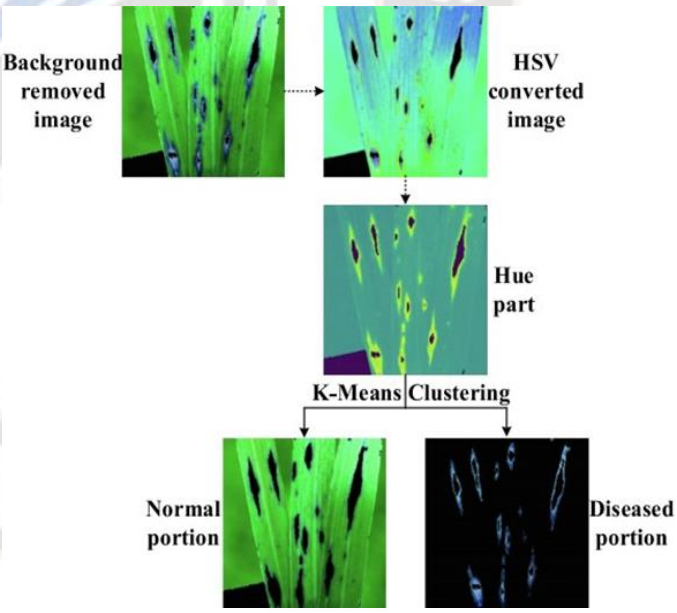

Fig.3: K-means clustering image

The features corresponding to the disease infection is extracted from the segmented images. The disease affected portion is calculated by the GLCM feature. The features such as mean value, standard deviation, energy, contrast and homogeneity are extracted in the GLCM algorithm to determine the blast effects. A classifier uses these extracted

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features to define the sort of image, whether it is uninfected or infected.
In SVM classifier, the value of k is fixed as 3, since the accuracy of SVM cluster is high when the value of k as 3. The leaf part with the background appears in the image, while the k value is 3. The accuracy of SVM classifier is 86% for normal images and 85% for blast affected images, at the selected k Values. The standard layered architecture is used in ANN Classifier, in which the extracted feature are used in the input layer. ANN classifier produces more accurate value when five neurons are present in one hidden layer. The characteristics of paddy leaf indicated by the output layer. The working of ANN is based on the initialization of weights, updating of the weights, and feed forward back propagation. The accuracy of ANN classifier is 100% for blast infected images and 99% for a normal image.

III. PROPOSED WORK

3.1 PERFORMANCE ANALYSIS OF SVM AND ANN CLASSIFIERS

The image dataset is processed using ANN and SVM Classifiers to detect the blast disease in paddy crops. The performance of the classifier algorithms is analyzed using the common QoS parameters as described in this section. Four outcomes such as false negative, true negative, false positive and true positive are used to derive the performance measure of ANN and SVM via confusion matrix. The confusion matrix for the classifiers (ANN and SVM) is depicted in Figure 4.

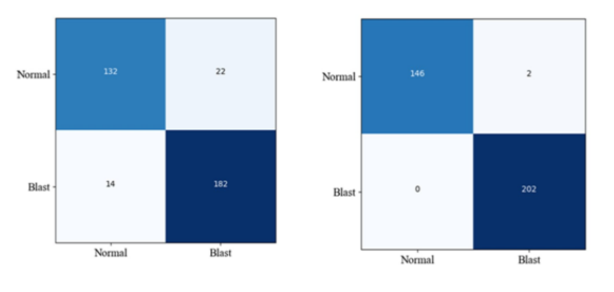


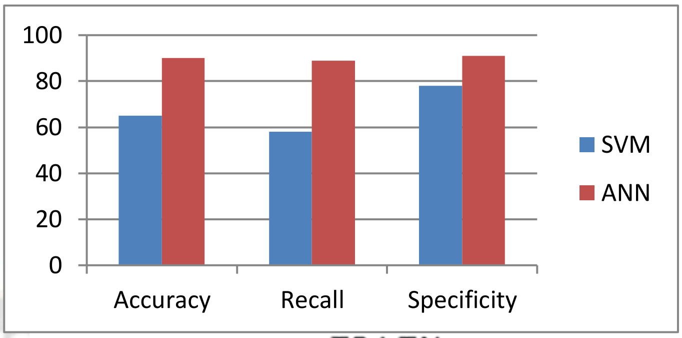
Fig. 4 Confusion Matrix of SVM and ANN

Using the confusion matrix presented in Figure 3.1, few other parameter are derived and described in the following sections.

(i) Accuracy

According to the confusion matrix, the accuracy of both SVM and ANN classifier measured is respect to the overall number[10] of images. The performance of both SVM and ANN classifiers in terms of recall, accuracy, and specificity are plotted in Figure

3.2. Accuracy (ACC) is calculated as the number of all correct predictions divided by the total number of the data set and given in below formula [5].



$$ACC = \frac{TP+TN}{TP+TN+FP+FN}$$

Fig. 5: Performance for recall, specificity and accuracy

(ii) Sensitivity (SN)

In this work, sensitivity is calculated from the relation between the accounts of correct positive predictions and the total accounts of positive images. In Fig.5. the sensitivity variance between SVM and ANN is plotted. The graph shows that the SVM classifier exhibits less performance than that of the ANN classifier. Sensitivity (SN) is calculated as the number of correct positive predictions divided by the total number of positives and the formula is given it is also called as recall or True positive rate.
SN=TP/P

(iii) Specificity (SP)

The successive rate of negative predictions among the negative images is known as the specificity. The specificity of both SVM and ANN classifier is presented in Fig. 5.which shows that ANN classifier delivers more specificity than SVM classifier. It is also named as the True Negative Rate and the given formula below it is also called as True negative rate.
SN=TN/N

(iv) Precision

The relationship between the number of correct predictions and the total positive predictions is known as the precision which is also referred as positive predicate value (PPV). Fig.6. shows the precision of ANN and SVM classifiers, in which ANN delivers more precision compared to SVM , in which x-axis shows the performance measure of precision, NPV, F1score and percentage of accuracy is provided in the y-axis. Precision (PREC) is calculated as the number of correct positive predictions divided by the total number of positive predictions and formula is given below

Prec=TP/TP+FP

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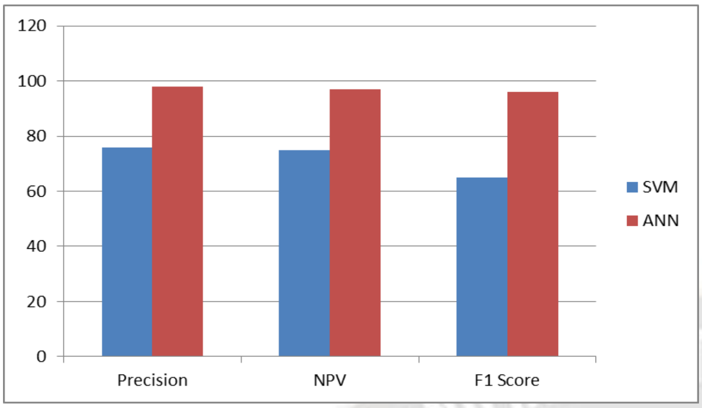

Fig. 6: Performance for Precision, NPV and f1 score

(v) F1 Score

F1 score of the employed classifiers is exhibited in Fig.3.3 which shows, that ANN has more F1 score than KNN and the formula is given below

F−Measure=2∗Recall∗precision/Recall + precision

(vi) Negative Predicated Value

The NPV is calculated as given below

NPV=TN/TN+FN

False Positive Rate

In order to calculate the false positive rate, the number of incorrect positive pre-dictions is divided by the number of negatives. False Positive Rate of both classifiers is shown in Fig. 7 which exhibits that ANN classifier has low False Positive Rate compared to SVM classifier, in which x-axis shows the performance measure of false positive rate, false discovery rate and percentage of accuracy is provided in the y-axis. False positive rate (FPR) is calculated as the number of incorrect positive predictions divided by the total number of negatives and formula is given below

$FRP = 1 - SP$

False Discovery Rate

In order to find False Discovery Rate, the incorrect positive prediction is divided with the summation of correct positive prediction and incorrect positive prediction. Fig.7. shows that the ANN classifier has low false discovery rate compared to SVM classifier, the false discovery rate is calculated by the formula

$FDR = FP/TP + FP$

False Table Accuracy of SVM and ANN

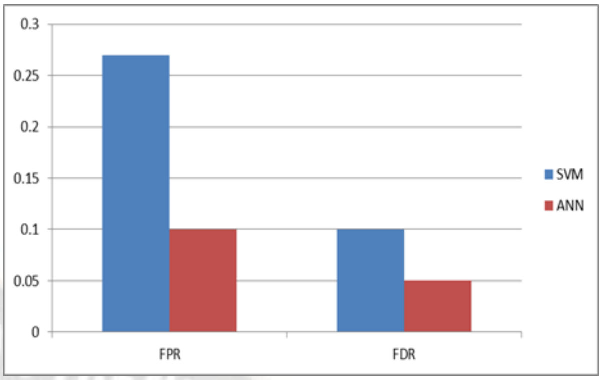

Fig. 7. Performance for FPR and FDR

Loss Function

The variance between the actual label(y) and predicted value(yˆ) are measured by using a loss function. If the value of the loss function is increased, the robustness of the model will be increased. For the values such as 0.25, 0.1, 0.02 and 0.2, the learning rates are tested. The above mentioned values are employed in a trial and error basis. The number of epochs are set in the limits of 100 to 1500. The loss function is shown in Fig. 8, in which the x-axis shows the number of epochs and the loss function value is provided in the y-axis.

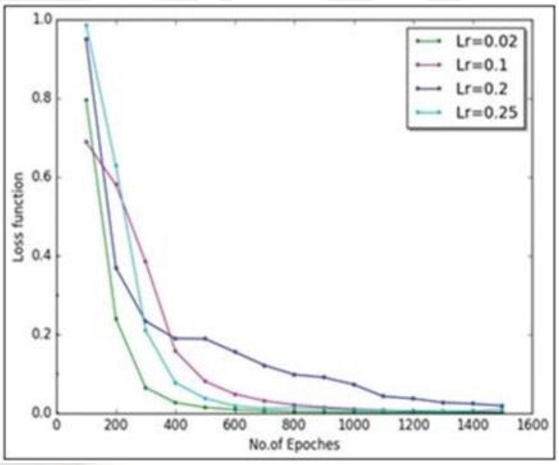

Fig.8: Loss function

3.2. Over All Accuracy Analysis

In this work, 22% of the images are used to analyze the performance of the proposed mechanism and 78% of images are utilized for training the classifier. Table 2 shows the performance measure of both ANN and SVM classifiers. From the table, it is inferred that the performance of ANN is high compared to the SVM.

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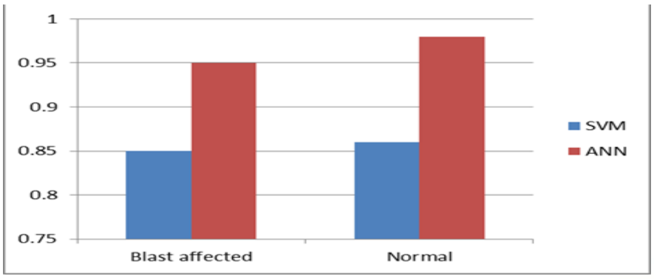

Accuracy of Training (Blast affected and Normal)

Accuracy of Testing (Blast affected and Normal)

Fig. 9 (a) Training accuracy for SVM and ANN (b) Testing accuracy For SVM and ANN

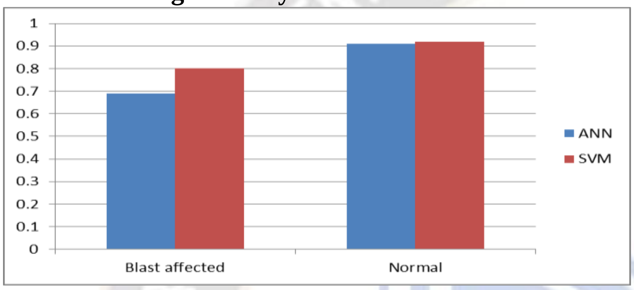

Table 2 Classification performance measure

S. No.	Performance Measure	SVM (%)	ANN (%)
1	Accuracy	75	91
2	Recall	66	89
3	Specificity	79	91
4	Precision	73	99
5	NPV	73	99
6	F1Score	66	98

The accuracy of SVM and ANN classification algorithms are exhibited in Fig.9(a), for training phase, based on the detection of blast affected images among the normal images. ANN classifier detects 99% of blast affected images among the normal images. At the same time, SVM classifier provides only 90% accuracy. The accuracy of both ANN and SVM algorithms for the detection of normal images, in the training phase, is 99% and 90% respectively. Fig.9(b), shows the performance of both classifiers ANN and SVM, at the stage of testing, in which, the accuracy of SVM and ANN is 63% and 88% respectively for the detection of normal images. At the same time, in the detection of blast affected paddy leaf images, ANN delivers 91% of accuracy but SVM delivers only 75% of accuracy.

IV. CONCLUSION

The blast disease of paddy crop is detected by means of image processing techniques. The proposed classification methodology involved deep learning algorithms namely SVM and ANN. In this part of the research, totally eight features are extracted for distinguishing the healthy and unhealthy leaves and k-means clustering technique is assisted in image segmentation. After completing the training of images with healthy and blast affected diseases, the performance comparison is carried out to find the optimal one. From the simulation results, it was studied that ANN provides better accuracy than SVM in detecting blast disease.

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