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Enhanced Accuracy in Blast Disease Prediction for Rice Crops: A Support Vector Machine vs. K-Nearest Neighbor Algorithm Study

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***Abstract*— This study endeavors to compare the performance of the K-Nearest Neighbour (KNN) algorithm and the Support Vector Machine (SVM) in enhancing the accuracy of blast disease detection in rice crops. The KNN and SVM algorithms were employed with different training and testing splits to predict rice blast disease. The analysis involved two groups, each comprising 169 samples, and was conducted over 10 iterations. The accuracy of the supervised learning setup was assessed using ClinCalc software. Additionally, approximately 80% of the GPower test was utilized, with power settings set at 0.05 and 0.80. The study evaluates the effectiveness of SVM and KNN in identifying blast disease in rice crops based on the selected dataset. The results indicate that SVM achieves an accuracy of 90.93%, outperforming KNN, which has an accuracy of 88.59%. A statistical analysis using the Independent Sample T-test yielded a p-value of 0.284, indicating no significant difference between the two methods. SVM demonstrates higher accuracy than KNN for detecting blast disease in rice crops. It performs particularly well when there is a clear distinction between affected and healthy plants. However, KNN may be more effective in datasets with high variability and no well-defined decision boundaries.**

***Keywords*— K-Nearest Neighbor Algorithm, OpenCV, Significance value, Plants, Crops, Diseases, Novel Support Vector Machine**

I. INTRODUCTION

This study recommended a suitable framework that includes enhancement, filter, colour segmentation, and colour feature for classification phases in order to correctly identify objects [10]. This study has proposed a feasible technique which colours the input and output images. According to [14], this study took into account a number of images processing stages, including enhancement, noise reduction, colour picture segmentation, and colour characteristics for identification.

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Based on the proportion of RGB value of the affected area, this study offers a novel method for recognising and classifying diseases through image processing [15]. Early detection of rice plant diseases has the main advantage of allowing farmers to take preventative measures, which increases yields and rice quality [4]. Blast disease in rice is an emerging research area. This study proposed an autonomous deep learning-based system for localising Rice Blast Diseases and for classifying images of blast diseases as either healthy, moderate, or susceptible [12]. In this work, the damaged area of the rice plant is segmented from the grayscale photographs using the k-means method, and the illness is then classified using the Novel Support Vector Machine [16]. A software system is crafted to identify the two diseases (brown spot and leaf blast). The YOLO Algorithm was used to design the system [1]. The system aims to build an Expert System that helps farmers to deal with rice illnesses in the state of Meghalaya. After consulting with subject matter experts and engaging with local farmers via a planned interview schedule, the most common rice illnesses in this region were identified and confirmed [5]. To improve classification accuracy, this study analyzes the performance of ANN with SVM. Using this proposed methodology, it improves the detection of the Rice Blast.

II. METHODOLOGY

The sample size was determined using GPower software to compare the performance of the SVM and KNN algorithms. Two groups were selected for comparison, with results derived based on their performance. Each group consisted of 10 sets of samples, totaling 10 samples for this study. The SVM and KNN algorithms were implemented using technical analysis software. The sample size for each group was set at 10, with GPower 3.1 software used for calculation (parameters: $\alpha = 0.05$, power = 0.85). Python OpenCV was utilized for designing and executing the proposed model.. To get accuracy-based results, the dataset was analyzed in the background as the algorithm ran.

A. *Support Vector Mchine*

SVM classifies the data points by translating them to a high-dimensional feature space when they can't be linearly separated. Once a divider across the categories has been identified, the data is converted so that the divider can be represented graphically as a hyper-plane. Next, we may determine which category a record belongs to by using the features of newly collected data. A linear kernel function is proposed if the linear distinction among the data is straightforward. Algorithm for SVM is considered as choosing the appropriate hyper-plane for three different cases and then two best cases are classified, and at last select a hyper-plane that sepeartes two cases.

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B. *K Nearest Neighbour Algorithm*

KNN categorizes new data or instances based on similarity measures. The classification of a data point is influenced by the labels of its neighboring points. The algorithm works by calculating the distances between a given query point and all existing data points, identifying the K closest instances, and then determining the final classification. For classification tasks, it assigns the most common label among the neighbors, while for regression, it computes the average of the neighboring labels.

C. *Statistical Analysis*

SPSS software has been employed to perform the statistical analysis of SVM and KNN algorithms. A separate sample t-test was performed using the data, that compares the Novel SVM and KNN algorithm. Image, objects, distance, frequency, modulation, amplitude, volume, and decibels are independent variables (Sreenivasaprasad and Johnson 2013). Images and objects being dependent variables, an independent T test has been performed to determine correctness.

III. RESULTS

Considering a sample size of 10, the proposed SVM and KNN methods were each ran separately in a Jupyter notebook. Table I displays expected SVM's accuracy and loss. Table II displays the KNN Algorithm's predicted accuracy and loss. Statistical values have been calculated and compared to corresponding loss values for both the approaches. The findings indicate that SVM had a Mean Accuracy of 90.9370% whereas KNN method has 88.595%. Table III displays the mean accuracy values for SVM and KNN algorithms. The mean value of SVM has a standard deviation of 2.37114 as opposed to the KNN Algorithm 6.27997. Table IV shows the SVM and KNN algorithm with an Independent Sample T -test value of $p = .004$. Fig 1. compares the KNN algorithm with the SVM in terms of mean accuracy and loss. SVM have equivalent averages of 90.9370, 2.37114, and.74982, respectively. The mean, standard deviation, and standard error mean for the KNN algorithm are 88.5950, 6.27997, and 1.98590, respectively. The mean, standard deviation, and standard error mean loss values for the SVM, on the other hand, are 9.0630, 2.37114, and.74982, respectively. The KNN Algorithm's mean, standard deviation, and standard error mean loss values are 11.4050, 6.27997, and 1.98590, respectively. For each of the two algorithms, the group statistics value, mean, standard deviation, and standard error mean are provided. A graphical depiction is used to compare and classify the SVM and KNN algorithms' means of loss. This shows that the classification accuracy rating of the SVM is 90.9370%, which is much higher than the classification accuracy rating of the KNN, which is 88.5950%.

TABLE II
PREDICTING ACCURACY OF RICE LEAF DISEASE DETECTION USING NOVEL SUPPORT VECTOR MACHINE (MEAN ACCURACY =90.93%).

Iterations	Accuracy (%)	Loss (%)
1	87.93	12.07
2	89.03	10.97
3	89.68	10.32

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4	92.85	7.15
5	89.78	10.22
6	90.02	9.98
7	93.05	6.95
8	89.07	10.93
9	95.40	4.60
10	92.56	7.44

TABLE III

PREDICTING ACCURACY OF RICE LEAF DISEASE DETECTION USING K-NEAREST NEIGHBOUR (MEAN ACCURACY =88.59%)

S. No	No. of Iterations	Accuracy in Percentage (%)	Loss in Percentage (%)
1	1	80.13	19.87
2	2	82.35	17.65
3	3	83.33	16.67
4	4	84.47	15.53
5	5	86.54	13.46
6	6	88.33	11.67
7	7	91.49	8.51
8	8	95.41	4.59
9	9	96.31	3.69
10	10	97.59	2.41

TABLE IV

GROUP STATISTICAL ANALYSIS OF SVM AND KNN ALGORITHMS

	GROUP	N	MEAN	STD. DEVIATION	STD. ERROR MEAN
Accuracy	SVM	10	90.9370	2.37114	.74982
	K-Nearest Neighbour Algorithm	10	88.5950	6.27997	1.98590
LOSS	SUPPORT VECTOR MACHINE	10	9.0630	2.37114	.74982
	K-NEAREST NEIGHBOUR ALGORITHM	10	11.4050	6.27997	1.98590

TABLE V

COMPARISON OF THE SVM AND KNN ALGORITHM WITH THEIR ACCURACY

CLASSIFIER	ACCURACY (%)
Support Vector Machine	90.9370
K-Nearest Neighbour Algorithm	88.5950

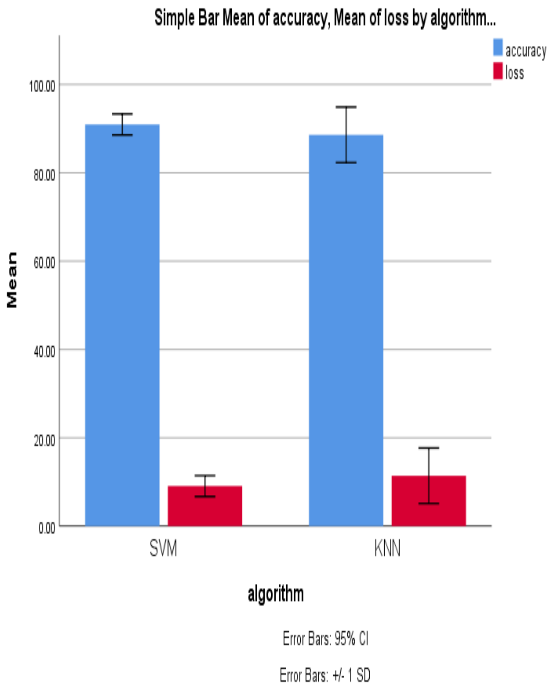

Fig 1. Comparison of SVM and KNN Algorithm based classifier.

IV. DISCUSSIONS

The significance of this study is the independent sample T-test value of p=.284, which suggests that SVM would be preferable to the KNN Algorithm. Support Vector Machine accuracy is 88.595% whereas accuracy analysis shows that SVM accuracy is 90.9370%. In this study, the grayscale images are segmented using the k-means technique using the Novel SVM. This investigation turned up five rice diseases. This study's methodology has a 96.77% accuracy score, which is higher than that of earlier methods and enables it to produce better results [16]. The development of an app for diagnosing Brown Spot or Rice Leaf Blast illnesses was the main goal of this study. The device's accuracy was 90.00% for the class 2 Brown Spot Disease and 70.00% for the leaf blast disease, respectively. The technology handled the third class, the unnamed sickness, flawlessly. Hence, the instrument's accuracy is 73.33%, while its commission error is 26.67%. To help rice growers in the Meghalaya state manage rice diseases, we plan to create an Expert System (ES). After speaking with subject matter experts and conducting a series of structured interviews with the farmers, the frequent rice maladies in this region were identified and confirmed. 89.57% is the calculated precision [18]. The suggested system detects leaf disease in rice plants using Mask R-CNN and Quicker R-CNN algorithms. Our test results show that mask R-CNN is the most effective method for recognising and detecting rice blast diseases, such as blast (96%, brown spot, and sheath blight. One of the study flaws is the fact that Support Vector Machine training takes a while, especially for large datasets. Future objectives of this study involve enhancing the system to accommodate a broader range of objects while reducing the training time for the dataset. One limitation of the work is that SVM training can be time-consuming, particularly with large datasets. Moving forward, the goal is to optimize the system for faster training while expanding its capability to recognize more objects efficiently.

V. CONCLUSION

The SVM's accuracy score is 90.9370%, whereas the KNN's score is 88.5950%. The analysis shows that SVM (90.9370%) outperforms KNN's Algorithm (88.5950%). In conclusion, both novel SVM and KNN models can be used to identify the blast disease in rice crops. However, based on the comparison of the two models, it appears that the SVM model performs better than the KNN model with reference to accuracy and predictive power for the selected dataset.

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