Original Article

Prediction of Plant Diseases using Simple Novel Image Detection Technique with Improved Accuracy and Compared with Support Vector Machine

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Abstract

Aim: The research mainly aims to compare the Simple Novel Image Detection Technique with the Support Vector Machine Algorithm to improve the accuracy of Plant Disease Detection for the purpose of plant protection from unidentified diseases.
Materials and Methods: Machine Learning algorithms based Simple Novel Image Detection Technique (N=50) and Support Vector Machine (N=50) were used for the implementation of the research. The research work uses 100 sample images for testing. The test is calculated using two groups which are done using G power with Pretest Power 0.8. The statistical analysis of two groups is done using SPSS software.
Results: The comparison shows that Simple Novel Image Detection Technique has better mean accuracy of 88.15% when compared with Support Vector Machine where the mean accuracy produced is 75.48% with a significant value of .016 ($p<0.05$) proves the significance among them.
Conclusion: The results show that the Simple Novel Image Detection technique has better accuracy than the Support Vector Machine algorithm.

Keywords: Image Processing, Machine Learning, Plant Leaf Diseases, Plant protection, Simple Novel Image Detection Technique, Support Vector Machine.

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INTRODUCTION

This study describes the plants and their importance of Plant Protection. Plants make human life possible on earth by giving many resources like food, water, and many for plant protection from unidentified diseases. The technique of prediction of plant diseases has been invented. The research explains about the Plant protection by detection of Plant disease using Simple Novel Image Detection Technique (SNIDT) by applying a Simple Image Detection algorithm ("DETECTION OF PLANT LEAF DISEASES USING IMAGE PROCESSING" 2020)("DETECTION OF PLANT LEAF DISEASES USING IMAGE PROCESSING" 2020) for the classification of image based on the image type , Plant type, Leaf, type of Plant Leaf Diseases and the final output will be as the type of image with type of plant and the name of the diseases are displayed as the output for the given input (Huang 1980)(Huang 1980) image. The author (Mahlein 2016)(Mahlein 2016) analyzes the types of diseases which help for future references about disease and it is more useful in the agriculture sector (Indhu 2020)(Indhu 2020). The model has been used in various applications, where it is very much helpful for many farmers which help them in preventing the (Narayanasamy 2001)(Narayanasamy 2001) crop from unidentified diseases by using this model . It is very helpful in finding new types of diseases.
This research mainly explains about the plant's diseases. There are multiple studies related to Plant diseases. There are many articles published in the last five years based on this study. Number of articles published in two databases related to this study are IEEE-93 and Science Direct-114. The articles which are mostly cited based on the analyzed databases, One of them is mainly depends up on study of unhealthy region of plant where it mainly uses the image processing and genetic algorithms to detect the unhealthy region of the plant for the purpose of Plant Protection (Singh, Varsha, and Misra 2015)(Singh, Varsha, and Misra 2015) and the other study depends up on

plants disease using soft computing techniques were used for detection of the plants diseases using plant leafs (Oo et al. 2018)(Oo et al. 2018) and the other study depends up on CNN algorithm for the detection of plant leaf diseases (Sardogan, Tuncer, and Ozen 2018)(Sardogan, Tuncer, and Ozen 2018) and the final study based on usage of neural networks for plant leaf disease detection (Dhaka et al. 2021)(Dhaka et al. 2021).Our team has extensive knowledge and research experience that has translate into high quality publications(Bhansali et al. 2021; Jayanth et al. 2021; Sudhakar, Ravel, and Perumal 2021; Sathiyamoorthi et al. 2021; Deepanraj et al. 2021; Raju et al. 2021; Arun Prakash et al. 2020; Kamath et al. 2020; Shanmugam et al. 2021; Rajasekaran et al. 2020; Adhinarayanan et al. 2020; Rajesh et al. 2020; Aurtherson et al. 2021)(Bhansali et al. 2021; Jayanth et al. 2021; Sudhakar, Ravel, and Perumal 2021; Sathiyamoorthi et al. 2021; Deepanraj et al. 2021; Raju et al. 2021; Arun Prakash et al. 2020; Kamath et al. 2020; Shanmugam et al. 2021; Rajasekaran et al. 2020; Adhinarayanan et al. 2020; Rajesh et al. 2020; Aurtherson et al. 2021)

The Existing research uses the SVM algorithm which has less accuracy value around 78%. The study aim's to get the improvement in accuracy of the proposed system when compared to the existing research support vector machine (SVM), The algorithm used for the existing research with an average accuracy rate. The research is being developed as a fresher by learning from various sources. The research has been developed using Simple Novel Image Detection Technique (SNIDT) to get improved accuracy.

MATERIALS AND METHODS

The setup of the research has been performed in the Data Analytics laboratory of CSE Department in Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences. The research mainly depends up on two Machine Learning algorithms one is for base and another for Comparison, which is classified into two groups as Simple Novel Image Detection Technique **(**SNIDT) and Support Vector Machine (SVM) with two sample sizes of 50 and 50 which is a total of 100 which is done using pretest power of 0.8, where group 1 performance is analyzed using Simple Novel Image Detection Technique and group 2 performance is analyzed using Support Vector Machine (Dhaka et al. 2021)(Dhaka et al. 2021).

The dataset used for the proposed model Plant Leaf Diseases detection has been imported from Kaggle by downloading the dataset containing records around 4000 images and having three types of attributes which includes the plant name, images, type of disease and different attributes related to output of the data.

SNIDT Algorithm

Simple Novel Image Detection Technique is a Machine Learning algorithm where it takes an image of Plant Leaf Diseases as an input and gives the output about what the image contains. A sample dataset of 50 images is used for analyzing the performance of the algorithm (Dhaka et al. 2021)(Dhaka et al. 2021).

Steps for SNIDT Algorithm

- The algorithm is calculated based on color RGB and Scale where change in appearance for the Shift is (u, v) where u, v indicates the variables.
- $E(U,V) = \sum [W(x,y)[I(x+y, y+v) - I(x, y)]^2$ which defines the mathematical representation of the algorithm the Image scale is taken in format of I(x,y).
- In SNIDT the image is given as input which undergoes pre-processing that normalizes contrast and brightness.
- Then the feature extraction is done to extract the important features of the image.
- The algorithm is applied for plant leaf disease detection and the output is given based on the RGB color techniques.

SVM Algorithm

SVM is a supervised machine learning algorithm and is used for both classification and Regression of given inputs. In this article, SVM is used for classification problems. SVM transforms the database, where it finds an optimal boundary between possible outputs. Support Vector Machine performs classification by finding the hyperplane that maximizes margin between its two classes. The vectors that define the hyperplane are called 'Support vectors'. There it splits with data involving the training and testing of data into fitting the model data to produce accuracy. The SVM algorithm defines the optimal hyperplane with the maximized margin. Map data to the high dimensional space where it is easier to classify with the linear decision surfaces. This term with the Tuning parameters with the data analyzing of Regularization, Gamma, Kernel (Sardogan, Tuncer, and Ozen 2018)(Sardogan, Tuncer, and Ozen 2018).

Steps for SVM Algorithm

Mathematical representation of algorithm,

- SUM (A, B, K, Y,A) where Each variable to refer to individual term which is useful for algorithm

- Let us consider the input : A S(h ; yi) & i=B,I,K,Y,A
- The output is in format of h (.)
- The mathematical representation has begun by setting V and U set V=(1/2-r) U=(1/2-r)
- Now deriving the I such that ∑B(j)<=U and it has maximum cardinality.Program Ends with output hypothesis h(.) -ABIL(A^* , B^*).

  Main steps of SVM algorithm are,
- Import the dataset.
- Explore the data to figure out what they look like.
- Pre-process the data.
- Split the data into attributes and labels.
- Divide the data into training and testing sets.
- Train the SVM algorithm.
- Make some predictions.

The research model is tested using the hardware components built in HP computer such as i5 processor, 16GB RAM and 500GB SSD storage. The operating system used for this experiment is Windows 10 and the code compilation platform used is Jupyter. The process of testing included the downloading of the required dataset according to the code requirement. The configuration for all the software packages were made to fetch the dataset, by splitting the dataset into testing (75%) and training (25%) the model is created and deployed.

Statistical Analysis

The IBM SPSS version 22 (64 bit) is the statistical software used for analysis. Independent sample T-test with significance $p<0.05$ and Confidence Interval (CI) 95% are obtained upon execution of the algorithms SNIDT and SVM. The variables such as name, image type, number, ratio were taken as independent variables. The dependent variables are types of disease such as seasonal disease, infectious disease, and non infectious disease. The images from a test dataset are used for calculating the accuracy of the algorithm. Using sample images of 50, each algorithm independent variable sample test was performed for Plant Leaf Diseases detection (Dhaka et al. 2021)(Dhaka et al. 2021).

RESULTS

Each group is executed with 50 different samples, for the comparison of the SNIDT and SVM. The Table 1 briefs about the group statistics values for the comparison of algorithms and the accuracy was measured for sample sample=50 for SNIDT and SVM. The obtained values are Mean=88.1522 for SNIDT and 75.4880 for SVM, Std.Deviation=3.46296 for SNIDT and 4.18260 for SVM, Std.Error Mean=.48974 for SNIDT and .59148 for SVM**.**

Table 2 briefs about the independent sample T-test using equality of the Variances and equality of means with the sig. (2-tailed) =.001 and sig (1-tailed) =0.016 for both assumed and non assumed variances and mean difference of 12.66420 for both assumed and non assumed variances and 95% of confidence value respectively**.**

Figure 1 depicts the comparison of the accuracy value obtained for algorithms SNIDT (Simple Novel Image Detection Technique) and SVM (Support Vector Machine), where the accuracy of SNIDT is 88% and the accuracy value of the SVM is 75%. The bar graphs were then plotted with error bars +/- 1SD and Confidence Interval (95%)**.**

DISCUSSION

The comparative analysis of the two algorithms are represented in the above result section and it is observed that the percentages of SNIDT is 88% and SVM is 75% accurate. Also, the significance gets 0.016 for the margin of $p<0.05$, based on the accuracy and significance result, it is proven that the experiment of SNIDT has better significance than SVM.

Many studies were reviewed related to the similar study, which shows that the findings of intelligent plant disease identification was performed using machine learning (Alagumariappan et al. 2020)(Alagumariappan et al. 2020). Image based detection of plant diseases was performed using machine learning algorithms (Chatterjee et al. 2021)(Chatterjee et al. 2021). Usage of a modern approach for plant leaf image pre-processing for classification and disease detection has been done using machine learning algorithms (Dhaware and Wanjale 2017)(Dhaware and Wanjale 2017). Hybrid methods are a new way of approach for plant leaf diseases detection and classification using digital image processing are done by using hybrid methods (Rao and Kulkarni 2020)(Rao and Kulkarni 2020). The opposing findings of the proposed algorithm is Plant leaf detection technique using Support Vector Machine (Gattim, Koneru Lakshmaiah Education Foundation, and India 2019)(Gattim, Koneru Lakshmaiah Education Foundation, and India 2019) which has accuracy of 75% and sensitivity around 70%, compared to SNIDT which has 88% of accuracy.

The limitations of the model describes that it cannot work with multiple recognition of images at the same time, only one image can be selected at a time and it can only be familiar with the leaf diseases of a plant. The future, this experiment scope can be upgraded to Convolutional Neural Network (CNN) in future applications for improving the accuracy of other algorithms.

CONCLUSION

The accuracy rate of the Simple Novel Image Detection Technique has been improved to 88%, compared to the Support Vector Machine algorithm which is having 75%. Hence, it is proven that SNIDT performs better than SVM algorithm with respect to statistical analysis and related supporting articles.

DECLARATIONS

Conflict of Interest

No conflicts of interest in this manuscript.

Author Contribution

Author RM was involved in conceptualization, data collection, data analysis, manuscript writing. Author KJS was involved in conceptualization, guidance, and critical review of the manuscript.

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TABLES AND FIGURES

Table 1. The table gives the values of group statistics with the comparison of algorithms with the accuracy.

Algorithm		**N**	**Mean**	**Std.Deviation**	**Std.Error Mean**
Accuracy	SNIDT	50	88.1522	3.46296	.48974
	SVM	50	75.4880	4.18240	.59148

Table 2. The table gives the output of independent variables like F, SIG, Mean difference, Std error difference etc.

	Levene's Test for Equality of Variance	**T-test for Equality of Means**

	F	Sig.	t	df	Sig. (2-tailed)	Mean diff.	Std error diff.	95% Confidence of the Differences	
								Lower	Upper
Accuracy Equal variances assumed	6.004	.016	16.492	98	.001	12.66420	.76792	11.14030	13.45342
Accuracy Equal variances not assumed			16.492	94.704	.001	12.66420	.76792	11.13964	14.35648

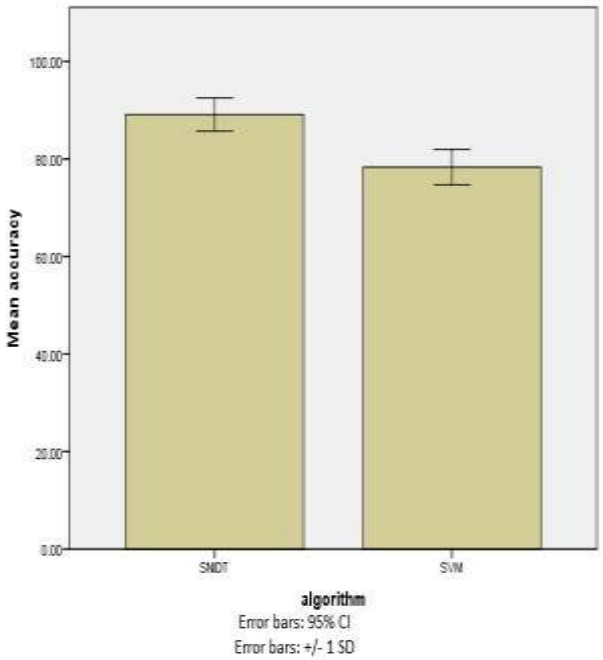

Fig. 1. Bar graph represents the comparison of Simple Novel Image Detection Technique and Support Vector Machine. X-axis has SNIDT and SVM algorithm results with error bars, Y-axis has the mean accuracy of both algorithms plotted for error bars confidence interval 95% and +/-1 SD.