ESTIMATE ACCURACY IN IMAGE PLANT DISEASES DETECTION USING CONVOLUTIONAL NEURAL NETWORK COMPARED WITH K-NEAREST NEIGHBORS

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Abstract:

Aim: To estimate accuracy in Image plant disease detection using Convolutional Neural Network over K-Nearest Neighbors.
Materials and Methods: Convolutional Neural Network and K-Nearest Neighbors are implemented in this research work. Sample size is calculated using G power software and determined as 10 per group with pretest power 80%.
Results and Discussion: Convolutional Neural Network provides a higher of 88.74 compared to K-Nearest Neighbors with 84.52 in predicting plant disease in plant diseases detection. There are statistically significant differences between study groups with $p = 0.048$ ($p<0.05$) Independent T-test value states that the results in the study are insignificant.
Conclusion: Convolutional Neural Network gives better accuracy then K-Nearest Neighbors.

Keywords: Plant Disease Detection, Novel Convolutional Neural Network, K-Nearest Neighbors, Accuracy in Neural Network, Image Processing, Innovative model

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1. Introduction

The aim of this study is to Estimate the accuracy in Image plant disease detection using Convolutional Neural Network over K-Nearest Neighbors. Current research uses imaging methods to predict plant diseases. Plant diseases affect the quality and quantity of plants. Plants are often exposed to a variety of factors, such as viral, bacterial, or fungal diseases that cause decomposition (Almadhor et al. 2021). This study aims to improve the accuracy of neural networks to detect plant diseases through image processing. The value of the input image is compared with the data set during image acquisition and processing, and the result is displayed based on the comparison (Dyrmann et al. 2021). Disease detection is the vital step for disease management. The detection is periodically carried out by human experts (Kong et al. 2018; Sankaran, Ehsani, and Etxeberria 2010). Protecting plants and crops on agricultural land is very important because it is a basic daily human need (Dyrmann et al. 2021; Zhu et al. 2021).

Plant disease causes a considerable decrease in the quality and quantity of agricultural goods. The protection of plants and crops in agricultural fields is critical. The leaves can be utilized to identify and diagnose ailments when they are still in the early stages (Xie and He 2016; Almadhor et al. 2021). Plants leaves, which are the most vulnerable, display disease symptoms first. From the beginning of their life cycle until they are ready to be harvested, the crops must be monitored for illnesses (Halder, Sarkar, and Bahar 2018).

The use of technology in the detection and analysis process increases the accuracy and reliability of these processes. The images of leaves of the plants can be used to detect diseases in plants (S. 2021). The plant leaf for the detection of disease is taken into account that shows the symptoms of disease (Joshi, Mishra, and Ponmagal 2021). By image processing, disease detection is done at an early stage. With this method we can easily identify the disease and preventative measures can be taken to cure the disease and maximize crop production (Joshi, Mishra, and Ponmagal 2021; Roy and Sharan 2021).

Plant Disease Detection can be carried out by many researchers. There are 173 articles which were published in IEEE Xplore digital library, 107 articles published in Science direct and 194 articles from Google Scholar. Among all the articles and journals the most cited papers are (Joshi, Mishra, and Ponmagal 2021; Roy and Sharan 2021; Radovanovic and Dukanovic 2020) and (Zhongzhi 2019). Our team has extensive knowledge and research experience that has translated into high quality publications (K. Mohan et al. 2022; Vivek et al. 2022; Sathish et al. 2022; Kotteeswaran et al. 2022; Yaashikaa, Keerthana Devi, and Senthil Kumar 2022; Yaashikaa, Senthil Kumar, and Karishma 2022; Saravanan et al. 2022; Jayabal et al. 2022; Krishnan et al. 2022; Jayakodi et al. 2022; H. Mohan et al. 2022). Many diseases are initially spotted on the leaves of the plants. It could lead to more harm if the disease is not identified in the first stage. The Image Processing models offer a quick, standardized and accurate solution to this issue (Gumber and Chand 2019). The main objective of this study is to identify plant diseases using Image processing methods.

2. Materials and Methods

The research work was conducted in the Image Processing Lab, Department of Computer Science and Engineering, Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences. Basically it is considered with two groups of classifiers namely Novel Convolutional Neural Network and K-Nearest Neighbors Algorithms, which is used to detect plant Diseases. Group 1 is the Novel Convolutional Neural Network algorithm with the sample size of 10 and the K-Nearest Neighbors algorithm is group 2 with the sample size of 10 and it was compared for more accuracy in neural network score and Loss values for choosing the best algorithm to detect plant diseases. The sample size was calculated and determined as standard deviation for Convolutional Neural Network = 3.61 and K-Nearest Neighbors = 4.30.

Convolutional Neural Network Algorithm

The CNN was utilized for classifying and differentiating input data types. A Novel Convolutional Neural Network is a deep learning algorithm that can record an input image, focus on different aspects of the image, and distinguish them.

Pseudocode for CNN Algorithm

```
Import Convolutional Network Classifier
Import Convolutional Neural Network as CNN
filename, pathname = ui getfile({'*.jpg'; '*.gif'; '*.png'; '*.jpeg'}
Load Image;
if isequal(filename,0)||isequal(pathname,0)
warndlg('Press OK to continue', 'Warning');
else
image aqa = imread([pathname filename]);
imshow(image aqa);
title('Input');
image aqa = Preprocess( image aqa );
figure;
```

```
imshow(image aqa);
title('Preprocess');
image aqa = imresize(image aqa);
Compare images and gives the accuracy;
Plot the graph for accuracy;
Plot the graph for specificity;
Accuracy of the Convolutional Neural Network classifier;
```

K-Nearest Neighbors Algorithm

A K-Nearest Neighbors Algorithm was used for the analysis. K-Nearest Neighbors also require the required amount of input data to perform the assigned task. It is a supervised learning algorithm. KNN is very simple to implement and is most widely used as a first step in any machine learning setup

Pseudocode for KNN Algorithm

```
Import K-Nearest Neighbors Classifier
Import K-Nearest Neighbors as KNN
filename, pathname = uigetfile({'*.jpg'; '*.gif'; '*.png'; '*.jpeg'}
'Load Image';
if isequal(filename,0)||isequal(pathname,0)
warndlg('Press OK to continue', 'Warning');
else
image aqa = imread([pathname filename]);
imshow(image aqa);
title('Input');
image aqa = Preprocess( image aqa );
figure;
imshow(image aqa);
title('Preprocess');
image aqa = imresize(image aqa);
Compare images and gives the accuracy;
Plot the graph for accuracy;
Plot the graph for specificity;
Accuracy of the K-Nearest Neighbors classifier;
```

Recall that the testing setup includes both hardware and software configuration choices. The laptop has an Intel Core i5 11th generation CPU with 8GB of RAM, an x64-based processor, a 64-bit operating system, and a solid state drive. Currently, the software runs on Windows 10 and is programmed in Python. Once the program is finished, the accuracy in neural network value will appear. Procedure: Wi-Fi connected laptop with Google Collaboratory search to write the code in Python. Run the code. To save the file, upload it into the disc, and create a folder for it. Log in using the ID from the message. Run the code to output the accuracy in the neural network and graph.

Statistical Analysis

This analysis was performed with IBM SPSS 28. This is a statistical software used for data analysis. In the case of 10 repetitions of innovative models and existing algorithms, 10 repetitions were observed to analyze the accuracy with up to 20 samples, each iterated. Independent T-test values were performed. Plant leaf normal or diseased are independent variables and plant disease detection is dependent variable.

3. Results

Images selected from the dataset are framed to check the disease of plants Table 1 shows the accuracy in neural network value of iteration of CNN and KNN. Table 2 represents the Group statistics results which depicts CNN with Mean Accuracy of 88.74%, and standard deviation is 3.61. KNN has a Mean Accuracy of 84.52% and Standard Deviation is 4.30. Proposed Innovative CNN algorithm provides better performance compared to the KNN algorithm. Table 3 describes the independent samples t-test value for CNN and KNN with Mean difference as 4.220, std Error Difference as 1.777. Significance value is observed as 0.594. FIG. 1 describes the average accuracy of CNN and KNN algorithms. CNN's average accuracy is88.74 % and KNN's is 84.52%.

4. Discussion

In this research work the Novel Convolutional Neural Network dominated the K-Nearest Neighbors. Both the simplicity of the approach and the achieved accuracy in neural networks confirm that the Novel Convolutional Neural Network is the way to follow for image classification problems with relatively large datasets. This technique identifies the disease, percentage of affected regions with good accuracy in the neural network for identification of different diseases(Mohanty, Hughes, and Salathé 2016). A careful study reveals the capabilities and limitations of the model. In general, validation in controlled environments shows an accuracy of 88.67%. This accuracy depends on several factors, including the stage of the disease, the type of disease, and the composition of the subject(Razmjooy and Estrela 2019). The data set used for this project includes the characteristics of the vacation before and after the illness. Therefore, while the results of studies conducted in conjunction with experimental and statistical analysis provide an understanding of performance, the proposed innovation model has some limitations such as limit values and accuracy. The introduction of artificial intelligence technologies to better predict and analyze the results will further improve the accuracy of plant disease detection at the level of the neural network. It has been observed that there are persistent difficulties in diagnosing plant diseases. Many infected plants can be easily identified by old

traditional methods. However, at an early stage, the disease cannot be detected by traditional methods. This proposed innovative model provides excellent information on plant diseases(Meena, Godara, and Meena 2020) Therefore, although the results of the studies carried out together with the experimental and statistical analysis provide clarity in performance, there are some limitations of the proposed innovation model, such as threshold and accuracy. By introducing artificial intelligence techniques to predict and analyze better results than traditional machine learning techniques, the accuracy of neural network detection of plant diseases using imaging can be further improved. In the future, large collections of plant diseases may be considered to validate the innovative models proposed for the scenario.

5. Conclusion

The Image Plant Diseases Detection by using Novel Convolutional Neural Network Compared with K-Nearest Neighbors. The current study focused on algorithms such as, Novel Convolutional Neural Network over K-Nearest Neighbors for higher classification in detecting Plant Diseases. The outcome of the study Convolutional Neural Network 88.74% higher accuracy than K-Nearest Neighbors 84.52%.

Declarations

Conflict of Interests

No conflict of interest

Authors Contribution

Author VG was involved in data collection, data analysis, manuscript writing. Author AG was involved in the Action process, Data verification and validation, and Critical review of manuscript.

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Tables and Figures

Table 1. Accuracy Values of Image Plant Disease Detection using CNN and KNN. The efficiency of CNN algorithm (88.74) is more than KNN algorithm (84.52).

S.NO	CNN	KNN
1	92.80	85.00
2	86.50	78.60
3	89.00	91.50
4	90.50	83.50
5	93.50	86.40
6	84.60	90.00
7	88.20	79.50
8	85.50	81.50
9	93.00	87.20
10	83.80	82.00

Table 2. Group Statistics Results-CNN has an mean accuracy (88.74%), std.deviation (3.61), whereas KNN has mean accuracy (84.52%), std.deviation (4.30).

Group Statistics					
	Groups	**N**	**Mean**	**Standard deviation**	**Standard Error Mean**
Accuracy	CNN	10	88.74	3.61	1.144

	KNN	10	84.52	4.30	1.359

Table 3. Independent Sample T- test Result is done with confidence interval as 95% and level of significance as 0.499 (Convolution Neural Networks seems to be significantly better than K-Nearest Neighbors with these value of $p < 0.05$)

Accuracy	**Independent Sample Test**									
	Levene's Test for Equality of Variances						**T-test for Equality of Means**			
	F	**Sig**	**t**	**df**	**Significance**		**Mean Difference**	**Std.Error Difference**	**95% Confidence Interval of the Difference**	
					One-Sided p	**Two-Sided p**			**Lower**	**Upper**
Equal variances assumed	0.294	0.048	2.375	18	0.014	0.029	4.220	1.777	0.486	7.953
Equal variances not assumed			2.375	17.488	0.015	0.029	4.220	1.777	0.478	7.961

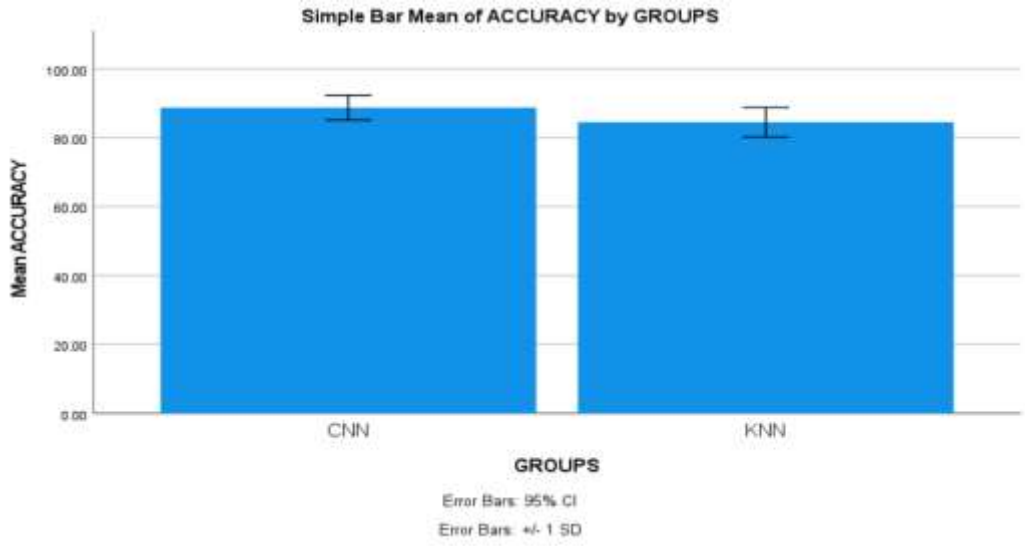

Fig. 1. Examination of CNN set of rules along with KNN set of rules in phrases of mean accuracy Std.Deviation of CNN (88.74%) is somewhat higher than KNN (84.52%). X Axis: CNN vs KNN.Y Axis: Mean accuracy of detection ± 1 SD.