International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 8 Issue 3, May-June 2024 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

An Efficient Adaptive Weighted Neural Network-based Leaves Disease Detection Model Using Improved Cheetah Optimizer

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ABSTRACT

Agriculture is the primary source of the economy and food in various regions. The influence of the plant productivity has a high impact on the nation's economy. The weather conditions and the climate changes result in the food crops agonizing from the latest disorders and creating them highly in danger to the pests. The identification of the plant disorder is significant as it has a high influence on the profits and productivity of the farmers. Early identification of the plant disorder can support the farmers in creating the essential activities to secure the productivity. Conventional mechanisms of plant disorder identification utilize the knowledge of the human for evaluating the plant disorder. But, the manual detection of the plant disorder is time-consuming and tiresome operation and needs the knowledge of the experts for better detection; hence the necessary remedy can be performed. Therefore, the machine learning-aided plant disorder approach requires to be enhanced for the correct estimation of the plant disorder. In this task, an efficient plant disease identification system is improved by applying a machine learning model. The images of the plants are collected from the benchmark data assets. The collected image is given to the watershed algorithm. Watershed is an advanced image segmentation technique utilized to segment the abnormality image. From the segmented image, the color and texture features are extracted. The segmented image from the watershed algorithm is now provided as input to the Adaptive Weighted Neural Network (AWNN). The parameters and the weights in the NN are optimized with the aid of a Modified Random Number of Cheetah Optimizer (MRNCO). The final detected plant disease is obtained from the AWNN architecture.

KEYWORDS: *Plant Disease Detection; Watershed Algorithm; Texture And Color Features; Modified Random Number Of Cheetah Optimizer; Adaptive Weighted Neural Network*

How to cite this paper: Amrita Arjun Kindalkar | Dr. Janapati Venkata Krishna "An Efficient Adaptive Weighted Neural Network-based Leaves Disease Detection Model Using Improved Cheetah Optimizer" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-8 | Issue-3, June 2024, pp.385-391, URL: www.ijtsrd.com/papers/ijtsrd64882.pdf

IJTSRD64882

1. INTRODUCTION

Agriculture is the primary job in India, and it drops 35% of the productivity of the crop once every year because of plant disorders. The population of the earth is enhancing gradually, and thus the need for crop products gets enhanced to a higher extent [6]. The crop production from the crop disorder provides an important role to satisfy the enhancing demand for food quality and quantity [7]. The security of food is in danger by the upsetting rise in disorders and pests quantity. These factors affected the ecological, social, and economic activities. The plant disorders create disease outbreaks frequently that lead the famine and death on a high scale [8]. Because of the divergent kinds of disorders, the production of crops is affected highly. However, it s not possible to check every land with the naked eye [9]. The automated estimation of the crop disorders is a crucial concept in the research sector because it can be beneficial in observing the critical agricultural lands and thus the immediate identification of diseases from its indications that seem high on the plant leaves.

The earlier detection of the plant is a tiresome operationdue to the insufficient understanding of the experts and theimproper facilities of the labs [13]. The automated detectionapproaches to plant disease are advantageous for minimizing the difficult technique of observing high crop regions and for detecting the symptoms of diseases earlier. The moderntechnologies in "deep learning and computer vision" haveillustrated the value of implementing the automatic detection approaches of plant disease according to the known indications on the leaves [14]. "Convolutional Neural Networks (CNN)" have provided high functionality in the classification of images and multiple other computer vision approaches. The detection of plant disease is a significant part of deep learning that has been explained by various modernmechanisms [15]. But, there is an urgent need for optimizingthese outcomes for "resource-constrained portable systems" such as smart phones. This is a complex issue due to deep learning approaches are resource extensive.

2. OBJECTIVE OF REVIEW PAPER

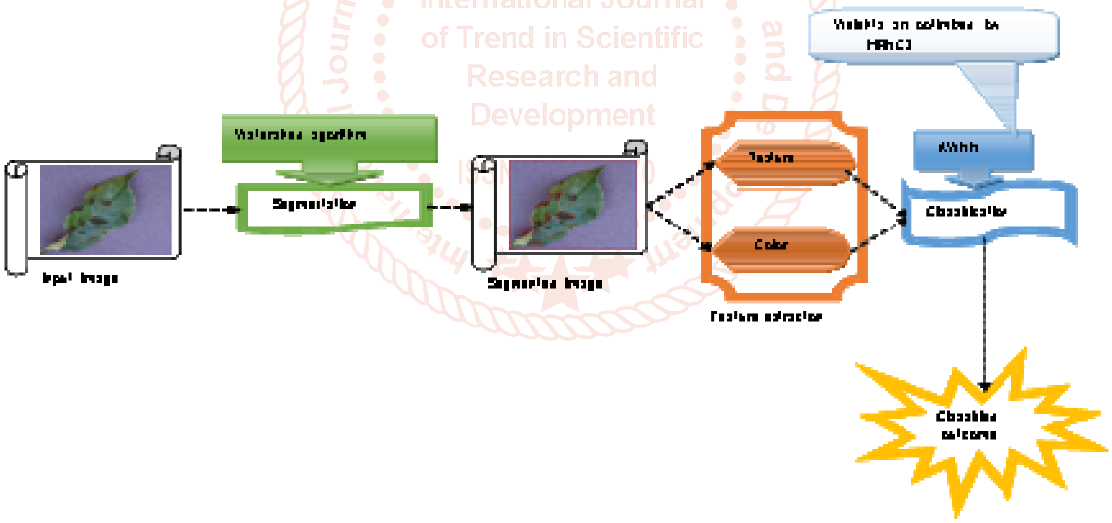
The primary objectives of the suggested plant disease detection approach are offered below.

- To design a plant disease detection mechanism that effectively identifies the diseases in the plants in the earlier stages and also improves the productivity.
- To segment the original images adopted the watershed algorithm that helps to segment the abnormal image. From this, the color and texture features are extracted.
- To classify the plant diseases utilized the AWNN framework where the weights presented in this network are optimized with the aid of designed MRNCO.

3. METHODOLOGY

There are five main steps for the detection of plant leaf diseases as shown in fig.1. The processing scheme consists of image acquisition that can be take through digital camera or web, image pre-processing includes watershed algorithm segmentation in order to find the affected , feature extraction and classification. Finally the presence of diseases on the plant leaf will be identified.

The images of leaf samples are picked from the database. The step-by-step is shown as below: 1) Input image; 2) watershed algorithm is applied; 3) Segment the leaves(component); 4) obtain feature extraction; 5) classified outcomes.



4. REVIEW OF LITERATURE/ RELATED WORKS:

In 2021, Ahmad *et al.* [1] have suggested an important approach to categorize symptoms of plant disorders utilizing CNN. Experts suggested a "stepwise transfer learning" mechanism that could support better convergence when minimizing the overfitting in the knowledge transfer. The approach was estimated and trained on two standard resources.The suggested task was dominated by the older mechanisms.

In 2023, Singh *et al.* [2] have deployed a CNN framework for categorizing and recognizing the similar disorders detected in the rice plants. The recommended work was estimated with the support of two optimization mechanisms utilizing some of the metrics. The research outcomes described that the system offered the highest accuracy.

In 2023, Datta and Gupta [3] have developed a CNN which included various hidden layers for the categorization of the diseases of tea leaves. The recommended approach demonstrated that the system was capable of correctly identifying the category of the affected tea leaf with better accuracy. Moreover, this approach was utilized in the smart applications and also employed to train distinct plant images to categorize the diseases.

In 2022, Kumar *et al.* [4] have presented a mechanism for categorizing and recognizing the disorders of the plant leaves utilizing an "Optimal Mobile Network-based CNN (OMNCNN)". This approach involved various operations to detect the affected sections of the image. The investigation of the system was adopted to highlight the functionality of the approach. The outcomes displayed the promising solutionsover other mechanisms.

In 2021, Sachdeva *et al.* [5] recommended an approach utilizing the "Bayesian learning" technique for the plant disease categorization. The evaluation was conducted for the comparison of the suggested approach with conventional classifiers. The suggested mechanism employed the features implemented by CNN highly in distinct mechanisms to utilize the "Bayesian" network and attained better accuracy.

B.In the modern days, the population of the world started toenhance quickly, but the appropriate cultivated land forcultivation remains similar. It urges the framers to establishinnovative mechanisms that enhance the plant yields to assist the enhancing population. So, maintaining plant health is very complex. Thus, early identification of disease in plants helps to improve the plant yield. Multiple research works have been developed. Table I shows the several features and complexitiesof the existing mechanisms. Mobilenet [1] is a very simple andefficient approach. It consumes very less power. However, it isquite expensive to compute. It cannot handle the large volume of data effectively. CNN [2] reduces the computationalrequirements. It can handle a high amount of datasets. But, it needs a high amount of information to learn. It is very time-consuming. DCNN [3] can generate highly accuratepredictions. It provides very accurate solutions. Yet, it is hardto understand that how the DCNN makes decisions. It has highcomputational complexities. MobileNet [4] has higher accuracy for classification. It utilizes only a small amount of parameters. However, it has underfitting issues. It is inefficientto train the NNs. DCNN [5] automatically extracts the essential features. It provides efficient solutions. But, it utilizes more time to understand the data. It does not work well in the small data resources. Therefore, a new mechanism has been developed for an effective plant disorder detection mechanism utilizing deep learning approaches.

Table I

Author [citation]	Methodology	Features	Challenges
Ahmad et al. [1]	Mobilenet	It is a very simple and efficient approach. It consumes very less power.	It is quite expensive to compute. It cannot handle the large volume of data effectively.
Singh et al. [2]	CNN	It reduces the computational requirements. It can handle a high amount of datasets.	It requires a high amount of information to train. It is very time-consuming.
Datta and Gupta [3]	DCNN	It can generate highly accurate predictions. It provides very accurate solutions.	It is hard to understand that how the DCNN makes decisions. It has high computational burdens.
Kumar et al. [4]	MobileNet	It has higher accuracy for classification. It utilizes only a small amount of parameters.	It has underfitting issues. It is inefficient to train the NNs.
Sachdeva et al. [5]	DCNN	It automatically extracts the essential features. It provides efficient solutions.	It takes more time to train the data. It does not work well in the small data resources.
Jaya Sil [27]	Zooming algorithm, SOM neural network	Two common dieasease are identified Segmentation, spot and boundary detection is identified	It take two method for input vector Four different types of testing for better classification.
Malik Braik [28]	K-Means clustering, Back propagation algorithm, CCM	Images of leaves are collected from Jordan's Al-Ghor area for testing	Accurate detection and classification with high accuracy

Abdul Hallis Bin Abdul Aziz [29]	Morphological processing, Color clustering, LABVIEW IMAQ Vision	Fourier transforming , Edge detection, morphological operations are used to extract features	Reduction of harmful chemicals
Navdeep Sharma [30]	CCM, K-Means clustering	histogram equalization method is used for grayscale acess	Textures and colour analysis are compared with the other images
Dr. M. G. Sumithra [31]	K-means clustering algorithm, Intensity mapping	Identifies bacteria on the leaves	Reduces manual cluster selection.
Prof. Ujwalla Gawande [32]	GLCM, SF-CES, SVMRBF & SVMPOLY classifier	Color space conversion and image enhancement	contrast, energy, homogeneity and entropy using gray co props function
Shah Rizam M.S.B [33]	Border segmentation, Pattern classification	involves histogram equalization, intensity adjustment and filtering for enhancing or modifying the image.	Thresholding in segmentation is used for start and stop point of line to trace edges.
Mona A. S. Alit[34]	SVM, Gabor wavelet transform	enhancement, smoothness; remove noise, image resizing, image isolation, background removing	SVM is employed using Invmult Kernel, Cauchy Kernel and Laplacian Kernel functions.
A. B. Patil [35]	Otsu thresholding, ANN, SVM, Back propagation network	Removes noise and other extra feature	color extraction using H & B and Color co-occurrence method
Vikrant Gulati[36]	CCM, Neural network	structure is created and color values in RGB are converted to the space.	Takes out masked cells inside the boundaries of infected cluster
Sahaya Anselin[37]	CCM, Back propagation algorithm	Conversion of leave image	Identifies weight and propogation using backpropogation
Shreekant Ghorpade [38]	RGB to HSI, K-means clustering, SGDM Matrix, GLCM	Conversion from rgb to hsv and then applies-means for space transformation	Features and texture stastics
Priyanka Pawar[39]	Linear SVM, Non Linear SVM and Multiclass SVM	Different quality resolution images are caputes	Identifies diease on sugarcane plant using different algorithm

5. RESEARCH GAP:

1. There is lack of the data set of small leaves which is hard to extract the features.
2. The primary focus of current models which uses watershed algorithm for segmentation and cheetah optimizers.
3. The parameter and weight of neural networks are extracted of leaves with different properties.

6. RESEARCH AGENDAS BASED ON RESEARCH GAP:

1. To create and organise broad, annotated datasets with a variety of leaves.
2. To carry out comprehensive research on the creation of algorithms that can handle the segmentation for feature extraction.
3. To improve the analysis of AWNN architecture by Modified Random Number of Cheetah Optimizer (MRNCO).

7. ANALYSIS OF RESEARCH AGENDAS:

1. The good annotated will greatly increase machine learning model training and accuracy for the good results.
2. Improving the algorithm will result in a more thorough and precise comprehension of disease content, which is necessary for farmer to do the analysis.
3. It make easy to find the accuracy, sensitivity etc of leave diseases.

8. CONCLUSION:

An review conclude by the effective plant disorder detection mechanism was developed with the aid of machine learning technologies. For this process, initially, the original images were assembled from the benchmark data assets. Further, the assembled image was provided for the watershed technique. The watershed technique was normally applied for the image segmentation task. So, the abnormality image was fed into the watershed algorithm and attained the segmented image. Subsequently, from the segmented images, the color and texture features are to be extracted and moved to the AWNN task.

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