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Enhanced Convolution Neural Network for Tomato Leaf Disease Classification

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Abstract: ***When plants and crops are affected by pests it affects the agricultural production of the country. Agricultural productivity depends heavily on the economy. This is one of the reasons why plant disease detection plays a major role in agriculture. Usually farmers or experts observe the plants with naked eye for detection and identification of disease. But this method can be time processing, expensive and inaccurate. Detection of crop disease using a few instantaneous strategy is helpful as it decreases comprehensive surveillance job in huge crop farms and locates disease side effects quite soon, i.e. if they tend on leaves and stems. Enhanced Convolutional neural networks (ECNN) have demonstrated great performance in object recognition and image classification problems. Using a public dataset images of infected and healthy Tomato leaves collected under controlled conditions, we trained a deep convolutional neural network to identify diseases in tomato. As the result, few diseases that usually occur in tomato plants such as Late blight, Gray spot and bacterial canker are detected.***

Keywords : ***Deep learning, Enhanced Convolutional Neural Network (ECNN), Leaf Prediction Tool (LPT), Tomato Leafs, Deep learning***

I. INTRODUCTION

Agriculture has emerging as much greater than sincerely a way to feed ever developing populations. However, plant illnesses are threatening the livelihood of this essential source. Plant sicknesses reason fundamental manufacturing and financial losses in agriculture and forestry. For instance, tomato (a fungal sickness in tomatoes leaf) has triggered a great financial loss and just through getting rid of 20% of the contamination, the farmers may advantage with an about 11 million-greenback earnings [1]. Therefore necessity of early detection and identity of plant sicknesses plays the utmost critical function to take timely measures.

There are numerous ways to discover plant pathologies. Some illnesses do not have any seen signs associated, or the ones appear best while it is too late to behave. In those cases, it's miles essential to perform state-of-the-art evaluation, normally via means of powerful microscopes [2]. In some cases, the signs can simplest be detected in parts of the electromagnetic spectrum that are not visible to humans.

This study specializes in detection and classification of tomato plant illnesses primarily based at the signs of the sicknesses that show symptoms on the leaves of the plant. In most instances, the diagnosis, or as a minimum a primary bet approximately the sickness is completed visually through humans. Trained specialists can be efficient in spotting the ailment. Unfortunately, maximum of the time there are not any specialists inside the vicinity to present a facts based totally analysis and suggest to the farmers. Therefore; searching out a quick, automatic, much less highly-priced and accurate technique to discover plant diseases is of extremely good importance

Learning based approaches such as K-means, Decision Trees, support vector machines and K nearest neighbours have been implemented in agricultural. Most of traditional based approaches are based on SURF, SIFT or some other training techniques by feature spaces. This leads to lacking the performance of prediction due to predefined features. The recent trends are deep learning techniques to implement for most of agricultural oriented research that learned efficient and effectively to indentify from large amount of images with minimal errors.

Deep Learning techniques in agriculture has been implemented inside the regions of sorting, detection of defects inclusive of dark spots, grading of fresh merchandise etc. Recent advancement in hardware generation have allowed the evolution of deep Convolution Neural Networks (CNN) and their wide variety of programs, together with complicated responsibilities inclusive of object identification, recognition and classification of image by intelligent smart phone application for shape and disease identity in plant leaves have been advanced. In this situation, this research is entered on amassing the information of illnesses in tomato plant life and educates a model for illnesses detection. This paper has feasibility of E-CNN to categorise the plant sicknesses from images of leaf taken under unrestrained of surroundings has been studied. Methods are implemented based at the LeNet architecture.

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The evaluation dataset has taken from various districts from tamilnadu such as Salem, Erode and Coimbatore.

Since CNN techniques has required large amount of data to categorize because of augmentation to increase trained data. The major advantages of the paper has outlined here:

a. This paper provides the novel Enchanced LeNet architecture for identification of leaf disease.
b. This paper has provides the novel approach of detection of tomato pant leaf disease to prevent the loss of financial for farmers.
c. The techniques have proved the efficient performance for accuracy of detection of disease.

This paper has organized in the structure of section2 has discussed about existing work in the similar area. In section 3 describes the proposed methodology and section 4 presents the results and experimental setup. Conclusion and future work has discussed in section5.

II. RELATED WORK

This section provides the related works of machine learning algorithms that supports in agriculture and how it helps to predicts the disease accurately and recent techniques an summarization of the work.

V .Singh, A.K. Misra (2017) [11] Provides a survey of separate infection class methods used during the identification of crop tomato infections as well as a set of standards for image segmentation methods which could be used for instant identification but also for the type of crop leaf illness later on. Banana, beans, jackfruit, lemon, mango, potatoes, tomatoes, and sapota are among the ten organisms upon which suggested set of standards is being examined. Based on less computational efforts also shows the performance of proposed algorithm is inaccurate to obtain the results.

Jayme Garcia *et al* (2016) [12] introduces a new digital photo-based totally algorithm for computerized plant sickness identity. The algorithm was designed to address numerous illnesses, and to be effortlessly retrained as new illnesses are covered. Its histogram-primarily based shape makes it moderately robust to the condition beneath which the pictures have been captured.

Roselia C. Morco *et al* (2017) [13] has presented the structure, design, and improvement of an professional gadget for the analysis of sicknesses within the rice flora. The advanced cellular application gadget presents facts on a way to determine the feasible reasons of illnesses together with micro organism, fungi or virus. It additionally provides information regarding the rice plants which can be affected by malnutrition primarily based on the symptoms. Moreover, the utility also can prescribe the perfect viable answers to sicknesses and problems consisting of herbal or chemical answers. Such software is useful for farmers who need assist to manipulate the issues of their rice plant. Based on the end result of the assessment, the respondents show a good reaction to the utility concerning its functionality.

Youwen Tian,Lide Wang,Qiuying Zhou (2012) [14] gives grading precision which has been converted into considerably sophisticated with both the assistance in the use of plant leaf infection type image analysis automation, decreases time and prices by implies of a manual assessment, and provides right information for the research of many other crop components. The physical requirements of a computer with the help of this system are quite low. The system of plant disease classification can be applied productively; this can induce defects and deficiencies by way of artificial classification, improving classification grading and efficiency.

Peifeng Xu *et al* (2017) [15] Proposed a DCNN)-primarily based method for automated detection of yellow rust in iciness wheat fields from UAV hyperspectral photos.

Sharada Prasanna Mohanty *et al* (2016) [16] presents a overall advantage and disadvantages of the machine learning algorithm. The traditional methods drawbacks are clearly explained and how it will further improvements in the deep learning techniques.

Table.1. Summarization of Related Work

Ref .No.	Techniques	Merits	Demerits
11	Image segmentation and soft computing techniques	Automatic technique is used for detecting	Detects the symptoms of little leaf diseases
12	Colour histograms	Created database for Identifying multiple plant diseases	Deficiency in accuracy
13	Agile Software technology	To detect rice crop disease by control option.	Immediate Communication to farmers
14	VMF techniques for pre-processing then statistical pattern recognition	Grading method for classify the plant disease based on image processing.	Accuracy and prediction time.
15	Image Embedded Processing	Automatic diagnosis for differentiate wheat diseases	Accuracy of 96.2% for image recognition.
16	Deep CNN	Trained model for classifying both crop species to recognize the disease	Image-Based Plant Disease Detection

III. PROPOSED METHODOLOGY

In our work, we provide a new tomato leaf disease classification method based on Enhanced LeNet (ELNet). A general of 2850 tomato leaf photographs are used from the Plant Village dataset [12] for testing the classification accuracy.

In the First Layer, We use LDA for preprocessing the images to select the feature for training the network. Remaining, datasets are partitioned into testing and training out subsets. The schooling subset is used to train the LeNet. The checking out subset is then used to evaluate the performance of the found out model.

A. ELNet Proposed Methodology

Convolutionary neural networks (CNNs) are basically special types of multilayer neural networks, developed to perceive visual patterns straight from pictures (pixels) with minimal pre-processing. LeNet comprises of cells with training weights and biases. . neuron takes multiple inputs, takes on a weighted number, transfers across an activation function which reacts with a CN output. Every receptor recognizes multiple inputs, requires over a weighted sum, moves it through an activation function, and needs to respond with output CNNs are inhibited from multilayer perceptrons, and retain a spatially close correlation between such a local sample between synapses of adjacent layers. In certain terms, the inputs of hidden neurons in layer N derive from a group of neurons within layer N-1.

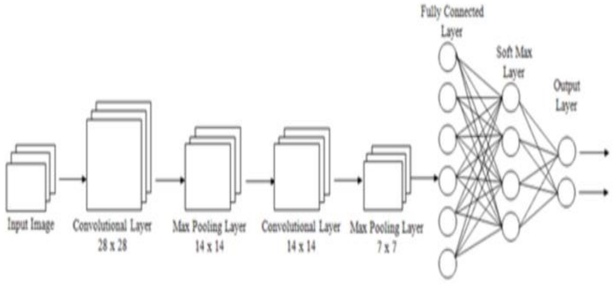

Fig.1. Proposed Architecture

In Fig.2. shows the convolutional operation. The convolutional operation filter the size of a input by 7 9 7. Moreover, the output features are mapped to linear filter and associated with bias and implement a non-linear function.

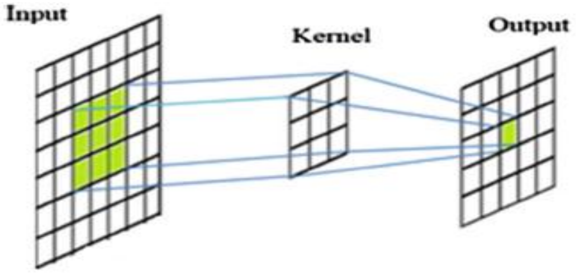

Fig.2. Convolutional Operation

IV. RESULTS AND DISCUSSION

In the ECNN proposed model is implemented in to tomato illness problem. The Plant Village dataset is used for our experimentation for evaluating the performance of proposed model. The dataset has categorized into six different classes. In that, tomato healthy leaf images has one classes remaining three classes are tomato leaf common disease. The details of the dataset are mentioned in Table.2. In Fig.4.shows the sample images of the tomato leaf disease. The size of the pixel of sample images is 256*256.

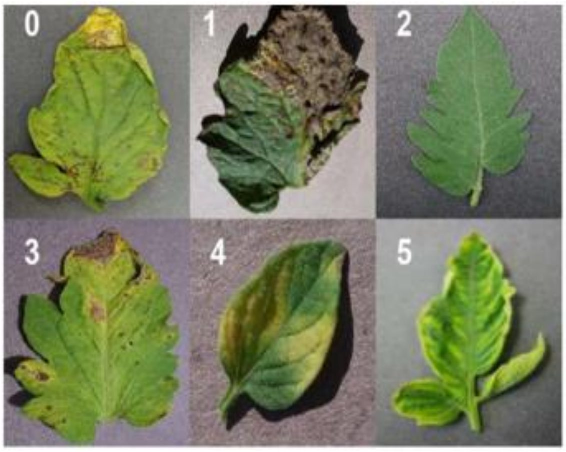

Table.2.Details of Tomato dataset from PlantVillage

Class	Dataset
Late_blight	500
septoria_leaf_spot	1120
spider_mites_two_spot	800
Leaf_Mold	1100

Table.3.Classification Accuracy

Test-Training Ratio (%)	Class Label	Accuracy	Average Accuracy(%)
80-20	Late_blight	99.28	90.20
	septoria_leaf_spot	89.10	
	spider_mites_two_spot	65.88	
	Healthy	99.20	
75-25	Late_blight	96.34	84.75
	septoria_leaf_spot	86.68	
	spider_mites_two_spot	60.30	
	Healthy	95.45	
50-50	Late_blight	80.34	74.695
	septoria_leaf_spot	75.68	
	spider_mites_two_spot	57.30	
	Healthy	85.45	

In Table.4. shows the classification accuracy in different ranges of test and training datasets.

V. CONCLUSION

The proposed DCNN based Enhanced LeNet for classification of tomato leaf disease is proposed in this paper. The proposed methodology has proved to classify the various diseases of tomato leafs by using the global and local features. Moreover, the performance of proposed methodology has estimated by various parameters like depth and kernel size. In Future work, the proposed techniques will implemented in another plant disease for determine the performance of accuracy.

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