Bell Pepper Leaf Disease Classification Using CNN

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***Abstract*— In classifying various plant diseases, Great success has been achieved through deep learning with convolutional neural networks (CNNs). This paper offers an overview analysis of current plant-based disease detection systems. In this analysis, using a CNN, equipped with a bell pepper plant image dataset, a variety of simulation approaches for neurons and layers were used. Plant diseases cause significant growth and economic losses, as well as a reduction in the quality and quantity of agricultural products. In monitoring large crop fields, the detection of plant diseases in a day has received increasing attention. Good plant health and disease identification data through effective management strategies may promote disease control. This approach would increase the production of crops. Bugs known as aphids spread viruses. That's why control of insects is so important to control pepper plant problems. Pepper-related diseases will devastate your entire garden like a virus or wilt. When you find issues with the pepper crop, the best thing to do is destroy the infected plant before it infects the entire garden. As it is understood Once trained on larger datasets, convolutional networks may learn features, there is no need to worry about image quality.**

Keywords- bell-pepper; Convolutional Neural Network; plant disease.

I. INTRODUCTION

Recent studies suggest that there are currently 220,000 to 420,000 species of flowering plants on Earth. Although many animals are endangered due to pollution and natural disasters, many species are still waiting to be discovered. Precise project recognition to support research on biodiversity conservation and environmental monitoring Automated plant identification in multiple fields can now replace manual sorting with subject matter experts from catalogs of large plant species and therefore deliver many advantages including cost and time savings, but also more precise identification [9]. Plant carries important information for developing countries that are largely dependent on their economy's agriculture. Successful crop cultivation depends on the identification of seeds, leaves, stems and the detection of pests or diseases, the percentage of the occurrence of pests or diseases, the symptoms of pest attacks or diseases. Plant diseases have become an issue as it can lead to a substantial reduction in both the quality and quantity of agricultural products as well as an increase in total cost of damage. The proposed approach aims to develop an automatic system by evaluating GA quality with PNN for vision-based disease detection and classification system for certain diseases of the tomato leaf [6]. Due to many types of diseases, cultures are now disturbed. Insecticides are not always known to be effective as insecticides can be harmful to some species of birds. Indian farming had a large variety of fruits and vegetables to choose an appropriate seasonal crop. It will be strengthened with technical support and advice assistance. The proposed method aims to build an Artificial Neural Network-based plant leaf disease detection system [2].

II. LITERATURE SURVEY

The following table presents some of previous work on plant leaf disease detection:

S. No	Reference	Publication & Year	Contribution	Techniques used	Results
1	Shivkumar Bagde et al.[2]	IJCSMC 2015	The main goal of the research work is to increase the efficiency of the disease detection technique.	K-means clustering, SGDM Matrix Generation, Texture Statistics Computation, Color Co-occurrence Method, Otsu method, Artificial neural networks.	An algorithm to detect whether a plant is healthy or unhealthy using the images of plant leaves and machine learning algorithms.
2	Aydin Kaya et al.[9]	ELSEVIER 2019	This paper proposes a method of classification of plant species using automated plant identification systems.	End-to-end CNN, cross-dataset fine tuning, Deep Learning features	This method got average classification accuracy up to 95% on datasets Flavia Swedish Leaf UCI Leaves Plant village
3	Md. Nazrul Islam et al.[6]	ICECTE 2012	Develop a computer vision-based recognition system automated disease detection and classification approach for plant leaf by analyzing the quality of GA and PNN.	Genetic Algorithm (GA) and Probabilistic Neural Network (PNN).	According to the model Genetiec Algoriithm achieved the highest overall classification performance, achieving an overall accuracy of 97 percent compared to PNN's 94.75 percent accuracy.
4	Amandeep Singh et al.[13]	IEEE 2018	This paper proposes a method for the prediction of a paddy crop by using image processing technology, which is simple and robust..	Histogram estimation and analysis.	We got 100% accuracy.
5	Alexander Johannes et al.[7]	ELSEVIER 2018	This paper proposes an algorithm for diagnosing plant disease using mobile devices for recording,	Image preprocessing,	Results of classification on the K-fold evaluation dataset. Rust, 0.85, 0.82, 0.7, 0.95 (Septoria, 0.90, 0.85, 0.91, 0.79) (Tan place, 0.89, 0.73, 0.69, 0.78). Where (Disease AuC Accuracy Sensitivity Specificity)
6	Siddhartha Singh Chauhan et al.[3]	IEEE 2018	This paper proposes a method of automatically using some artificial intelligence approach to recognise and classify plant leaf diseases..	Bacteria foraging algorithm, radial basis function neural network.	Average specificity of K-Means is 0.7914 Average specificity of Genetic-Algorithm is 0.8139 Average specificity of BRBFNN is 0.8558

7	Artzai Picon et al.[11]	IEEE 2018	This paper proposed an adapted Deep Residual Neural Network algorithm to detect multiple plant diseases under real conditions of acquisition.	Residual Neural Network	The algorithm results for an image of the leaf of a plant affected with Septoria shows the results Sensitivity– 0.94 Specification – 0.96 BAC – 0.96
8	Srdjan Sladojevic et al.[14]	Hindawi 2016	This paper proposes a method to recognize plant diseases using leaf image classification with Deep Neural Networks	Neural Network Training, Fine-Tuning	An accuracy of 96% was achieved after fine tuning.
9	Chia-Lin Chung et al.[4]	ELSEVIER 2016	This paper proposed a method to create a model which detects whether the crop is healthy or not (i.e. Bakanae disease) using machine vision and by image processing and machine learning techniques	Support vector machine (SVM) classifiers	This method shows very high accuracy in detecting the disease.
10	P. Revathi et al.[12]	IJCSIT 2018	Works in the world of agriculture on the importance of data mining techniques.	ABC algorithm, Machine Learning Techniques, SVM	Highlights the significance of machine learning in plant disease detection

III. PROPOSED WORK

CNN has been used in this paper to detect bacterial spot in bell pepper leaves. (CNNs) is one of the major categories of image recognition, image classification, in neural networks. Detection of objects, identification, etc. are some of the fields in which CNNs are commonly used. The identification of objects by CNN takes, processes and classifies an input image into some categories

Convolution Layer:

Convolution is the first layer to eliminate features from an input image. Through using tiny squares of input data to learn image features, Convolution preserves the relationship between pixels. Then the image matrix conversion multiplies with the filter matrix called "Feature Map".

Figure 1(a). Infected bell pepper leave

Figure 1(b). Healthy bell pepper leave

Strides:

Stride is the number of pixels that pass across the matrix of the results. If the step is 1 the filters are moved to 1 pixel at a time. We switch the filters at once and so on to 2 pixels when the phase is 2.

Padding:

Sometimes the filter does not fit perfectly with the input image. We have two options: zero-padding the image to fit Delete the part of the image where the filter did not fit. This is called true padding, comprising only part of the real image.

Non Linearity (ReLU):

ReLU stands for a non-linear operation as a rectified linear unit.

$$f(x) = max(0, x).$$

ReLU's aim is to incorporate non-linearity in our ConvNet. Other non-linear functions, such as tanh or sigmoid, can also be used instead of ReLU.

Pooling Layer:

If the images are too large, section pooling layers would reduce the number of parameters. Spatial pooling, also known as subsampling or down sampling, reduces each map's dimensionality but retains important information.

Spatial pooling can take various forms:

- Max Pooling
- Average Pooling
- Sum Pooling.

Max pooling from the corrected feature map takes the largest element. It could also take the largest element from the average pooling. Definition of all elements in the function map called full pooling.

Fully Connected Layer:
We flattened our matrix into a vector and fed it like a neural network into a fully connected layer.

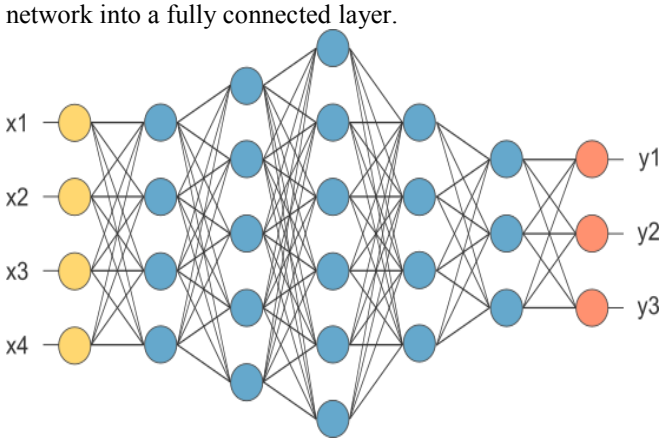


Figure 2. Convolutional Neural Network

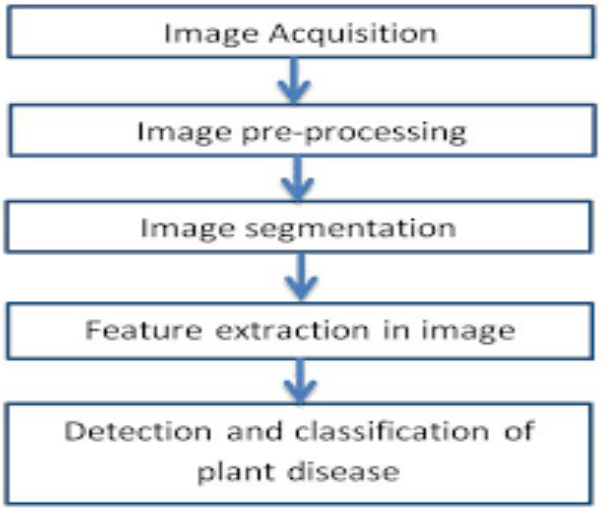


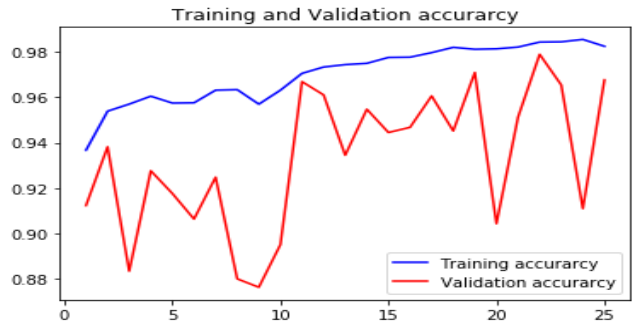
Figure 3. Proposed Work

IV. RESULT

Keras and tensor flow library were Used to analyze the image. A number of hundred leaves have been used for testing in this work. In a good light-up environment, the images are taken. The algorithm uses neural networks to classify two types of leaves whether it is heathy or infected. The disease occurs throughout the world where pepper and tomato are grown in dry, moist areas. Most of the disease are found in leaves so if we will successfully classify the healthy and infected leaves it will increase our crop production. The table below shows the results after the experiment. We got test accuracy: 96.78%. We have collected bell pepper images from the garden and tested it whether our algorithm successfully classifying it correctly or not. Twenty leaves were given for screening, and the process properly identified the diseased leaves and healthy leaves.

Table 1. disease identification results

SL NO	LEAF NAME	RESULT
1	Sample_1	Unhealthy
2	Sample_2	Unhealthy
3	Sample_3	Unhealthy
4	Sample_4	Unhealthy
5	Sample_5	Unhealthy
6	Sample_6	Unhealthy
7	Sample_7	Healthy
8	Sample_8	Healthy
9	Sample_9	Unhealthy
10	Sample_10	Unhealthy
11	Sample_11	Unhealthy
12	Sample_12	Healthy
13	Sample_13	Healthy
14	Sample_14	Unhealthy
15	Sample_15	Healthy
16	Sample_16	Unhealthy
17	Sample_17	Healthy
18	Sample_18	Healthy
19	Sample_19	Healthy
20	Sample_20	Unhealthy



V. CONCLUSION

There are many methods in the identification and classification system of automatic or computer vision plant disease, but there is still a shortage of this research field. Therefore, there are still no commercial approaches in the market, except for those concerned with identification of plant species based on the photographs of the leaves. This paper suggests an image recognition algorithm which is based on neural network to identify and recognize the disease. The leaves of the bell pepper plant are taken as a group of leaves to identify disease. The algorithm produces better results and it is possible to distinguish healthy and unhealthy plants with this algorithm. That's why control of insects is so important to control pepper plant problems. Pepper-related diseases will devastate your entire garden like a virus or wilt. When you find issues with the pepper crop, the best thing to do is destroy the infected plant before it infects the entire garden. We can build a IOT embedded application which will easily identify infected and healthy plants leaves which will use CNN to successfully identify them.

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