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Early Detection of Plant Leaf Disease Using Deep Learning

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ABSTRACT

As crop diseases spread, farmers need to prevent and control their contamination to increase productivity and yield. In addition to affecting plants, plant diseases affect market access and agricultural production. As one of the most important vegetable plants in the world, leaf images can be used to classify diseases early. In addition to Yellow Curved, Late Blight, and Leaf Spot, Bacterial leaf Spot, there are other diseases of plants. The dataset is taken from the Internet. In this paper, we take leaf images with various leaf diseases and train it with the best model Convolutional Neural Network (CNN). We then use the weights from CNN to test new leaf images. By using convolutional neural networks (CNNs) and deep learning techniques, we have proposed a system that classifies plant leaf diseases. With the hybrid approach, the model will demonstrate its accuracy. To identify the best model, performance analysis is done with accuracy and finds solution to the problem.

Keywords : Plant Leaf Disease, Deep Learning, CNN Algorithm, Image processing, Neural Network, Agriculture

I. INTRODUCTION

Agriculture is the root of all human civilizations. The focus is on improving productivity without taking into consideration the environmental effects that have appeared in the deterioration of the environment. Diseases can have a big impact on the quality and quantity of plants in agricultural development. Diseases of plants can include fungi, bacteria, viruses, moulds, etc. Farmers or specialists typically identify plants with naked eyes, and then diagnose them with disease. This approach can be time-consuming, expensive, and inaccurate, therefore, detection and classification of plants diseases using deep learning technique presents quickly and accurately. Photographs of symptoms of plant infection are used for detection of plant disease and for study, teaching, and analysis. This is a machine learning technique that uses image processing and deep learning to get a quick and accurate diagnosis of plant diseases. Studies have shown that these techniques are effective at classifying plant diseases. The primary impels have been made to provide greater dependability, correctness, and accuracy when detecting and classifying plant illness. An automated system that can help diagnose plant diseases by the

presence and visible signs of the plant could be of great help to learners in the growing process. The researchers used visualization techniques to extract disease information from CNN data. There are many researchers doing image processing and computer vision every year. We propose a system that can identify and classify diseases using a machine learning technique. Our work in deep learning, using CNN technology, has resulted in great success. The data set that was taken from a global data set which is (Plant Village) includes several plants.

II. RELATED WORK

This section describes how deep learning can be used to detect illness in plant leaves. Prajwala TM, et al, designed a system to detect and classify diseases in tomato leaf, by implements, a slight difference of the CNN design named Le Net. This research is trying to find a way to detect tomato leaves disease using the easiest method possible while using minimum computational resources. Neural network systems use an automated extraction of features to help distinguish the input image into several classes of illness, such as cancer, infectious diseases, and other diseases. This system has achieved an overall accuracy of 94-95 %, showing even under unfavorable conditions the viability of the neural network approach. Atabay is proposing a work that will require deep residual learning strategies. CNN classifies tomato plant leaves according to how disease-affected they are. There are other ways to train a CNN from scratch, such as using the deep residual learning strategy. CNN is proposed to be used to analyse pictures of tomatoes in a Plant Village dataset. The proposed design outperforms pre-trained models on the Image Net dataset by both exactness and the time required for re-training. In these two previous works, there is a lack of research. The tomato plant is easy to detect diseases in because it only has one plant. Unlike our work, there are three types of plants. There will only be a detection for diseases and not for plant types. The presentation suggests that there are certain factors that must be considered when judging an image, and that accurate judgment can be achieved with scientific methods. The unhealthy leaf in the image is caught. HSV features are based on the colour segmentation. Artificial Neural Networks (ANN) are more accurate than other methods when identifying sick and healthy samples. This work is accurate to 80%. This accuracy, using the neural network, is low and contains some detection errors for plant diseases. This research found that Kawasaki students are more likely to take on more challenging projects than their classmates. The CNNs method of distinguishing healthy cucumbers from diseased cucumbers is by utilizing photos of leaves. CNN was able to diagnose two dangerous viruses in this survey: MYSV (melon yellow spot virus) and ZYMV (zucchini yellow mosaic virus). They used a data set that includes images of leaves from cucumbers (200 with ZYMV, 300 with MYSV, or 300 with healthy leaves). The data set was enlarged using a rotational transformation on images. CNN uses a 96-member multivariate classifier to do its multi-classification. Three convolutional layers, a pooling layer, and a regularization layer. This system operates using a rectified Linear Unit activation method. This analysis has a precision of 94.9%.

III. PROPOSED SYSTEM

This part of the article discusses a computer vision system that can identify plant diseases. The procedure is shown step by step of the purpose system. fig1. shows the main structure of the proposed system.

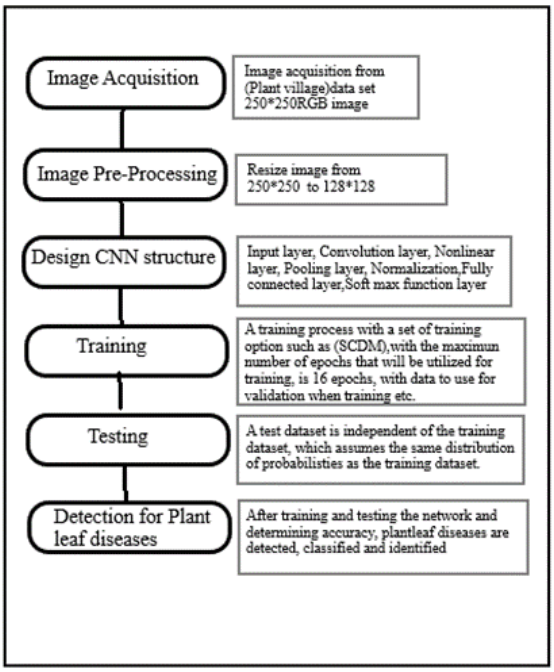


Figure 1: General Diagram for Plant Leaf Diseases Detection and Classification System

There is a lot of potential for growth in this figure 1, which shows the construction of our proposed system for detection and classification of plant leaf diseases, the first stage in it is the stage of image acquisition.

3.1. Image Acquisition (Dataset)

The plant leaves disease pictures from the Plant Village treasury show the plants with symptoms of disease. The dataset includes images of all diseases that could influence the three types of plants in the dataset - tomato, pepper, and potato. All the images downloaded have a default RGB colour space. They have been saved as uncompressed JPEGs.

3.2. Image Pre-Processing

To speed up the training process and obtain more accurate model testing calculations, the pictures in the dataset are resized to 128 x128 resolutions. Optimizing the input or aim variables can help to speed up the train processing. We will keep the data in the image safe from any loss.

3.3. CNN Structure Design

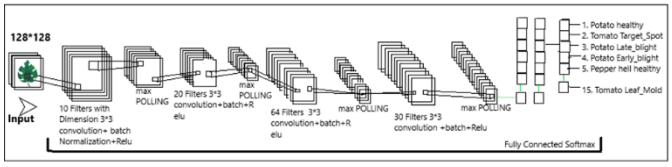
CNN is a popular approach for deep learning in which multiple layers are successfully trained. The image recognition technology is highly effective and is widely used in various applications of computer vision. CNN can be used to classify images into specific categories. In our algorithm, a structure has been built to make it more efficient. This structure is made up of several interconnected layers. CNN was built using a specific architecture that allowed us to create a realistic and efficient network.

3.3.1. Input Layer

The input layer contains the input images, together with their pixel values.

3.3.2. Convolutional Layer

CNN uses a different kernel for converting the object and for creating different feature maps. In our research, we have used 4 convolutional layers, in the first layer, we used 10 filters that have a height and width of 3 with padding character arrays 'same'. The padding applied to the input to make it look more professional or like it was made for a different type of device. Padding is set to ensure that the output size is the same as the input size. In the second convolutional layer, the input is split into a train and a test signal. The train is used to encode the features of the test signal, while the test signal is used to decode the features of the train. Used 20 filters that have a height and width of 3 which has padding character arrays-'same'. In third layer, there is 64 filters that have a height and width of 3 with a padding of character array-'same' and in fourth convolutional layer, 30 filters are used that have a height and width of 3 with padding character array-'same' as shown in Figure 2.



3.3.3. Pooling Layer

Pooling layers often follow convolutional layers and can be used to reduce the feature maps and parameters of the network. Similar to convolutional layers, pooling layers are interpretatively invariant because neighbouring pixels are considered in their computations. The most common approaches are average pooling and max pooling. In our research we used a max pooling layer.

3.3.4. Non-Linear Layer

A non-linear transformation is implemented to the enter with the aid of using the CNN, the item of that's to classify the functions inside consistent with hidden layer. In CNN shape we use Rectified linear devices. Rectified

linear devices are normally used as nonlinear transformation. This type of layer executes a easy operation with a threshold wherein any enter price smaller than 0 is ready to 0.

3.3.5. Fully Connected Layer

The facts arrive on the ultimate layer of the CNN, which is the completely linked node, later a great deal generation of the previous layers. In the neighbouring layers, the neurons are linked without delay to the neurons in the completely linked community as proven in Figure 2.

3.3.6. Normalize Layer

In our proposed gadget we use a batch normalize layer. Batch normalization layer shape normalizes any channel with the help a mini-batch. This can assist to lower sensitivity to data variations.

3.3.7. Soft Max Layer

The network's performance may be hard to interpret. It is regular to complete the CNN with a tender max feature in category issues. After extracting values of 15 classes of plant sicknesses within side the absolutely linked step, a soft max could be made for them, so that the magnificence could be decided on in every technique and consistent with the capabilities that have been extracted via the preceding layers that the snap shots of plant sicknesses went via it. In this layer, the right magnificence of disorder is decided via way of means of applying the Soft max feature.

4. Training

Training a network is a method of acquiring kernels in convolution layers and weights in fully linked layers that lessen variations on a training dataset among output predictions and detailed fact labels. In our work, we used 70% of the facts for training, via this stage in order that the network that has been constructed learns by extracting functions from plant leaf disorder photos in an effort to analyse from these functions for every picture to be prominent on its basis.

5. Testing

The testing is a dataset applied to offer an unbiased very last layout suit assessment at the training set of data. In this stage, we use the group that had been skilled with inside the previous step that trained in CNN, and the functions had been extracted with the aid of using studying the network when the data set passes from plant leaf sicknesses in this network, we used 70% of the data for testing.

6. Theory and Calculation

The previous operations, plant species illnesses are detected and categorised in accordance to 3 sorts of plants, specifically tomatoes, peppers, and potatoes. All results, detection and class can be supplied with inside the subsequent section.

6.1. Mathematical Expressions and Symbols

$$Accuracy = \frac{a+d}{a+b+c+d}$$

$$Accuracy = \frac{number\ \ of\ correctly\ classified\ images}{total\ number\ of\ images} \times 100$$

6.2. Preparation of Figures and Tables

TABLE I. CONFUSION MATRIX

Predicated			
Positive	**Negative**		
a	b	**Positive**	**Actual**
c	d	**Negative**	

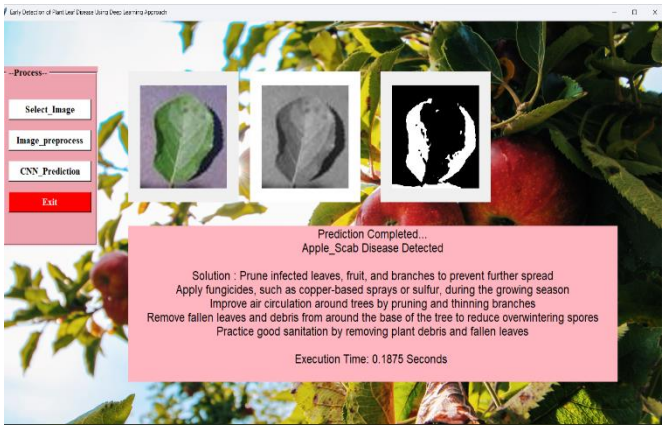


Figure 3: CNN Prediction and Classification

IV. RESULTS AND DISCUSSION

The experiments are done on MATLAB R2018b; RAM 4 GB and processor core (TM) i5_4300U CPU. We educate the community and keep the trained network in order that the training technique isn't repeated and so the time taken for training is provided, and then the network is likewise tested by testing data and displaying the accuracy. In the ultimate stage, via which the illnesses of plant leaves are detected and classified, a random choice is made for any image, right here we've selected an instance of the potato plant paper after loading it to the system and deciding on the network that became trained and press the Detection button, the sickness and the kind of the affected plant will be found out as with inside the that illustrates the detection and type technique using the CNN set of rules for Late blight sickness, to the potato plant leaf. The technique of calculating the accuracy became done to be displayed later with inside the confusion matrix consistent with TABLE I and similar to "(1)" and "(2)" via which the accuracy is calculated for every class and additionally the entire accuracy is calculated for all classes.

V. CONCLUSION

Given the significance of agriculture and plants with inside the entire global and in our country, India, and due to many plant illnesses, that exist today, this studies proposed a robust methodology to locate and classify those illnesses with correct and fast results based on laptop facilities and Deep Learning Techniques. We conducted this work to achieve the results through the use of CNN algorithm. We acquired excessive results, and this brought about very accurate and speedy detection of the sort of sickness and additionally the sort of plant that contains this sickness via the leaf of that plant. Fifteen one-of-a-kind classes are categorized as plant illnesses encompass one-of-a-kind plants, internationally famous, and important in our country, India, are tomatoes, potatoes, and peppers. Various learning quotes and optimizers may want to too be implemented as part of destiny work to test with the proposed system. Also, we aspire to increase a big

variety of various kinds of plants with different types. Use multiple techniques and create an professional system that detects and classifies plant leaf illnesses.

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