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Improved plant leaf disease classification by optimizing weight with convolution neural network learning approach

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ABSTRACT

Agricultural productivity is something on which the economy highly depends. This is one of the reasons that disease detection in plants plays a vital role in the agriculture field, as having disease in plants is quite natural. If proper care is not taken in this area, then it causes severe effects on plants and due to which respective product quality, quantity, or productivity is affected. In synopsis proposed approach optimized segmentation to find active area for features and reduce noise, then extract texture base features and learning by ensemble classifier approach. In Proposed framework main emphasis on getting sufficient features from disease and learning combination of Convolution and nonlinear classification function.

Keywords: Image Processing, Image Segmentation, K-Mean Clustering, Feature Extraction, CNN

1. INTRODUCTION

The Indian economy wants agricultural production urgently. The discovery of diseases in plants plays an important role in the agriculture sector. Automated detection techniques are helpful to identify a plant disease at the start. For starters, a disease known as a small leaf disease is an unstable disease found in US pine trees. Usually, the infected tree grows hard and dies before or at the age of 6 years. In Georgia, Alabama, the southernmost areas of the United States[1] the influence of this disease is generally seen. Under such cases, early recognition may have been positive. The latter approach to recognise plant diseases is a naked-eye interpretation by experts to complete the diagnosis and recognition of plant-based diseases[2]. This entails a huge number of experts, who are similarly consistent with the observation of a plant that costs a lot with respect to large farms. Around the same time, farmers in some countries do not have sufficient facilities or cannot reach the experts, so consultants cost a lot. The proposed approach is useful for monitoring large harvest areas under these conditions. It is almost as expensive by automatic detection of the disease by actually watching the signals on the plant leaves. This also enhances machine-based vision to scan, direct and track images[3] automatically.

Identifying plant disease in a visual way is a process that is increasingly challenging, at the same time less precise and achievable only in restricted regions. Although an automatic detection system is used, it typically takes less time, effort and becomes increasingly reliable. Any major distresses in plants are yellow and brown spots, late and early oceans, while others are microbial, bacterial and fungal diseases. Image analysis is used to measure the area of infection affected and to assess the difference in the shade of an influenced area [4]. Picture segmentation is a method of isolating an image in several sections. These provide a wide variety of systems for image division, ranging from a basic Thresholding approach to cutting-edge image division techniques. These sections usually equate to what humans would see and separate clearly as separate objects. PCs may not have methods for perceiving objects intelligently; hence a wide variety of techniques for fragmenting images have been developed. The segmentation protocol normally depends on the various features in the image. This could be colour details, a section in the borders of a picture [5].

A. Image Pre-processing

The pre-processing of the image is to expel noise from the expulsion of an image or another object through different pre-processing processes. Using image-based scaling in this process. The image scaling is used to change into thumbnails over the original image since the pixel scale of the actual image is huge and time is required for the general process. Now that the image is changed to thumbnails, the pixel size reduces and it takes less time. [9].

Fig. 1: Image pre-processing: (a) Cropping (b) Smoothing (c) Identification[8]

B. Image Segmentation

Image segmentation [10] in a decision-oriented application is considered as the most utilized strategies to characterize the image pixels precisely. It partitions an image into the various discrete type of regions with the end goal that the pixels possess high resemblance in every area and high complexity among various regions. It is a significant apparatus (tool) in numerous fields including social insurance, picture preparing, traffic picture, design acknowledgment image processing, health care, pattern recognition, traffic image, and so on [11]. The process of image segmentation involves various methods such as edge-based, threshold-based, neural network-based, and cluster-based. From various strategies, one of the most proficient techniques is the clustering strategy. Once more, there are various kinds of clustering techniques: Fuzzy C-means clustering, K-means clustering, subtractive clustering technique, and mountain clustering technique. K-means clustering presents one of the most utilized algorithms of clustering. It is straightforward and computationally quicker than the hierarchical type of clustering. Moreover, it can work for a huge number of factors or variables. Though, it produces a distinctive cluster outcome for various numbers of quantities of the cluster group. Thus, it is essential to initialize the best possible number of quantities of clusters (K2). Yet again, it is essential to initialize (reset) the 'k' number of centroids. Diverse estimated values of the centroid (in its initial phase) would result in distinctive clusters. Along these lines, the choice of the legitimate introductory centroid is additionally a significant task. These days image-based segmentation appears as one of the significant instruments in the medical region where it is utilized to extract RoI from its elementary origin. So medicinal pictures are segmented utilizing distinctive procedure and the results are utilized for further examination in medical (t) plant.

K-Means Clustering

The mechanism of Clustering represents a technique to separate a data set into a particular number of groups. K-means clustering is one of the mainstream strategies of clustering. In this clustering technique, it segments the data-based collection into a 'k' number data-based group [12]. It groups a given data set into 'k' number of disjoint clusters. there are two separate stages for the k-means cluster algorithm. In the principal stage, it estimates the k-centroid and in the second stage, it carries every point to the cluster group having closest centroid from the distinct data point. Multiple techniques are used to characterize the separation of the closest centroid and Euclidean distance represents the most utilized strategies to be used in the analysis [13]. When the procedure of grouping is completed, the new centroid is recalculated for each of the clusters and dependent on that centroid, another Euclidean distance is determined among each middle and every data-based point and it further allocates various points in the group cluster having least Euclidean distance. Every cluster in the segment is characterized by the centroid and by its member objects. The centroid for every cluster represents the point to which the aggregate of distances from all the objects in the cluster is limited. Thus, K-means implies an iteratively built algorithm that limits the aggregate of distances from every object to its cluster-based centroid [14].

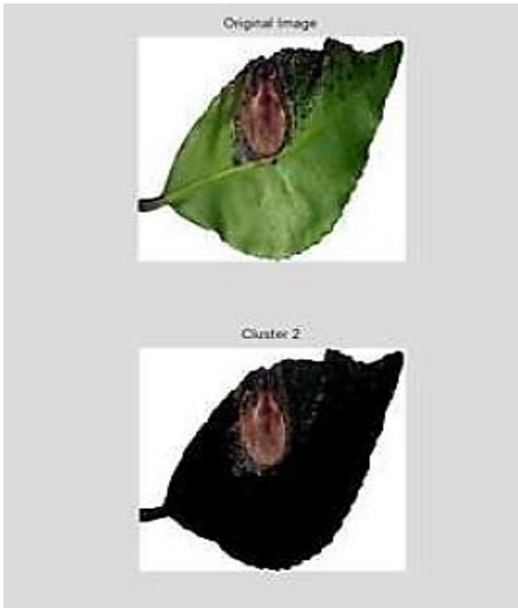

Fig. 2: Cluster Selection [1]

Otsu Method

After segmentation of image using the K-means clustering method, green pixels estimation of the leaf is covered and afterward evacuates these greens masked pixels and got the object-based threshold value by using Otsu's strategy. Otsu's strategy is used to perform the mechanism of clustering-based image threshold in an automatic manner or, the decrease of a gray level image to a binary image.

2. RELATED WORK

G. Saranya et al. propose the framework for example mostly utilized for distinguishing the plant ailment. The primary parts of disease distinguishing are to assist farmers with fast precision. The strategy depicted presently is utilized to outline the plant disease for the early discovery of plant ailment. It likewise commits future investigation on consequently assessing the security of the sickness **[1]**.

Malusi Sibiya et al. Propose an algorithm to measure the seriousness of disease in a plant leaf by using maize leaf samples. In the literature review several analysts investigated the problem of determining the nature of the disease of plant leaves, while a few, for example, Sannakki et al., used a fugitive logical-base technique to assess the severity of seed leaf ailments. This paper aims to refresh the existing algorithm used in the application "Leaf Doctor" that is, used to determine the seriousness of the leaf disease by presenting the benefits of fluffy and rational decision making guidelines. This technology would bring precision to the advancement of agrobusiness by providing an algorithm that could be embedded in cellular devices and used in applications such as the "Leaf Doctor" application. **[2]**.

S. Bhaggiarajet al. presents an algorithm based on the method of image segmentation that is utilized for automatic discovery of plant leaf ailments and portrays how the proposed framework deal with plant leaves which are influenced by utilizing the mechanism of image processing to identify disease or ailments. The process of segmentation of an input image presents an important viewpoint for disease discovery. It is accomplished through fuzzy logic for detecting the plant ailment. A test picture is taken and contrasted with and afterward utilizing Artificial Neural Network (ANN), the disparity is determined with database image separated parameters that are removed utilizing the GCLM i.e. Gray Level Co-occurrence Matrix (GLCM) technique **[3]**.

Edna ChebetToo et al. center around evaluating and fine-tuning state-of-the-art profound CNN for image-based classification of plant disease. An experimental examination of the profound or deep learning design is completed. The models assessed incorporate ResNet, Inception V4, VGG 16 with 50, 101 and 152 layers and DenseNets having 121 layers. DenseNets possesses a tendency to reliably improve in precision with a developing number of periods, without any indications of overfitting and execution disintegration **[4]**.

Saradhambal.Get al. To predict the tinted region of the leaves, suggest an upgraded k-mean clustering. A model based on the shading-based segmentation model segments the corrupted field and positions it in its main groups. Exploratory analysis on test images has been carried out as far as time-based uncertainty and the polluted field zone are concerned. This work is used to classify the plant diseases and to include responses to the disease. It shows the affected percentage portion of the leaf [5].

Vijai Singh et al. presents an algorithm for the technique based on the process of image segmentation utilized for automatic classification and detection of plant leaf disease. It additionally covers a study on various techniques of disease classification used for the detection of plant ailment. The process of image segmentation presents a significant perspective for the detection of disease in plant leaf that is completed by using GA. To improve the rate of recognition in the process of classification. The hybrid algorithm, Bayes classifier, Artificial Neural Network, and Fuzzy Logic can likewise be utilized [6] .

Pallavi.S.Maratheet al. In this paper the identification as wells the solution for restoring is accomplished. This task uses GSM to send the message to each sort of versatile mobile handset. This paper uses different techniques of image segmentation which give precise outcomes [7] .

SrdjanSladojevic et al. This research paper talks about an additional methodology to deal with the enhancement of plant disease-based recognition model, given the classification of the leaf, via deep CNN. Novel training technique and a method are utilized for fast and simple execution of the framework. Out of the healthy leaves, this model helps observe 13 exclusive categories of plant disease, with the capacity to identify plant leaves. As indicated by the information, this strategy for recognition of plant leaves has been proposed for the very first time. Every single primary step required for actualizing this model is completely portrayed all through the paper, beginning from image collection to make a database, surveyed by agriculture specialists [8].

K. Sumithra et al. This paper exhibits an audit on different sorts of systems of image processing, for example, image enhancement, image restoration, image recognition, image restoration, and image segmentation has been talked about quickly and gives away from of uses utilized in image processing [9] .

Prakash M. Mainkar et al. summarizes and reviews various techniques of image processing for several species of the plant utilized for recognition of plant diseases. The significant systems utilized are GLCM, BPNN, and K-means clustering. A portion of the difficulties in these methods are optimization of the system for a particular plant, impact of the background noise in the gained picture and automation procedure for a constant automated screening of plant leaf ailment under practical field conditions. The proposed method represents an important methodology, which can essentially bolster an exact identification of leaf infections in a small computational effort. Further future work can be reached out by choosing better feature extraction; classification algorithms; better segmentation; and NNs to build recognition rate of the definite classification process [10].

Pradnya Ravindra Narvekar et al. examines the successful way utilized in performing recognition of grape infections with the help of leaf feature review. The image of Leaf is caught and proposed to control the wellbeing status of every plant. The diagnosis of plant ailment represents an art just as science. The procedure of diagnosis (for example signs and symptom recognition) is characteristically visual and requires instinctive judgment just as the utilization of scientifically logical strategies. Photographic pictures of signs and symptoms of plant infections utilized broadly to improve the depiction of plant illnesses are precious in the investigation, diagnostics and so on [11].

3. THE PROPOSED METHOD

3.1 Proposed Methodology

- In the convolution layer, the real force of profound learning comes from the convolutional layer, especially for image recognition. It is both the first and the most important plate. CNN uses multiple filters in this layer to convert the whole image and even the intermediate functional images, creating single maps of functions (Figure 5). The chart involves mapping between the hidden layers and the input layers. Three hyper-parameters are necessary to control the output volume of the convolution layer: zero-padding. The output volume depth mainly controls the number of neurons in a layer which binds to the same volume region in the input. Each neuron can learn how to activate the input's specific characteristics. For instance, if the first Co evolutionary layer accepts input in the shape of a raw image, different neurons will produce depth in the presence of different directed boundaries.
- The zero-padding hyper parameter is suitable for padding the input with the nulls on the limit of the input volume. Zero padding controls the output volume's spatial size. It is also necessary to keep the input volume spatial. It seems that the input is 64x64x3. If the volume has two zero limit pads, get a volume of 256 (dense layer). When applying the

convolution layer to our 5x5x3 filters, you also get a volume-based output of 256 (dense layer).

- The convolutional layer appears to have three main advantages: (a) the weight sharing function on a single feature map eliminates the collection of parameters (b) local communication revels associations between neighbouring pixels (c) invariance to the item's location.
- It is the layer of the rectified linear units. This is really a layer of neurons that uses non-saturating loss function or non-linearity function:
- f (x) =max (0, x)-----------------(1)
- The role of pooling the information collected by mapping functions is to simplify and to minimise spatial measurements. Include three different types of pooling: one is average pooling, one is the normal pooling of L2, and the most common usage is max pooling for its improved convergence and speed. In general, a filter is required (2 to 2). The input for this layer is indeed a number vector. An input is connected to each output and thus the term "fully connected" is used. In the last layer the pooling layer normally processes in the CNN phase. Completely connected layers operate as traditional NNs and consist of 90% of CNN parameters. This layer uses basically the output from the last input and output of the pooling layer of the N-dimensional vector, with N representing the number of classes the system has to choose from. It allows us to transmit the NN to a vector with a fixed length. Loss layer utilizes functions that take into account the output of the model and the goal, and evaluates a value helps in measuring the performance of the model. It may possess two key functions:

1. Backward (input, target): determines and returns the output of the loss function gradient associated with the criterion.
2. Forward (input, aim): measure loss value-based input and goal value.

4. RESULT ANALYSIS

4.1 Result Analysis

Results

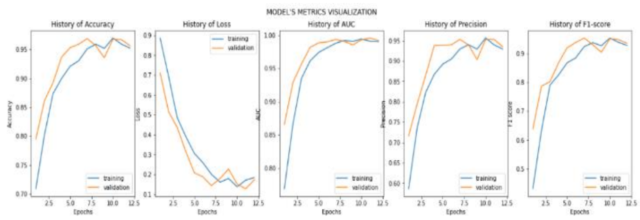

Fig. 3: Tomato (10-class) performance by proposed approach

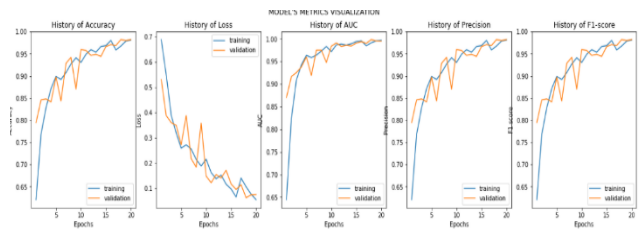

Fig. 4: Pepper (2-class) performance by proposed approach

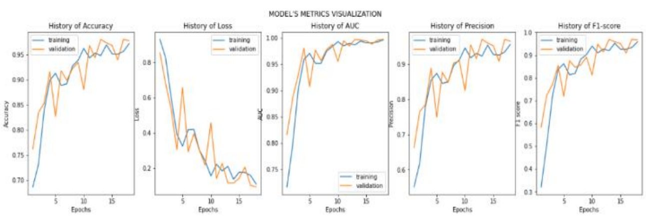

Fig. 5: Potato (3-class) performance by proposed approach

1. In figure 3 and 4, the experimental analysis is done based on CNN based architecture. The only difference is that the result from figure 6 comes only after hyper parameter tuning. On the other hand, the fig3-based proposed approach follows hyper parameter tuning and dependency base learning, which effectively use domain base knowledge of leaf.
2. Both the results help to improve the results of the base classifier.
3. In figure 3, the results are based on training and validation accuracy i.e. approx. 90%. So, it is free from over and under fitting.
4. In figure 4, the results are based on training and validation accuracy i.e. approx. 98-99.2% which changes as per the drop rate.
5. In the proposed approach, the results from over fitting and under fitting are not present.

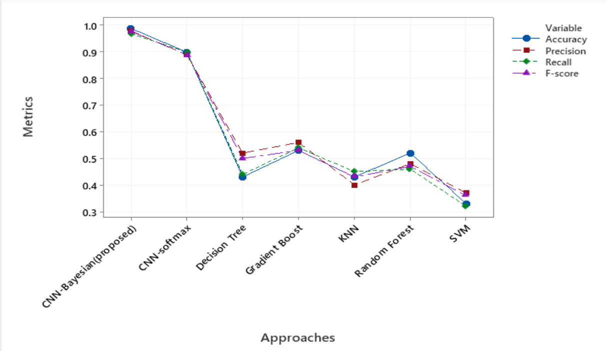

Fig. 6: Comparison of Proposed and existing approaches

Show the comparison of machine and CNN approach. All approaches analysis on four performance metrics Accuracy, precision, recall and f-score. If analysis in a machine and CNN approach the deep learning approaches improve significantly and improve 40-42% average. These results show machine learning not improves classification of leaf disease because of the following reason.

- Features are not efficient to describe leaf part where disease exists.
- Non-linear mapping of features not present.
- Only work on low level features.
- 15 classes increase the overlapping and reduce the performance.

5. CONCLUSION

This Paper learned to recognise and classify environments of plants for stable and diseased plant pictures based on CNN architectures. Analysis in a machine and CNN approach the deep learning approaches improve significantly and improve 40-42% average. These results show machine learning not improve classification of leaf disease because of the non-linearity mapping of features ignore in machine learning Training/validation models are performed using an open dataset. This research offers an appealing means of diagnosing the infection type in various leaves. This is the first time we extend the Bayesian learning base CNN to our full understanding. CNN is largely oblivious to 2,3 and 10 leaf groups for Detection of illness. The key aim of this study is to integrate the Bayesian approach to efficient function learning at the top of the Residual Network. In figure 6, the results are based on training and validation accuracy i.e. approx. 90%.

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