Estimation of Cotton Leaf Infection Using Deep Learning VCG16 Model on Segmented Cotton Leaf Images contained through deformable model

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Abstract

Agriculture is the major area of any country economy. If plants get infected whole crop will be destroyed and that affects the complete agriculture trade. In this article we discuss about the plant leaf diseases and its detection methods. For plant leaf infection detection multiple methods are available but the deep learning approaches give best results. Here in this article the performance of VCG16 model is evaluated in which deep learning approach is used with input of segmented images received from deformable model.

Keywords: Crop, Leaf disease, Deformable model, Deep learning, VCG16 model.
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Introduction

Crop plays an essential part in humans' life, especially framers. Crop yield gets affected because of various reasons like climate change, water shortage. If the crops are not taken care of properly, then they might get affected by diseases. The disease is an important issue for framers, and it becomes crucial to recognize and diagnose it at the earliest. Though framers can identify the diseases by bare eyes, it may not be possible for larger areas. The time taken for this task would be a huge and very tough task. For many years, there has been extensive research in this area. and also many researchers introduced variety of approaches for disease prediction and classification. Much research was done on images with a simple background and not much on a complex background. However, nowadays, the all kinds of images are taken into consideration for the experiment. In literature, there are many segmentation methods researchers proposed like K means [1], immune algorithm and PCN [2], integrating superpixel, HOG and active contour [3], adaptive snake algorithm [4], etc. Later, various feature extraction methods were introduced like color features [5], texture features -HOG features [5], GCLM features [6], and for disease classification, numerous classifiers are existing ANN, SVM, KNN. The performance of the classifiers depends on the features extracted, which can be one among many dependencies.

So, generally. three steps followed after the database creation 1) image segmentation, 2) Feature extraction, and 3) classification. Earlier feature extraction used to be carried out by the researchers explicitly but now deep learning will perform it. In the past few years, there has been a rapid rise in deep learning models for segmentation [7,8] and classification [9,10].

Since the accuracy of the deep learning model is more so, we also used it for our database. However, very few publications can be found in the literature discussing disease classification with complex backgrounds to the author's best knowledge. A fundamental limitation of many research work is that very little research was addressed on overlapping leaf images or greenery background. Because segmenting the images from the same colour background will be a challenging task.

Generally, the deep learning model is used for disease classification using standard datasets. Sometimes researchers use images that are captured with white background or simple background.

Based on the discussion, this paper aims to classify cotton leaf diseases using a deep learning model. The remainder of the paper is into sections: section II describes the various researcher's contributions will be discussed. Section III is devoted to the methodology used for disease classification. Section IV shows experimental results, and finally, section V concludes with a summary.

Material and methods

Deep learning is recognized to be the most important trending method now for semantic segmentation and classification. The dataset used in this paper are cotton leaf images and nearly 500 images are included.. But from the literature we can observe that the model requires greater database so, we approached data augmentation. Experiments were conducted by a group of researchers for disease classification but the experiment was carried out standard dataset with simple background. Very less research done on the standard dataset with complex background and in this paper, we are considering the similar type of datasets. There is no standard dataset with complex background available for research so we developed our own dataset

Table 1: Cotton Leaf Dataset

	Number of images
Healthy images	120
Cercospora leaf spot	120
Grey mildew	120
Bacterial blight	120

The dataset samples were captured using digital camera under natural conditions and there are three types of diseases considered for experimentation as shown in figure. The raw images are used for segmenting the leaf image using modified chan-vese method. The segmented images are fed to the CNN _VGG model.

Figure 1: (a) Alternaria (b) Cercospora (c) grey mildew

Image Augmentation

This method helps to increase the dataset as deep learning models requires large dataset. The dataset can be expanded by augmenting the images. This process is to augment the images by rotating, flipping horizontally or vertically so that from a single image multiple images can be generated. The dataset will increase based on the augmentation and because of this it will help to overcome overfitting problem. With this large dataset, performance of the system will increase.

Detection model for cotton leaf disease

The experiment proceeds following the steps outlined below:

1. Input images
2. Segmenting the leaf image from complex background using modified chan vese method
3. Later cropping the images to remove the unnecessary background
4. Data augmentation
5. VGG model for feature extraction and classification

Input image
Leaf segmentation
Cropped images
Deep learning model

Figure 2: Data flow diagram

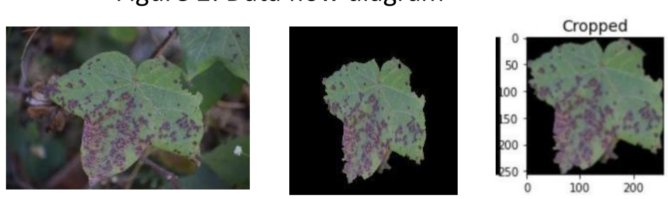


Figure 3: leaf Segmentation

In the first step of process, the leaf gets segmented using modified chan vese method. This method represents ground breaking to segment the image from complex background. After the segmentation is done, we can then crop the images to remove the black background. The cropping is performed using canny edge detection and the cropping doesn't perform if the front and the background colour is same. This stage sets it to be ready to train the deep leanring model. The model VGG[22] is built and the training and validation accuracy is calculated.

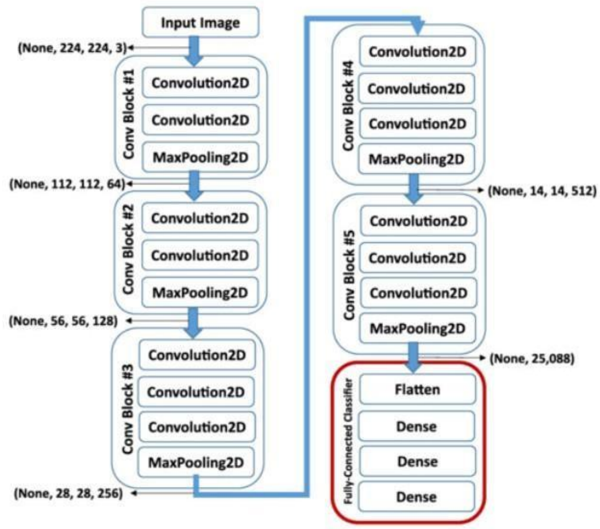


Figure 5: VCG16 model

VGG network architecture consists of

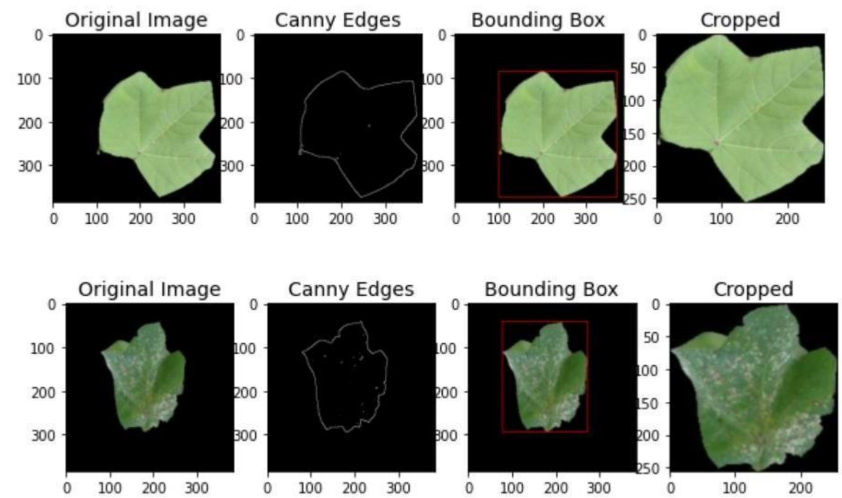
	Layers
1	Conv2D 32->Pool
2	Conv2D 32 -> pool
3	Conv2D 128 -> pool
4	Conv2D 128 -> pool
5	Conv2D 128 -> pool
6	FLAT
7	Drop
8	Dense 512
9	Dense len

Experimental Results

In this study, we observed that the performance of CNN model for cotton leaf disease classification. The experiment was implemented using google colab and core i3 processor – 8GB ram. The performance of the classifier was discussed in the following subsections.

The figure shows the use of canny edge detector to crop the image. The canny edge detection algorithm helps in detecting the edges and later the bounding box is drawn based on the edge detection. The cropped image will be only the required image removing background. This algorithm gives original image if the background is same as the required image.

Without cropping if the model is trained then the accuracy of the model will not be good, so cropping was carried to improve the model accuracy.



(a) (b) (c) (d) Figure 6: a) original image b) canny edge c) boundary box d) cropped image

Later, the cropped images are used for data augmentation and every single image will have six duplications as shown in figure. The images trained will be nearly 600 in each class and now the model can be trained. The training and testing of 80:20 ratio.

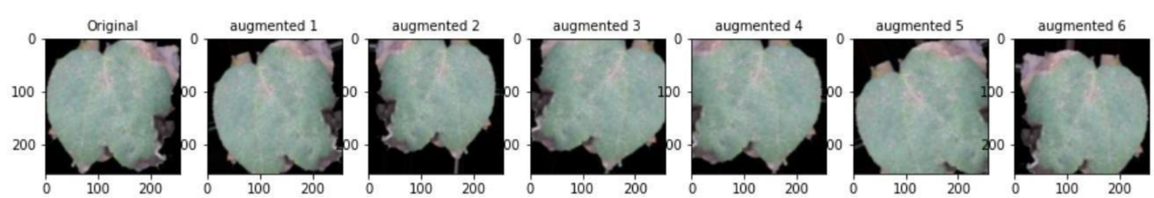


Figure 7: augmented images

After training the model accuracy and loss can be seen in figure.

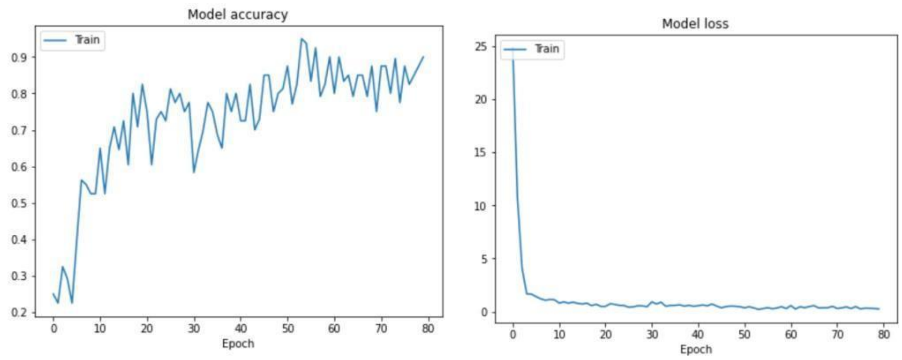


Figure 8: model and loss accuracy

The figure shows the prediction of a leaf images and we can observe that almost all images are predicted correctly. If any test image is predicted wrongly then it will display both correct class and predicted class.

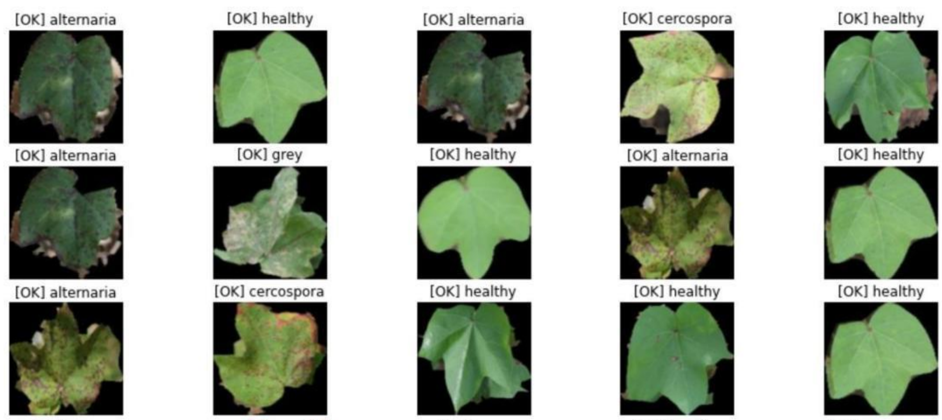


Figure 10: prediction output images

Conclusion

Cotton leaf disease classification using VCG16 model. Cercospora, Alternaria, Grey Mildew are the three different types of diseases are considered for classification. The deep learning model is fed with segmented images and trained the model. The model accuracy was high when compared to model which was trained with natural images. The accuracy of the VCG16 model is more for performing the cropping of the segmented images. The prediction of the test images is almost correctly classified.

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