

Data Augmentation Methods to Enhance CNN Performance for Plant Disease Detection

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Abstract—Image data augmentation is a technique that can be used to artificially expand the size of a training dataset by creating modified versions of images in the dataset. Training deep learning neural network models on more data can result in more skillful models, and the augmentation techniques can create variations of the images that can improve the ability of the fit models to generalize what they have learned to new images. To increase performance of CNN we can use various types of augmentation methods. In this paper we are discussing about the techniques used to increase the data set size for plant disease detection. Here we take Chili plant diseases as an example and try to increase the collected real time data set size using various augmentation methods.

Keywords: Deep neural networks, CNN, Data augmentation, Plant disease detection

I. INTRODUCTION

Due to the high performance of convolutional neural networks (CNNs), it becomes a general trend to apply them to practical application scenarios. However, it is hampered by their large number of computational costs and a lack of datasets that makes it become a hot topic for researchers. Chili peppers are popular for their ability to improve the taste of any meal with their hot flavor. Common Chili diseases include, Anthracnose, Bacterial leaf blight, Mosaic virus and Powdery mildew etc. These Chili diseases usually affect leaves and fruits, affecting fruit quality and damaging economic benefits. Chili is one of the common crop in our home garden. But most of the common people are not bothered about its diseases, symptoms and control measures. This problem will affect crop cultivation. In case of chili farmers, the fast detection and diagnosis of plant disease will help to increase the productivity and hence to reduce economic losses. Image data augmentation is a technique that can be used to artificially expand the size of a training dataset by creating modified versions of images in the dataset (Fig: 3.3). Training deep learning neural network models on more data can result in more skillful models, and the augmentation techniques can create variations of the images that can improve the ability of the fit models to generalize what they have learned to new images. So, to get more data, we just need to make minor alterations to our existing dataset. Minor changes such as flips or translations or rotations. Our neural network would think these are distinct images anyway.

II. RELATED WORKS

WENYAN PAN et. al [7] proposed a Smart Mobile Diagnostic System for Citrus diseases based on simplified Densely Connected CNN. They use 2000 images of fruit and leaves of Citrus plant infected by 6 forms of diseases. It's an intelligent diagnostic system supported by Mobile services computing. Here small number of images are there in data set,

over fitting occurs. To avoid this problem data augmentation is employed. Here data augmentation of training set and test set by horizontal flip, vertical flip, increasing brightness and contrast of images in real time data set. For training and testing DenseNet is used here. DenseNet means, each neuron in an exceedingly layer receives an input from all the neurons present within the previous layer. Hence they are called as densely connected, i.e. fully connected neural network. There are 4 Dense blocks in an exceedingly DenseNet. To cut back possibility of over fitting remove 5 bottleneck layers and added batch normalization activation function, global average pooling & softmax layers to make last dense block. Hence called simplified DenseNet. Upload the trained data set model within the cloud model. Users can upload image to the present system through We chat applet. System realized using this applet in mobile device. Users can upload images to it. Then name of the disease and its control measures are come as output. This method has the advantages as, reduce the vanishing gradient problem, strengthen feature propagation, encourage feature reuse and reduce number of parameters. They used a pretrained model, which reduces the time interval. we are able to expand dataset used for training and testing and further optimize method to attain acquires

III. METHODOLOGY

A Convolutional neural network that can robustly classify objects even if its placed in different orientations is said to have the property called invariance. More specifically, a CNN can be invariant to translation, viewpoint, size or illumination (Or a combination of the above). This essentially is the premise of data augmentation. In the real world scenario, we may have a dataset of images taken in a limited set of conditions. But, our target application may exist in a variety of conditions, such as different orientation, location, scale, brightness etc. We account for these situations by training our neural network with additional synthetically modified data. We present some basic but powerful augmentation techniques that are popularly used. We'll use the below techniques for our work

- Flipping: A flip (mirror effect) is done by reversing the pixels horizontally or vertically. For instance, for an horizontal flip, the pixel situated at coordinate (x, y) will be situated at coordinate (width - x - 1, y) in the new image. A flipped image is generated by a mirror reversal of an original across horizontal or vertical axis. In this work horizontal flipping, vertical flipping and horizontal + vertical flipping are used.
- Brightness & Contrast Enhancement: Brightness enhancement is the shifting of intensity to a higher level. The darker and the lighter pixels both get their values shifted by some constant value. Contrast is the difference between light and dark tones. You can also think of it as

these separation between the shadows and highlights. An image with low contrast is said to look flat or dull, while high contrast makes an image look punchy or “contrasty”. Saturation is the depth or intensity of the color. The lower the saturation, the less intense are the colors. They can look weak and pale. We can enhance contrast as we increase saturation by multiplying saturation channel with a constant.

- Noise addition:
 - 1) Gaussian noise: In digital image processing Gaussian noise can be reduced using a spatial filter, though when smoothing an image, an undesirable outcome may result in the blurring of fine scaled image edges and details because they also correspond to blocked high frequencies. Gaussian noise is statistical noise having PDF equal to that of Gaussian distribution
 - 2) Salt and pepper noise: Salt-and-pepper noise is a form of noise sometimes seen on images. This noise can be caused by sharp and sudden disturbances in the image signal. It presents itself as sparsely occurring white and black pixels

IV. IMPLEMENTATION

I collected datasets of 4 types of diseases affected on chili leaves and fruits along with healthy leaves and fruits and displayed 20 images among them randomly (Fig 4.1). Total number of collected images are 325. Count of each collected category is displayed in Table 4.1.

Label	Count
Healthy leaf	32
Healthy fruit	55
Anthraco nose	47
Mosaic virus	75
Bacterial leaf blight	45
Powdery mildew	71

Table 1: Count of collected images

Collected 325 images of Chili fruits and leaves. Randomly displayed 20 images among these data set. Resize collected images to a standardized form (224*224). Data augmentation used to enhance dataset, to avoid overfitting of deep neural network we use 7 general ways to augment our training set and test set. horizontal flip, vertical flip, horizontal +vertical flip, increase brightness and contrast and addition of gaussian noise & salt and pepper noise. In this way, the size of the training set and test set is increased by seven times. The data augmentation methods and examples are shown in Table 5.1 and Table 5.2. The number and proportion distribution of each category after data augmentation are shown in Table 5.3

METHODS	SPECIFIC OPERATIONS
Flipping	Horizontal flipping, Vertical flipping, Horizontal + vertical flipping
Increase brightness	Image intensity + 40
Increase contrast	Extract saturation channel * 1.5
Noise addition	Gaussian noise & salt and pepper noise

Table 5.1: Data Augmentation Methods

DISEASE TYPE	ORIGI AL IMAGE	DATA	AUGMEN TED	SAMPLES					
		HORIZONT AL FLIPPING	VERTICA L FLIPPING	HORIZONT AL+ VERTICAL FLIPPING	BRIGHTN ESS ENHANC ED	CONTRA ST ENHAN CED	GAUSSI AN NOISE	SALT&PEP PER NOISE	
Anthraco nose									
Mosaic virus									
Powdery mildew									
Bacterial leaf blight									
Healthy leaf									
Healthy fruit									

Table 5.2: Examples of augmented images in each category

LABEL	COUNT
Healthy leaf	224
Healthy fruit	385
Bacterial leaf blight	315
Powdery mildew	497
Mosaic virus	525
Anthracnose	329

Table 5.3: Count of augmented data set in each category

V. CONCLUSION

The work done in the phase 1 of the project focuses on data establishment for the work. 325 images of chili plant affected with 4 types of diseases along with healthy leaves and fruits are collected from both network and home garden. Standardize their size. Since these data is not enough for a deep neural network based classifier, data augmentation carried out. 7 types of augmentation methods are used. After that total count of data set became 2275. Hence classification accuracy can be increased as a future work we have to develop a CNN using this augmented data set for classifying and detecting Chili plant diseases.

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