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Plant Quality Detection using Deep Learning

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***Abstract*: Farming is the art and science of cultivating soil, growing crops and raising livestock. Crops play an important role in the livelihoods of millions of poor agriculturalists. This project mainly categorizes the leaves into diseased and healthy, in order to increase the production of the crops by assessing the quality of crops so that required necessary actions can be taken. In this, Convolutional Neural Network (CNN) based method will be used to assess the quality of crops. Thus this system helps to reduce the difficulties faced by the farmers during cultivation which helps in increasing the crop yield.**

***Keywords*: Keras, Convolutional Neural Network, Deep Learning, Machine Learning.**

1. Introduction

Deep Learning is a branch of machine learning algorithms that uses multiple layers to extract higher-level structures or features from raw input also it is a kind of mimic of human brain since the neural network can mimic the human brain. Every level learns to transform its input data into a slightly more abstract and compound representation. It achieves great control and flexibility by learning to represent the world as a nested hierarchy of thoughts, with each concept defined in relation to simpler concepts, and more abstract representations computed in terms of less abstract ones.

Economy of a nation depends on agricultural production. Majority of the population are dependent on the cultivation. Farmers cultivate various crops based on the soil richness and availability of resources. Due to environmental changes such as rain fall, temperature, soil fertility, crops are getting affected with many diseases such as fungi, bacteria and viruses. Recognition of plant disease at the initial stage will be beneficial since the disease can be controlled. Thus modern farming is used nowadays which yields more profit. The latest techniques used in agriculture helps to analyze the condition of the soil in fields, temperature, the pesticides that must be used for specific crops, disease diagnosis, water level to be used etc.

This project is used to classify or identify the leaf disease using CNN. The leaves of the plants are taken into consideration and analyzed. The symptoms present on the leaves are processed with the help of pre-processing, feature extraction, feature selection and finally classification which is the main source for the detection of diseases. They can be of various types depending on the stages of the disease. Thus, detection of the diseases at any stage should be possible. Here the process is divided into two types; training and testing. The system is trained such that it distinguishes between healthy and diseased leaves. The user provides the training data to the model which helps it to get trained. Large amount of training data gives good accuracy of the results. Next the testing data is given to the trained model. The result depends on how much the system has been trained. Plant Village dataset will be used to train and test the model. Plant Image dataset contains more than 50,000 images of classified plant diseases and healthy images. The images span 14 crop species with total of 39 classes.

The existing method for plant disease detection is simply naked eye observation by experts through which identification and detection of plant diseases is done. For doing so, a large team of experts as well as continuous monitoring of plant is required, which costs very high when we do with large farms. In recent years, CNN has achieved high success and gradually become the main method in the area of image classification. This will involve collection of crops leaf images. Plant Village dataset will be used to train and test the model. The images will be inputted to developed CNN model as input. First the model will be trained with training data and then it will be evaluated on testing data. The output of the model will give the result, based on which the quality of the crop can be classified.

2. Literature Review

Various studies and research are done on quality detection of crops using machine learning. Radhika Deshmukh and Manjusha Deshmukh showed that paddy leaf diseases are detected using K-means algorithm and Artificial neural network algorithm. The flow of this paper is Image Acquisition, Image Preprocessing Feature Extraction and Classification using Keras. CNN is being built for the image classification task. This paper results in fast disease detection with the help of healthy and diseased leaves label. System detects and classifies plant diseases. Total of 39 classes are used for training as well as testing. Different types of diseases namely, Bacterial leaf blight, Black rot, Common rust, Powdery mildew, Leaf scorch and Leaf smut etc. are detected. The results show that the accuracy of the method is 92.25%, which is better than the traditional method, thus reducing the influence of disease on agricultural production and being favorable to sustainable development of

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agriculture. Problems related to computer vision were saturating on their accuracy before a decade. However, with the rise of deep learning techniques, the accuracy of these problems has drastically improved. One of the major problem was that of image classification, which is defined as predicting the class of the image. Apple and Grapes image classification is one such example of where the images of apple and grapes are classified. This paper aims to incorporate state-of-art technique for object detection with the goal of achieving high accuracy. With the development of artificial intelligence, deep learning is more and more widely used in image recognition. As a representative deep learning algorithm, convolutional neural network has been widely used due to its excellent performance in image processing. It is widely used in various fields and has made great achievements. Image recognition is the most important problem in the development of computer vision. Since computers can recognize objects, computer vision can be used in many fields. In the current image classification task, convolutional neural networks (CNNs) focus on processing pixels and often ignore the semantic relationships and human brain mechanisms. With the development of image analysis and processing techniques, the information in the image is becoming increasingly complicated. Humans can learn about the characteristics of objects and the relationships that occur between them to classify the images. It is a significant characteristic that sets humans apart from the modern learning-based computer vision algorithms. Deep Learning models have made incredible progress in some discriminative tasks. This has been fueled by the advancement of deep network architectures, powerful computation, and access to big data. Deep neural networks have been successfully applied to Computer Vision tasks such as image classification, object detection, and image segmentation thanks to the development of convolutional neural networks (CNNs). With the rapid development in deep learning, more powerful tools, which are able to learn semantic, high-level, deeper features, are introduced to address the problems existing in traditional architectures. These models behave differently in network architecture, training strategy and optimization function, etc. Recently, image classification is growing and becoming a trend among technology developers especially with the growth of data in different parts of industry such as e-commerce, automotive, healthcare, and gaming. The most obvious example of this technology is applied to Facebook. Facebook now can detect up to 98% accuracy in order to identify your face with only a few tagged images and classified it into your Facebook's album.

3. Problem Statement

Agricultural productivity is something on which economy highly depends. This is the one of the reasons that disease detection in plants plays an important role in agriculture field, as having disease in plants are quite natural. If proper care is not taken in this area then it causes serious effects on plants and due to which respective product quality, quantity or productivity is affected. Detection of plant disease through some automatic technique is beneficial as it reduces a large work of monitoring in big farms of crops, and at very early stage itself it detects the symptoms of diseases i.e. when they appear on plant leaves.

4. Methodology

A. *Proposed Model*

The CNN model comprises of different steps that are involved during the training process. The model's first layer is Conv2D layer. Since it is the first layer of the model, input shape of the images that are going to be supplied to the model is being mentioned. Next layer is a batch normalization layer. Then comes activation layer corresponding to the conv2d layer. Further there is another set of conv2d, batch normalization and activation layer with different number of kernels in the conv2d layer. Later on a max Pooling layer and then a dropout layer is present. The same set of layers is again repeated with different number of kernel's and dropout rate. The convolution layers ends with this set.

Next comes the fully connected layer. The Sequential model API is used to build model. The sequential API allows you to create models layer- by-layer. The 'add()' function used to add layers to our model. The model needs to know what input shape it should expect. For this reason, only the first layer in a Sequential model needs to receive information about its input shape.

Further, the Dropout layer is used to avoid over fitting on the dataset and dense is the output layer that contains only one neuron which decide to which category image belongs.

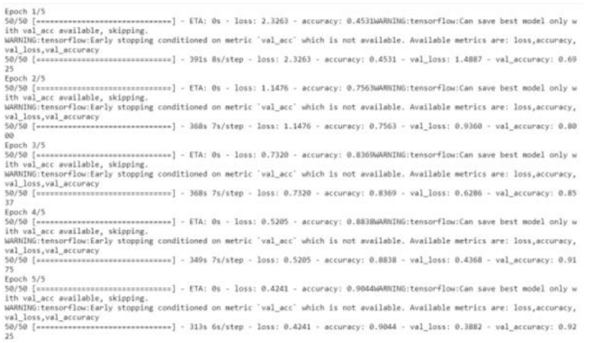
Activation layer is used to apply the activation function to the output of that layer. The purpose of the activation function is to introduce non-linearity into the output of a neuron. Relu and sigmoid activation functions are used in the model.

Batch Normalization is used for improving the speed, performance, and stability of artificial neural networks(ANN). Batch normalization is a method we can use to normalize the inputs of each layer and achieve faster convergence.

Then the Flatten Layer is used to flatten the dimensions of the image obtained after convolving it. Dense is used to make this a fully connected model and is the hidden layer.

In Conv2D layer, a kernel, convolution matrix, or mask is a small matrix. It is used for blurring, sharpening, embossing, edge detection, and more. This is accomplished by doing a convolution between a kernel and an image. This layer creates a convolution kernel that is convolved with the layer input to produce a tensor of outputs.

Then comes the fully connected layers. It contains only 2 layers. First one is the global average pooling layer to minimize overfitting by reducing the total number of parameters in the model. Second layer and the final layer is the Dense layer with sigmoid activation. Global Average Pooling 2D layer is used to minimize overfitting by reducing the total number of parameters in the model. GAP layers perform a more extreme type of dimensionality reduction, where a tensor with dimensions $h \times w \times d$ is reduced in size to have dimensions $1 \times 1 \times d$. GAP layers reduce each $h \times w$ feature map to a single number by simply taking the average of all hw values. During the model compilation, the optimizer algorithm, loss function and the list of metrics are parameters which are to be taken care of. The model trained for 5 epochs. Below is the table showing the end result of training i.e. train accuracy, test accuracy, train loss, test loss and epochs.



```
Epoch 1/5
50/50 [==============================] - ETA: 0s - loss: 2.3263 - accuracy: 0.4531WARNING:tensorflow:Can save best model only w
ith val_acc available, skipping.
WARNING:tensorflow:Early stopping conditioned on metric `val_acc` which is not available. Available metrics are: loss,accuracy,
val_loss,val_accuracy
50/50 [==============================] - 391s 8s/step - loss: 2.3263 - accuracy: 0.4531 - val_loss: 1.4887 - val_accuracy: 0.69
25
Epoch 2/5
50/50 [==============================] - ETA: 0s - loss: 1.1476 - accuracy: 0.7563WARNING:tensorflow:Can save best model only w
ith val_acc available, skipping.
WARNING:tensorflow:Early stopping conditioned on metric `val_acc` which is not available. Available metrics are: loss,accuracy,
val_loss,val_accuracy
50/50 [==============================] - 368s 7s/step - loss: 1.1476 - accuracy: 0.7563 - val_loss: 0.9360 - val_accuracy: 0.80
00
Epoch 3/5
50/50 [==============================] - ETA: 0s - loss: 0.7320 - accuracy: 0.8369WARNING:tensorflow:Can save best model only w
ith val_acc available, skipping.
WARNING:tensorflow:Early stopping conditioned on metric `val_acc` which is not available. Available metrics are: loss,accuracy,
val_loss,val_accuracy
50/50 [==============================] - 368s 7s/step - loss: 0.7320 - accuracy: 0.8369 - val_loss: 0.6286 - val_accuracy: 0.85
37
Epoch 4/5
50/50 [==============================] - ETA: 0s - loss: 0.5205 - accuracy: 0.8838WARNING:tensorflow:Can save best model only w
ith val_acc available, skipping.
WARNING:tensorflow:Early stopping conditioned on metric `val_acc` which is not available. Available metrics are: loss,accuracy,
val_loss,val_accuracy
50/50 [==============================] - 349s 7s/step - loss: 0.5205 - accuracy: 0.8838 - val_loss: 0.4368 - val_accuracy: 0.91
75
Epoch 5/5
50/50 [==============================] - ETA: 0s - loss: 0.4241 - accuracy: 0.9044WARNING:tensorflow:Can save best model only w
ith val_acc available, skipping.
WARNING:tensorflow:Early stopping conditioned on metric `val_acc` which is not available. Available metrics are: loss,accuracy,
val_loss,val_accuracy
50/50 [==============================] - 313s 6s/step - loss: 0.4241 - accuracy: 0.9044 - val_loss: 0.3882 - val_accuracy: 0.92
25
```

Fig. 1. Training result per epoch

B. Dataset

To perform deep learning method for our proposed work, we use PlantVillage dataset inorder to train and test the model. Plant Village dataset contains more than 50,000 images of classified plant diseases and healthy images. Data set consists of two sets of folder with images such as Train and Validation. Here the dataset consists two categories: Diseased and Healthy as shown in fig.2. There are 39 different classes where each class consists of atleast 500 images. Since the images were chosen at random for each collection, the accuracy varies depending on which image was chosen, and we report the average accuracy and loss.

(a) (b)

Fig. 2. Example of grape leaf images from dataset train
(a) Healthy leaf, (b) Diseased leaf

5. Result

The image classification of leaves as diseased and healthy is successfully obtained. By using just small amount of dataset 92% accuracy has been obtained. If more images are used, then accuracy will also increase. It is seen that image classification using CNN-Keras is very efficient and easy to implement.

6. Conclusion

This work gives efficient and accurate plant disease detection and classification technique by using CNN. Despite from the traditional system used in agricultural industry, that concerns the crops classification or plants density assessment, the proposed system aims at detecting the plant leaves, and assess its quality. This automated system reduces time of detection and labour cost. It can help the farmers to diagnose the disease and take remedial action accordingly.

7. Future Scope

Future work should focus on extending the database for more leaf disease identification. Under the out-door condition, the lighting condition is affected by movement of sun and cloud, which may lead to under and overexposure. To prevent, an auto-iris objective is recommended, which is able to adjust the iris size to adapt the changing condition of lighting. Further we can use sensors and some networks and convert this into live project. The farmers can directly use the sensors and see whether the plant leaf is diseased or healthy within few seconds instead of taking pictures and loading it into the system.

References

[1] J. Rasmussen, M. Norrenmark, B. M. Bibby, "Assessment of leaf cover and crop soil cover in weed harrowing research using digital images," Weed Research, vol. 47, pp. 299-310, August 2007.

[2] C. Gee, J. Bossu, G. Jones, F. Truchetet, "Electronic Imaging & Signal Processing - Detecting crops and weeds in precision agriculture," SPIE Newsroom, 2008.

[3] M. S. Nixon, A. S. Aguado, Feature extraction and image processing, Amsterdam, Elservier Press, 2008.

[4] J. Ronghua, "Real-time plant image segmentation algorithm under natural outdoor light conditions", New Zealand Journal of Agricultural Research. vol. 50, pp. 847-854, 2007.

[5] Radhika Deshmukh, Manjusha Deshmukh, "Detection of Paddy Leaf Diseases", in International Conference on Advances in Science and Technology, 2015.

[6] Amritha A. Joshi, B. D. Jadhav, "Monitoring and Controlling Rice Disease Using Image Processing Techniques", in International Conference on Computing, Analytics and Security Trends (CAST), 2016.

[7] Amandeep Singh, Maninder Lal Singh, "Automated Blast Disease Detection from Paddy Plant Leaf - A Color Slicing Approach", in International Conference on Industrial Technology and Management, 2018.

[8] Harshad Kumar, B. Pragapati, "Detection and Classification of Rice Plant Diseases," in Intelligent Decision Technologies, vol. 11, 2017.

[9] Vijai Singh, A. K. Misra, "Detection of Plant Leaf Diseases using Image Segmentation and Soft Computing Techniques", Information Processing in Agriculture, vol. 4, pp. 41–49, 2017.