Paper Review: 02

Title: DELM: Deep Ensemble Learning Model for Multiclass Classification of Super-Resolution Leaf Disease Images.

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1. Introduction

The most crucial task in precision agriculture over the past few years has been automated plant disease identification. Climate change has the potential to accelerate the spread of plant diseases, and blight is the most common disease in tomatoes. The tomato crop is susceptible to many different illnesses at each stage of its growth. Identifying these diseases may prevent a considerable loss in yield. Early detection and therapy of plant diseases is challenging. Deep learning models can be used to accurately diagnose several plant leaf diseases in real-world circumstances, and these models have proven to be effective in image segmentation and classification. A CNN model was used to identify illness in a variety of plants using weight values and connections between local values. Three layers of feed network make up the artificial neural network, which contains layers for "input", "hidden" and "output". The arrangement of different recognition models varies. Deep learning models are used in a variety of applications, including the categorization of plant diseases, pests, damaged and healthy fruit, and weeds. The proposed DL model outperformed prior state-of-the-art methods in terms of detecting and classifying tomato leaf diseases, as well as demonstrating excellent accuracy.

After reading numerous papers, issues arise regarding image quality and early illness detection. The current work intends to analyse the deep learning method's efficiency for the multiclass organization of the superresolution tomato leaf image dataset to address the following research questions.

This paper proposes a deep ensemble learning model (DELM) for classification of superresolution tomato leaf images using the transfer learning approach. It also compares the evaluation performance of single and ensemble models.

2. Related work

As per the assessment of the state of the art, significant work has been published in recent years for leaf ailment detection and classification from superresolution tomato leaf images. The current approach uses a deep ensemble learning model with the fusion of four different models.

3. Materials and methods

In this work, VGG16, InceptionV3, AlexNet, and GoogleNet models are compared to achieve high accuracy in multiclass classification. A DENN with transfer learning is suggested to reduce inaccurate positive and negative values through limiting assets.

3.1. Data collection and preprocessing

Superresolution images of tomato leaves were taken from Plant Village, and the data was split into two subsets with the testing and training proportion being 20:80. The data collection technique was important in instantaneous procedures because inaccurate information in the database may undermine the outcome of the experiment. Preprocessing input data improves the quality of the data, reduces or eliminates noise, and scales the image. This improved image is then used to evaluate pretrained unimodals.

3.2. Data augmentation

After preprocessing and splitting, data augmentation is utilized for the training process to enhance the data and reduce the risk of overfitting. Geometric transforms including rotations, shifts, shears, and flips are also used in the strategies.

3.3.1. VGG16

VGG16, a variant of CNN, is the best computer vision model available right now and it is presented in Figure 3. It shows a significant enhancement over the state-of-the-art setups.

3.3.2. InceprtionV3

CNNs are the foundation of the DL model known as Inception V3, which uses batch normalization, convolutions, max pooling, and dropouts to classify images.

3.3.3.AlexNet

AlexNet is a deep neural network that uses eight layers to model objects in images. It uses RGB images with a resolution of 256 x 256 and resizes non-256 x 256 images to 256 x 256.

3.3.4. GoogleNet

GoogleNet Architecture is a deep learning convolution neural network architecture that uses an inception module as the first layer and stacks other layers on top of it to apply parallel filtering on input from the layer before. The proposed deep ensemble learning model (DELM) achieves several goals.

A variety of pretrained CNN models were used to create an ensemble model that shows more than 90% accuracy. The algorithm provides a thorough justification of the suggested approach, and the training set was divided into mini batches to reduce experimental harm.

Superresolution tomato leaf images are processed with necessary preprocessing techniques like image improvement, colour space transformation, scaling, and noise removal. A set of pretrained models is imported and the last layer of every model is replaced with a (398 1) dimension layer.

This proposed model uses preprocessing techniques to improve the detection accuracy of tomato leaves. The learning rate is 0.0001 and 50 epochs are used with a batch size of 32.

4.1. Experimental setup

The studies were carried out with the use of Python programming language and the tomato leaf disease dataset. TensorFlow and Keras were used as the backend for deep learning and NVIDIA Tesla P40 with 24 GB RAM was used for training and testing.

4.2. Quality assessment

The current work compares the functioning of an ensemble learning model and a single pretrained model using five assessment criteria, including precision, recall, F1-score, specificity, and accuracy.

Precision = Tp

The F1-score is a measure of how well the neural network classified the data set, and its accuracy is determined by Equation (7).

Specificity = Tn Tn + Fpp

The pretrained model VGG16 has 16 layers with 138,423,208 trainable parameters and the accuracy increased from epoch 0 to 40 until it reached the testing and training values of 94.01% and 96.18%, respectively. The accuracy curve stabilized after 40 epochs at a value of 95.27%. The proposed DELM model has included 51.2 M parameters for trained the dataset and attained 98.01% accuracy as well as showed 93.58% F1-score which is far better than other models.

The AlexNet shows 91.18% sensitivity with 97.12% of specificity, and the VGG16 shows better accuracy results as compared with other trained models.

5.2. Ensemble model evaluation performance

This study compares ten different ensemble learning models to determine whether performance metrics have improved by the architecture shown in Figure 1. The VGG16 shows better accuracy in comparison with other prototypes that are trained ahead, and the two-layer ensemble model shows less accuracy. Ensemble learning is used to demonstrate its effectiveness in comparison to a single model, and the ensemble deep learning model with InceptionV3, VGG16, and GoogleNet models shows a 96.41% F1-score value which is far better than another model.

5.3. Discussion

The present study utilized both ensemble learning models and single pretrained models to conduct a multiclass classification analysis of superresolution tomato leaf images. The results indicate that the F1-score appears to be a more advantageous statistic in situations where the distribution of classes is imbalanced.

The amount of deep learning models integrated to create DL ensembles does not appear to have a significant influence on the model's precision. The sort of ensemble chosen has an impact on the outcomes.

InceptionV3, VGG16, and GoogleNet are effective methods for categorizing diseased superresolution images into ten different classes, including Early blight, Bacterial spot, Healthy, Leaf mold, Late Blight, Septoria spot, Mosaic virus, Spider Mite, Yellow Curl Virus, and Target Spot.

6. Conclusion

The following study uses ten classes of superresolution images to classify tomato leaf disease using both ensemble and single learning models.

The proposed DELM model has been used for medical diagnosis of various diseases such as skin, brain. Its accuracy increased from epoch 0 to 40 until it reached the testing and training values of 94.01% and 96.18%.