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AN INCREMENTAL LEARNING METHOD FOR CLASSIFICATION OF PLANT LEAVES USING DEEP LEARNING

P. SIVA PRASAD and Dr. A. SENTHILRAJAN

Research Scholar
Department of Computer Science
Alagappa University, Karikudi
630 003, Tamil Nadu, India
E-mail: prasadsiva_17@yahoo.com

Professor and Director
Department of Computational Logistics
Alagappa University, Karikudi
630 003, Tamil Nadu, India
E-mail: agni_senthil@yahoo.com

Abstract

Research on plant leaves is an impact on Agriculture. Plant leaves have an essential role in environmental protection. Recognition of plant leaves is essential to agricultural environments. A leaf dataset has a collection of shape and vein, colour, and texture features extracted from digital leaf images. In this paper, we have used Flavia dataset and we have proposed a Boost incremental learning method to train the model on small leaf sub-datasets when extracted features are huge to place into memory. Due to this boost incremental approach, we have obtained 98% accuracy in classification of plant leaves. This work addresses and provides better solutions for classification of plant leaves using Convolutional Neural Network.

I. Introduction

The leaf is an important part of a plant. Leaves are in various shapes and sizes. A leaf has only one blade. This type of leaf is called a simple leaf. An oak leaf is example of simple leaf. A leaf has two or more blades. This type of leaf is called compound leaf. An ash leaf is example of compound leaf. Leaf

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shape, margin, and venation are the key features used in plant recognition. Leaves of plants are different shapes (rounded, oval, spear shaped, heart shaped or triangular). Some leaves look like fingers. The leaves of the plants have a lot of information about the plants. This information is used to detect plant leaves. To detect plant leaves with manually extracted features from leaf images, the machine learning methods are used. Using Deep learning techniques, we can store the leaf image to a system and then the system can extract essential features automatically. With deep learning workflow, valid features are automatically extracted from leaf images. In deep learning, one of the most and best popular approaches is Convolutional Neural Network (CNN). This approach eliminates the need of manual feature extraction. CNN approach can extract the features automatically from the leaf images and recognise the leaf using extracted leaf features. There are different layers in Convolutional Neural Network (CNN). These are input layer, a convolution layer, a pooling layer, a fully-connected layer, and an output layer. These layers are classified into two parts. These are feature extraction part and classification part. Feature extraction part has an input layer, a convolution layer, and a pooling layer. Classification part has a fully-connected layer and an output layer. In the below CNN workflow, CNN takes a leaf as input, which is learned and recognized under a certain class as Apple, Mango, Lemon, etc. In CNN, each input leaf image will pass by a sequence of convolution layers along with pooling, fully connected layers, filters. Later, we will apply the Soft-max function to classification the leaf image. In this research, we have proposed a boost incremental learning approach to train the model on small sub datasets when extracted features are too huge to fit into memory. Due to this boost incremental approach, we have obtained better accuracy score in classification of plant leafs.

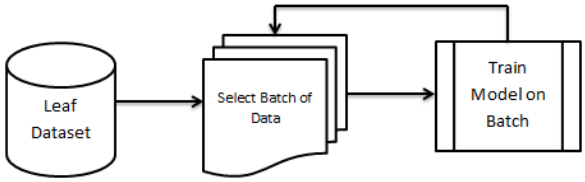
II. Related Work

Many Researchers have completed research works on the recognition of plant leaves. Various Research Studies have recognized the plant leaves by extracting of features from the leaf image. Many Researchers have published Research papers on detection of plant leaf in Journals and conferences. Several researchers have worked on Artificial Neural Networks and Machine Learning approaches for classification of leaves of plants.

III. Proposed Learning Approach

In this paper, we have proposed a boost incremental learning approach. This approach trains the model on the small sub-datasets when extracted features are large to fit into memory.

Process of boost incremental learning method. First, this method can Load a small batch of data from the dataset, then Train the model on the batch, and then repeat looping through the leaf dataset in batches, training, until reach convergence.



When extracted features are large to place into memory, we have trained small subsets of the data using batches. With a batch, we have loaded significantly less data. With batches, we do not need to load entire dataset into memory at the beginning.

IV. Evaluation Results

To test the proposed method, we have used a Flavia dataset. This dataset has a collection of shape and vein, colour, and texture features extracted from digital leaf images. The evolution of implementation is done with *R*-Programming and several packages are used to get the well results. For the research point of view, *R*-Programming is for several applications based on research. The results have showed a better degree of accuracy compared to the previous approaches. The experimental outcomes show that the proposed approach is a valuable approach, which can significantly support an accurate detection of plant leaves in a little computational effort.

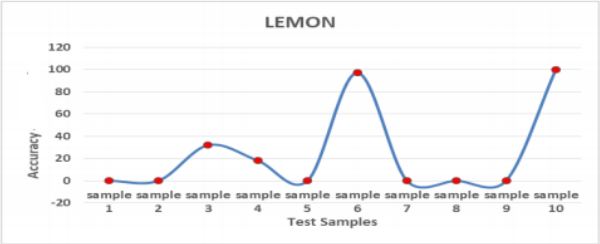


Figure 6. Lemon Plant Leaf Accuracy.

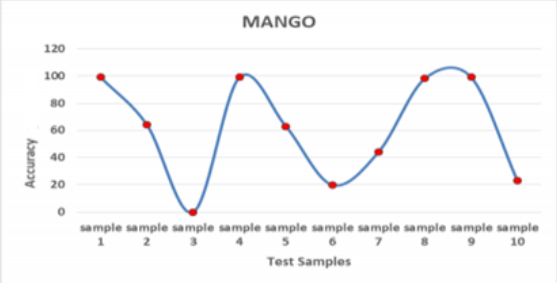


Figure 7. Mango Plant Leaf Accuracy.

The boost incremental approach plays a prominent role in the performance. In this work, we acquired 98% accuracy due to proposed learning approach.

Table 1. Results of CNN for various dataset labels.

Dataset Labels	CNN
3	98%
6	91%
10	86%

V. Conclusion

In this paper, we have proposed a boost incremental learning approach to train the model on small subsets of the data when extracted features are too huge to fit into memory. The proposed learning approach can train the model on datasets to fit into memory. In this work, the proposed learning approach performs well compare with the previous approaches. Flavia dataset is used

to extract the features to shows the performance. Due to proposed method, we got the better accuracy. This work addresses and provides better results to detect plant leaves using CNN. Compared with existing approaches, proposed approach is fast in performance, efficient in classification and easy in implementation.

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