

Plant Leaf Recognition

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I. INTRODUCTION

The number of plant species is estimated to be over 220000 in the world [1]. Automatic plant species recognition with image processing has gained increasing interests recently. The main application are crop/weeds identification, plant biology research and species tracking [3]. We compare the results of traditional handcrafted features and features extracted from pre-trained convolutional neural network, particularly on natural images, which can may have mutiple objects, various shape, color and texture due to viewpoint and occlusion.

II. RELATED WORK

There are lots of research on leaf classification and most of them focus on shape, texture and margin features, [1] [3]. These features can achieve very good accuracy on ideal images, which consist of single well aligned object on a contrasting background, such as data set [TODO]. Recently, with the huge success of Convnets [TODO]

III. APPROACH

A. Overview

We break down the problem into two pieces. Firstly, we want to locate the leaf in the image which is an object detection problem. This becomes more important if the leaf is not the single salient object in the image. We use typical method which is to scan the image and determine where the match may occur by a constructed binary classifier.

The variations of leaves can this harder. Then, optionally we can apply background removal on the detected image. Finally, we identify the leaf to one of the varied classes, which is a category recognition problem. For which we explore traditional method Bag of Feature method and CNN.

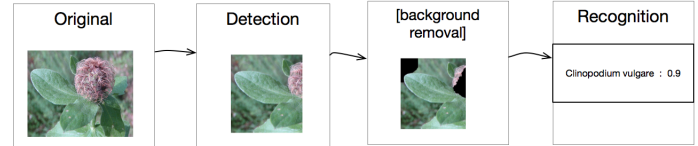


Fig. 1. Pipeline of the system

B. CNN

We use transfer learning method i.e., pre-trained model as feature extractor and then fine-tune the model to fit our data. [Explain the data set for our pre-trained model and why this is this is applicable to our problem, i.e. same feature space.]

The rest of the report is organized as follows. In section ??

IV. DATASET

We found these datasets.

- 1) ImageCLEF [7]: the most challenging dataset as images are collected through crowd sourced application. 250 species with 26077 images.
- 2) UCI leaf dataset [4]: 40 species with 5 to 16 samples per specie
- 3) Kaggle leaf dataset[3]: 99 species with 16 samples per specie
- 4) Swedish leaf dataset [5]: 15 species with 952 samples (roughly 60 samples per specie)
- 5) Flavia leaf dataset [6]: 33 species with roughly 60 samples per specie

V. OBJECT DETECTION

A. Object Detection with HOG

We use tranditional exhuastive search method to scan through all scales

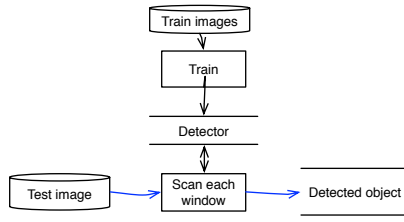


Fig. 2. Leaf Detection

VI. OBJECT RECOGNITION

A. Bag of Features (BoF) + local feature descriptors

Due to the simplicity and performance, this well established approach was taken at first. Interest points are detected from the raw images and then local invariant feature descriptors are collected, which are clustered to form the visual vocabulary/codebook. Afterwards, each raw image can be represented with histograms of visual words, i.e. term vectors. We have prototyped a BoF system, based on the OpenCV package. Here is the illustration of the system 3.

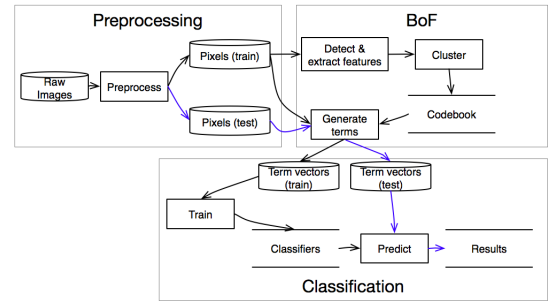


Fig. 3. System Design for BoF

During preprocessing, raw images are converted to gray-scaled images and resized to reduce computation complexity. We extract SIFT descriptors from the pixels after detecting the key points. Limiting the width of image to 128 pixels, we have roughly 200 SIFT descriptors per image. Then all the descriptors are clustered to build visual words via K-Means. Due to computation complexity, we pick randomly 100 training images to build the visual vocabulary for the initial run.

B. CNN

VII. RESULTS

VIII. CONCLUSION

REFERENCES

- [1] Charles Mallah, James Cope, James Orwell. Plant Leaf Classification Using Probabilistic Integration of Shape, Texture and Margin Features. Signal Processing, Pattern Recognition and Applications, in press. 2013
- [2] Itheri Yahiaoui, Nicolas Herve, and Nozha Boujemaa. Shape-based image re-trieval in botanical collections, Lecture Notes in Computer Science including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics, vol. 4261 LNCS, pp 357-364, 2006.
- [3] Jassmann TJ, Tashakkori R, Parry RM (2015) Leaf classification utilizing a convolutional neural network. In: SoutheastCon
- [4] Neeraj Kumar, Peter N Belhumeur, Arijit Biswas, David W Jacobs, W John Kress, Ida C Lopez, and Joao VB Soares, Leafsnap: A computer vision system for automatic plant species identification, in ECCV, pp. 502516. Springer, 2012.
- [5] DavidHall,ChrisMcCool,FerasDayoub,NikoSunderhauf, and Ben Upcroft, Evaluation of features for leaf classification in challenging conditions, 2015.
- [6] Monica G Larese, Ariel E Baya, Roque M Craviotto, Miriam R Arango, Carina Gallo, and Pablo M Granitto, Multiscale recognition of legume varieties based on leaf venation images, Expert Systems with Applications, vol. 41, no. 10, pp. 46384647, 2014.
- [7] Hasim A, Herdiyeni Y, Douady S (2016) Leaf shape recognition using centroid contour distance. In: IOP conference series: earth and environmental science, p 012002
- [8] Hall, David, McCool, Chris, Dayoub, Feras, Sunderhauf, Niko, Upcroft, Ben (2015), Evaluation of features for leaf classification in challenging conditions. In IEEE Winter Conference on Applications of Computer Vision (WACV 2015), 6-9 January 2015, Big Island, Hawaii, USA.
- [9] Pedro F. B. Silva, Andre R.S. Marcal, Rubim M. Almeida da Silva. Evaluation of Features for Leaf Discrimination. 2013. Springer Lecture Notes in Computer Science, Vol. 7950, 197-204.
- [10] <https://archive.ics.uci.edu/ml/datasets/Leaf>
- [11] Oskar J. O. Sderkvist. Computer vision classification of leaves from swedish trees. Master's Thesis, Linkoping University, 2001.

- [12] Stephen Gang Wu, Forrest Sheng Bao, Eric You Xu, Yu-Xuan Wang, Yi-Fan Chang and Chiao-Liang Shiang, A Leaf Recognition Algorithm for Plant classification Using Probabilistic Neural Network, IEEE 7th International Symposium on Signal Processing and Information Technology, Dec. 2007, Cairo, Egypt
- [13] <http://www.imageclef.org/2013/plant>