Plant Leaf Recognition

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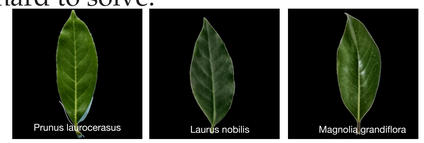
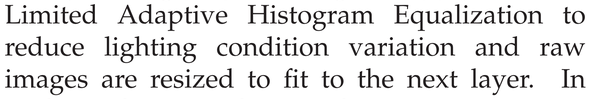
Problem

Fine-grained leaf recognition with image processing has important application in weeds identification, species discovery, plant taxonomy, and so on. The subtle differences between species and the sheer large number of categories makes it hard to solve.



Method



Firstly, during preprocessing, we apply Contrast Limited Adaptive Histogram Equalization to reduce lighting condition variation and raw images are resized to fit to the next layer. In traditional approach, we also use K-means to remove background color heuristically. For challenging dataset, we find the convex hull containing the largest N contours and then use GrabCut to segment leaf out of the background clutter. Next we extract features and we explore two options,

1. ConvNets. We take transfer learning approach, in order to make use of the power of ConvNets with the constrains of time and computations. Specifically, we take a couple of ConvNets that are pretrained with ImageNet for ILSVRC object image classification task, remove one or two top layers and then treat the rest of the ConvNet as fixed feature extractor for the our data set.
2. SIFT + Bag of Features Key points are densely sampled and SIFT feature descriptors are retrieved from each raw images. Then At last, we train a classifier, using the feature vectors from the above step and predict labels for our test data.

Dataset

1. Clean images: little or no luminance or color variations), e.g. Swedish leaf dataset and Flavia leaf dataset.
2. Challenging images: considerable variations on lighting conditions, viewpoints, background clutters and occlusions, no bounding box, e.g. ImageCLEF which is crowd sourced. (To effectively evaluate our approaches, we use subsets of this dataset.)

Transfer Learning - ConvNet

[Explain architecture and give more insights for ConvNet]

Results

Vocabulary size	Softmax	Linear SVM	RBF SVM
100	0.86	0.86	0.87
1000	0.93	0.93	0.93
2500	0.93	0.94	0.94

Discussions

1. As expected, pre-trained CNN codes yields better accuracy than hand crafted features.
2. Image augmentation is important for datasets with huge variations between train and test data.

Future works

[Explain object detection half backed idea and works]

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