A Morphological and Gradient based Approach to Classify Plant Leaves Using Support Vector Machines

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Abstract

Plants are an important resource for human well-being. Plant recognition is very essential in agriculture for the management of plant types whereas botanists can use this application for medicinal purposes. Leaves of different plants have different characteristics which can be used to classify them. The key issue in leaf recognition lies in whether the chosen features are constant and have good capability to discriminate various kinds of leaves. This paper presents a simple and computationally efficient method for plant identification using digital image processing and machine learning techniques. The proposed approach consists of three phases: preprocessing, feature extraction and classification. Preprocessing is the technique of enhancing data images prior to computational processing. The feature extraction phase derives features based on basic geometrical, digital morphological and histogram of oriented gradients (HOG) of a leaf image. The basic feature measures are the leaf diameter, area, perimeter, physiological length and width. The morphological features are smooth factor, aspect ratio, form factor, rectangularity, narrow factor, and perimeter ratio of diameter, perimeter ratio of physiological length and physiological width, and vein features of leaves. These features are then represented as a fixed-length feature vector which is the input to a standard classifier for efficient classification. The testing results were obtained with linear support vector machine (SVM) classifiers performed as multiclass classification. SVMs are generally robust over different training samples as it delivers a unique solution, since the optimality problem is convex. The proposed method is evaluated on *Flavia* dataset that consists of thirty two classes each having 50–77 sample of plant leaves. The proposed system is trained with few images (i.e., 30 images per class) and tested on a large number of images of the *Flavia* dataset. Moreover, the proposed system involves no manual process in extracting features and classifying them. Testing results show around 90% of classification rate using HOG descriptors combined with basic and morphological features. We also increased our training set and reduced the testing set to be as 10 images per class so that the comparison of the proposed technique becomes same as of others' experimental setup in the literature. In this regard the classification rate is slightly better than others and found to be near 95% with the reduced feature set of basic and morphological features. Our main argument in this work is not just to show an increased performance but to propose the selection of discriminative features that could be applied on the classification of plant leaves.

Author Keywords

Plant leaf identification; geometrical features; morphological features; *Flavia* image leaves