ISSN: 2278 – 909X
International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE)
Volume 1, Issue 4, October 2012

A Survey on Image Classification Methods

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***Abstract*— Image classification is one of the most complex areas in image processing. It is more complex and difficult to classify if it contain blurry and noisy content. There are several methods to classify images and they provide good classification result but they fail to provide satisfactory classification result when the image contains blurry and noisy content. The two main methods for image classification are supervised and unsupervised classification. Both classification has its own advantage and disadvantage. It is difficult to obtain better result with the noisy and blurry image than with normal image. The main aim of literature survey is to provide a brief overview about some of most common image classification method and comparison between them. Finally it has shown that Self Organizing Tree Algorithm, an unsupervised classification method classify the images to 81.5% even it contain blurry and noisy content. Hence proved that it is the best classification method.**

Index Terms*— Blurry images, Image classification, Noisy images, Supervised classification, Unsupervised classification.

I. INTRODUCTION

Every day thousands of images are generated, which implies the necessity to classify and access them by an easy and faster way. Classification is an information processing task in which images are categorized into several groups. Categorization of scene allows us to efficiently and rapidly analyse surroundings. A scene is characterized as a place in which we can move. Classifying scenes (such as outdoor, indoor, and sports) is not an easy task if it contain blurry and noisy content. The scene classification problem has two critical components representing scenes and learning models for semantic categories using these representations. When images include occlusion, poor quality, noise or background clutter it is very difficult to recognizing an object in an image and this task becomes even more challenging when an image contain multiple objects.

To identify the features occurring in an image is the main objective of image classification. Supervised classification and unsupervised classification are the two main image classification methods. In supervised classification, trained database is needed and also human annotation is required. In unsupervised classification, human annotation is not required and it is more computer automated.

Manuscript received Aug15, 2012.

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II. IMAGE CLASSIFICATION METHODS

Image classification is one of the important and complex processes in image processing. There are several image classification methods. The two main image classification methods are supervised classification and unsupervised classification.

A. Supervised classification

Supervised classification requires prior information before testing process and it must collected by analyst. In this analyst identifies representative training sites for each informational class and also here algorithm generates decision boundaries. Commonly used supervised classification approaches are parallelepiped, minimum distance to mean and maximum likelihood. The steps in supervised classification approach are:

- Training areas for each informational class are identified by analyst
- Signatures identifies(mean, variance, covariance, etc)
- All pixels are classified
- Map Informational Class

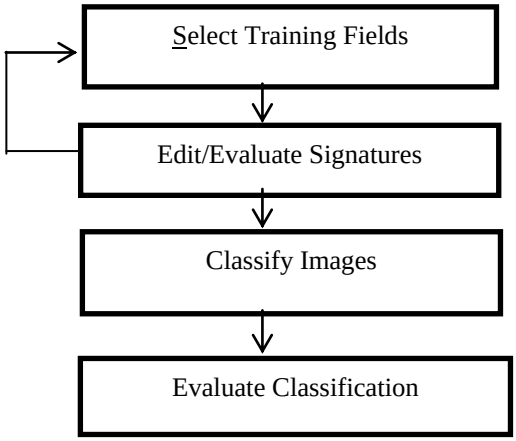


Fig 1.Supervised Classification

Noridayu *et al*. [1], proposed a new approach for improving performance of object class recognition by combining different features with local features. In this, the features are extracted from the image, which are boundary-based shape features and local features. The first type of feature is based on the outline of segmented objects while the second are based on the interior information of objects. Two features thus obtained are combined and then concatenating those features in a new single feature vector by

using feature fusion approach. Then features are classified by using Support Vector Machine. The classification accuracy is 70%.

Yasuo *et al*. [2], increased the performance of global features by using local feature correlation and then classifying scene. First local features are extracting from the image. It involves two steps, keypoint detection based on grid and feature description using SIFT descriptor. Next classification of scene is based on Linear Discriminant Analysis (LDA). The average classification accuracy rate is 70%. This method does not classify objects more clearly, they only classify scenes. The disadvantage is that method is poor in object recognition.

Shanmugam *et al*. [4], classifying war scene from the natural scene by extracting wavelet features. By using After extracting wavelet features they are classified by using Artificial Neural Network and then Support Vector Machines (SVM). This paper also compares Artificial Neural Network and Support Vector machine and determining which one is best to classify war scene. First from the input image wavelet features are extracted and then that extracted features are given to normalization inorder to maintain the data so that performance of classifier can be improved. Normalized features are given as input to Artificial Neural Network and also to Support Vector Machine. ANN classify the image using backward propagation algorithm and SVM classify the image using radial basis kernel function with p=5. In the case of SVM, it gives only 59% classification rate and in the case of ANN, it gives only 72.5% classification rate. Thus ANN provides good classification result in classifying war scene by extracting wavelet features when compared with SVM.

Vogel and B.Schiele [5], proposed a novel image representation to access natural scenes by local semantic description. They use a spatial grid layout which split the images into regular subregions. The techniques use both color and texture to perform landscape image classification and retrieval based on a two stage system. First the image is partitioned into 10×10 subregions and each one is classified using K-NN or SVM. An image is then represented by a so-called Concept Occurrence Vector (COV) which measures the frequency of different objects in a particular image. Given the image representation a prototypical representation for each scene category can be learnt. Image classification carried out by using the prototypical representation itself or Multi SVM approach. The advantage of this approach is that they it uses human meaning to classify the object and then image and able to classify image into big number of categories. The average classification accuracy is 71.1%. The disadvantage of this approach is that here image classification is based on object occurrence so a wrong object classification will result into erroneous image classification.

Ponce *et al*. [9], proposed a spatial pyramid matching for recognizing natural scene categories. This technique works by repeatedly subdividing the image and computing histograms of local features at increasingly fine resolution and taking a weighted sum of number of matches that occur at each level of resolution (L). This simple operation significantly improve performance over a basic bag-of-features representation. Two features extracted first one is "weak features," which are oriented edge points, i.e., points whose gradient magnitude in a given direction exceeds a minimum threshold. Second one is higher dimensional "strong features," which are SIFT descriptors of 16×16 pixel patches computed over a grid with spacing of 8 pixels. The pyramid matching works by placing a sequence of increasingly coarser grids over the feature space and taking a weighted sum of the number of matches that occur at each level of L. The two points are said to match at any fixed resolution if they belongs to same cell of the grid. The resulting "spatial pyramid" is a simple and computationally efficient extension of an orderless bag-of-features image representation, and it reduces to standard bog- of-words when L=0. Multi-class classifier is done with SVM. This method achieves high accuracy on a large database of 15 natural scene categories and the well known Caltech-101 dataset. The classification rate is 72.2%.

Discussion

The advantage of supervised classification are operator can detect errors and often remedy them. The disadvantage of this approach are training data can be time consuming and costly and also training data selected by the analyst, may not be representative of conditions encountered throughout the image. The another disadvantage of supervised classification is it is prone to human error.

B. Unsupervised classification

In unsupervised classification, prior information is not needed. It does not require human annotation, it is fully automated. This algorithm identifies clusters in data and also analyst labels clusters. The steps in unsupervised classification are

- Clustering data
- All pixels are classified based on clusters
- Spectral class map
- Clusters are labeled by analyst
- Map informational class

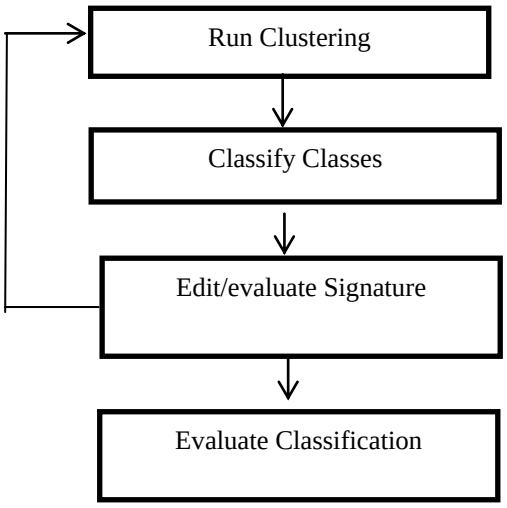


Fig 2. Unsupervised Classification

Selim et al. [5], proposed a new method for classifying outdoor scenes. First, by using one-class

classification and patch-based clustering algorithms images are partitioned into regions. Secodly, to obtain region types codebook , the resulting regions thus obtained are clustered, and then two models are constructed for scene representation: a bag of individual regions representation where each region is considered separately, and a bag of region pairs representation this means regions with same spatial relationships are considered together. Given these representations, scene classification was done using Bayesian classifiers. The advantage of this approach is that the proposed models significantly outperform global feature-based techniques. The correct classification rate is 62%.

Fei-Fei *et al*. [6], proposed a new approach to classify events into static images by integrating scene and object categorization. The technique used to categorize scene and object is an integrative model. By using this model they are extracting local features from the image and then categories object and after categorizing object they recognize the scene and then by integrating both scene and object recognition events are classified. For example if an event is given such as rowing, inorder to identify this event as rowing firstly identify the objects such as tree, water, athelete and then label scene as lake and finally by integrating both scene and object classification, that particular event is identified as rowing. Thus this model is trying to tell three answers: what, where and who. The model can classify the events correctly at 73.4% accurately. The disadvantage of this paper is that by scene or object categorization alone cannot achieve this performance.

Fei-Fei and P. Perona [7], proposed a method to classify natural scene. The images of scene are represented by a collection of local regions. These local regions are denoted as codewords. Then these codewords are automatically distributed to each local patch. Then identify a model that represents the distribution of these codewords in each category of scenes. In recognition, they first identify all the codewords in the unknown image. Then find in which category model distribution of these codewords of that particular image belongs to. Thus they classify images. In this classification scenes are categorized in the training phase itself so time will be less when recognizing unknown images and also here codewords are automatically distributed to each local patches that extracted froom the image. The images are correctly classified at 76%.

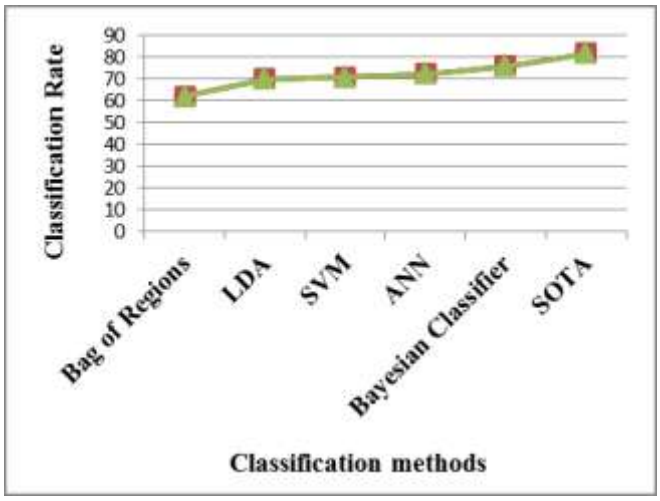
Jiang *et al*. [8], proposed a scene oriented hierarchical classification of blurry and noisy images. Three strategic approaches used are global pathway for essential capture, local pathway for highlight detection and thirdly hierarchical classification. In this firstly extracting global features by using gabor filter, from that gabor image extract only real part and then applying Principle Component Analysis (PCA) to reduce dimensionality. Then get the visual context by combining real part of gabor image and PCA. Secondly, pseudorestoration is done directly on blurry and noisy images and from that pseudorestored image highlight detection ie set of local features has been finded and then extract conspicuous local features by using Harris Affine detector and thirdly combining both features by using log linear model and clustered by using Monte Carlo approach. Finally, these clustered features are classified by using Self Organizing Tree Algorithm (SOTA). The classification rate is 81.95%.

Discussion

The advantage of unsupervised method are time taken is less and minimize human errors and also no extensive or detailed a priori knowledge of the region is required.The disadvantage of this method are maximally-separable clusters in spectral space may not match our perception of the important classes on the landscape and also limited control over the "menu" of classes**.**

TABLE 1
CLASSIFICATION RATE OF VARIOUS IMAGE CLASSIFICATION METHODS

METHOD	**CLASSIFICATION RATE**
Bag of Regions	62%
Linear Discriminant Analysis(LDA)	70%
Support Vector Machine(SVM)	71.1%
Artificial Neural Network(ANN)	72.5%
Bayesian Classifier	76%
Self Organizing Tree Algorithm	81.95%



Graph 1 Comparison of Classification Rate for different Classification Methods

III. DISCUSSION

The classification rate of various image classification methods are shown in the table 1. It is shown that Self Organizing Tree Algorithm classify images at the rate of 81.95% even it contain blurry and noisy content when compared with other image classification methods. In the

graph 1 comparison of classification rate for different classification methods are also shown. In the X-axis classification methods and in the y-axis classification rate is shown.

III. CONCLUSION

In this paper, we discussed different image classification methods for classifying blurry and noisy images. We also discussed advantages and disadvantages of supervised and unsupervised classification. Finally we compared all the methods and conclude that Self Organizing Tree Algorithm is best one to classify images even it contain blurry and noisy content and it also reduces computational cost.

ACKNOWLEDGEMENT

We would like to express our gratitude to all those who gave us the possibility to complete this paper.

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