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Nature Scene classification using different color feature

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ABSTRACT

This paper describes a process for extracting hybrid color features for natural scene images. There are different approaches to color feature analysis are tested on the classification of image from Oliva, Antonio Torralba database. For this purpose three set of image categories are taken viz coast, river, and mountains. The first method employs multispectral approach, in which image features are extracted from each channel of RGB color space. The second method uses YCbCr color space in which image features are extracted from the luminance channel Y and color features from the chromaticity channels Cb and Cr. The third method uses HSV color space in which texture features are extracted from the luminance channel V and color features from the chromaticity channels H and S. The last one uses combination of all these three method. The extracted features are trained and tested with Feed forward classifier. All the applications of the image analysis so far are limited to gray scale images. This paper investigates the usage of color natural image classification problem.

Keywords - **Feature extraction, Hybrid feature, Neural Network, HSV color model, RGB color model, YCrCb model.**

1. INTRODUCTION

Classifying scenes such as coasts, mountains, forest is not an easy task owing to their variability, ambiguity, and the wide range of illumination and scale conditions that may apply. Image classification from a database is particularly difficult for traditional machine learning algorithms because of the high number of images and many details that describe an image. For these reasons, traditional machine are unstable to classify images from a database. Furthermore, these machines take long time for classification. Hybrid combination of latent generative model with a discriminative classifier in beneficial for the task of weakly supervised image classification. They introduce a novel vocabulary using dense color SIFT descriptors, and their investigate classification performance by optimizing different parameters [5]. A method has been proposed by Caelli and Reye [7], They extract features from three spectral channels by using three multi-scale isotropic filters.

Existing image storing systems such as QBIC [3] and VisualSEEK [4] limit classification mechanism to describe an image based on color information [3], texture, or shape features. [1] Extracted wavelet and color features from a captured natural image to classify out of three groups one of the existing methods for recognition, classification and retrieval of images is based on Neural Networks (NN). An Artificial Neural Network (ANN) is an information processing system which is composed of a large number of highly interconnected processing elements (neurons) workings in unison to solve specific problem. A neuron is a simple processing unit with several scalar inputs and one scalar output. It receives the output of each neuron of the previous layer with the help of weighted connection. In order to compute its output, it multiplies each input by the corresponding connection weight, sums the resulting values, adds a threshold and then applies a transfer function to the sum. The simplest modification idea is to change the transfer function. The preprocessing computation may also be modifies [8]. The neurons may be derived from a radial basis function (RBF) as in [9], or from a multidimensional wavelet [10]. The work [2] different types of noise are classified using feed forward neural network. Images that we use in this paper have [256,256] pixels Such image is used as an input of NN, the number of input unit of NN are going to increasing and cause to The size of the NN also are increasing.

In this paper, we use the color moments information as an input of NN. Color moments have been successfully used in many color based image classification systems, especially when the image contains just the object. Feed Forward NN (FFNN) with ten hidden layer is used in this paper for classification. Optimized methods with Momentum are used to learning the NN.

Artificial neural networks were originally developed by researchers who were trying to mimic the neurophysiology of the human brain [11]. By combining many simple computing elements (neurons or units) into a highly interconnected system, a complex phenomenon such as intelligence is produced.

2. FEED FORWARD NEURAL NETWORK

Neural networks are a very popular data mining and image processing tool. Their origin stems from the attempt to model the human thought process as an algorithm which can be efficiently run on a computer.
The multi layer perceptron is now widely used as an efficient tool for classification and for function approximation. To enhance its performance and to reduce its training time, many author proposed modification of simple structure.

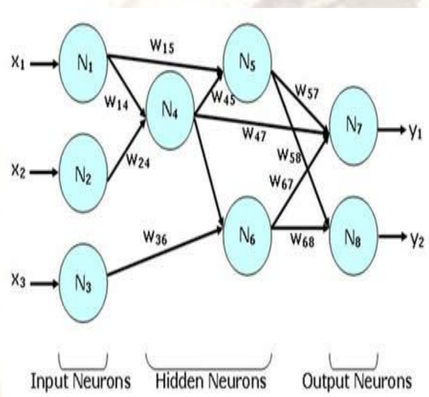

Figure 1: Neural Network

The algorithmic version of a neural network (called an artificial neural network) also consists of neurons which send activation signals to one another as shown in Figure 1. The aim of network training is to find a set of weight values that allows correct output when a feature-vector is input. Each node outputs a value to the nodes above it that are connected to it by links. Each input node outputs the value of a feature. The output of each node in the output and hidden layers in the network is computed from the values of the nodes in lower layers. The end result is that the artificial neural network can approximate a function of multiple inputs and outputs. As a consequence, neural networks can be used for a variety of data mining tasks, among which are classification, descriptive modeling, clustering, function approximation, and time series prediction. Neural networks are also commonly used for image processing.

3. HYBRID FEATURES

Since only color of the images will not be able to distinguish the different type of the image. In this approach, we use different color spaces, in order to obtain one channel containing the luminance information and two other containing the chrominance information.

Hence, hybrid feature is constructed by combining color moment feature of RGB color component, YCrCb color component and HSV color component feature of an image.

3.1 Rgb color component

Color images are represented in digital system by color intensity values of each pixel. These intensity values usually are described by three dimensional RGB color model as shown in the Figure 2.We have extracted all the three color components separately and then these are represented through statistical moment.

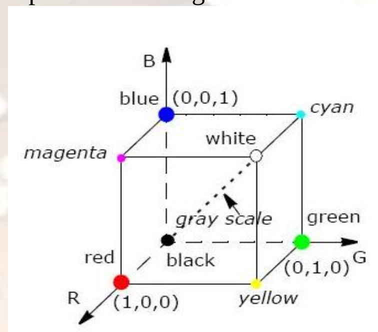

Figure 2. RGB Color Model

3.2 YCrCb color component

The YCbCr color space is widely used for digital video. In this format, luminance information is stored as single component(Y), and chrominance information is stored as two color difference components (Cb and Cr). Cb represents the difference between the blue component and a reference value, Cr represents the difference between the red component and a reference value. These features are defined for video processing purposes and so are not meaningful for human perception. The following equations transform RGB in [0,1] to YCbCr in [0,255]. These intensity values usually are described by three dimensional RGB color model as shown in the Figure 3.

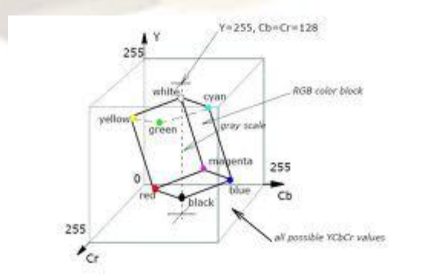

Figure 3. YCbCr Color Model

:Y=6+65.481R+128.553G+24.966B…(1)
:Cb=128-37.797R-74.203G+112B….. (2)
:Cr=128+112R-93.786G-18.214B…. (3)

3.3 HSV color component

Cylindrical-coordinate representations of points in an RGB color model, which rearrange the geometry of RGB in an attempt to be more intuitive and perceptually relevant than the Cartesian (cube) representation. They were developed in the 1970s for computer graphics applications, and are used for color pickers, in color-modification tools in image editing software, and less commonly for image analysis and computer vision. HSV stands for hue, saturation, and value, and is also often called HSB (B for brightness).

Hue
The "attribute of a visual sensation according to which an area appears to be similar to one of the perceived colors: red, yellow, green, and blue, or to a combination of two of them".
Saturation:
The "colorfulness of a stimulus relative to its own brightness".
Lightness, value:
The "brightness relative to the brightness of a similarly illuminated white".

In each cylinder, the angle around the central vertical axis corresponds to "hue", the distance from the axis corresponds to "saturation", and the distance along the axis corresponds to value.

the HSV (hue, saturation, value) color space was used. It corresponds better to how people experience color than the
RGB color space does: hue(H) represents the wavelength of a color if it were monochromatic. Hue varies from 0
to 1 when color goes from red to green then to blue and back to red. H is then defined modulo 1. As color is seldom monochromatic, saturation (S) represents the amount of white color mixed with the monochromatic color. Value(V) does not depend on the color, but represents the brightness. So H and S represent chrominance and V is intensity. The following equations transform RGB in [0,1] to HSV in [0,1]:

:V = max(R,G,B) ……………….. (4)

$:S = \frac{V - \min(R,G,B)}{V}$ …………………….(5)

$:H = \frac{G-B}{6S}, if\ V = R$ ………………...(6)

$:H = \frac{1}{3} + \frac{B-R}{6S}, if\ V = G$………..……(7)

$:H = \frac{21}{3} + \frac{R-G}{6S}, if\ V = B$……………(8)

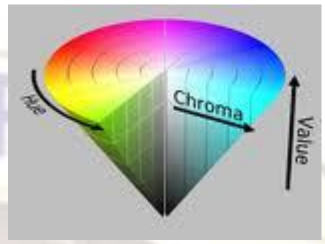

Figure 4 HSV Color Model

3.4 Color Moment Feature

The first order (mean=μ_K) the second order (variance=σ_k) and the third order moments (skewness=S_k) of) color components are described through the following equations.

$$\mu_K = \frac{1}{MN}\sum_{i=1}^{N}\sum_{j=1}^{M} P_{i,j}^{K}$$

$$\sigma_k = \left(\frac{1}{MN}\sum_{i=1}^{N}\sum_{j=1}^{M}(P_{i,j}^{k} - \mu_k)^2)\right)^{\frac{1}{2}}$$

$$S_k = \left(\frac{1}{MN}\sum_{i=1}^{N}\sum_{j=1}^{M}(P_{i,j}^{k} - \mu_k)^3)\right)^{\frac{1}{3}}$$

$p_{i,j}^{K}$ is the value of the k-th color component of the image ij-th pixel, and M is the height of the image, and N is the width of the image.

4. METHODOLOGY:

Features are extracted by using given methodology. We are using three features of images that are RGB color value ,YCrCb color value ,HSV color value and combination of all of them. After that histogram are generated of these components to find out their statistical moments (mean, variance and first order moment). After applying this process we get 27 feature of each image(3*(rgb+YCrCb_HSV component))* 3 features(mean, variance, skewness value)).

4.1 Data Set

Nine hundred sample images are taken from Oliva, Antonio Torralba database [12] with 300 sample each category mountains, cost and Forest. Each sample scene is shown in the Figure 5.

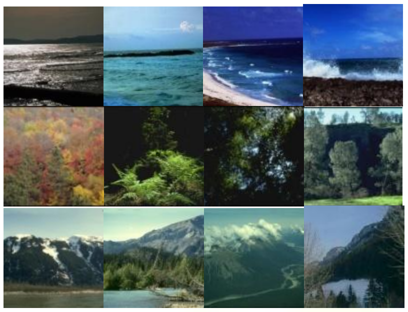

Figure 5. Sample Images of coast, Forest, Mountain

4.2 Algorithm for proposed Scheme

Step 1: Load Database in the Matlab Workspace.
Step 2: Resize the image for [256,256].
Step 3: Find out RGB, YCrCb, and HSV color component feature value from each image.
Step 4: Generate the histogram of each color space values.
Step 5: Generate 18 signatures of hue, 3 for saturation and 3 for value and 3 stastical moments for each RGB, YCrCb.
Step 6: Store the signature of images into databases of matfile, for hybrid feature RGB, YCrCb and HSV color space feature.
Step 7: Train the network using Feedforword neural network.
Step 8: Load the test image.
Step 9: Repeat steps 1 to 7 to find signature of test image.
Step 10: Classify.

4.3 Feature Extraction

The feature extraction and classification process is shown through the figure 6. A database is created of different classes of image (coast, forest, mountains). Out of 900 sample images 300 images are used to train the neural network and rest 900 images are used to test. Firstly images are resized to [256,256].

For signature or descriptive value we find the statistical moment up to 3 order moment of the coefficient matrices. Hybrid feature vector is prepared by finding the second feature color moment of the sample image, which are also described through statistical moment of RGB components extracted from the original image.

This process produces 27 signature values for each image. According to the combined color feature, images database is created. After this network are trained using 100 images of each class. Thus 300 images are used to train the network and 900 to test the Network using feed forward Neural Network.

The classification is performed over a feed forward neural network model that consist of one input layer with five neurons, one hidden layer with ten neurons and one output layer with 3 neurons. Feed Forward Neural Network is used to train system, where the training dataset is constructed by the extracted features of the image. The entire input features are normalized into the range of [0,1], whereas the output class is assigned to one for the highest probability and zero for the lowest. The training performance graph is shown in the figure 7 with the goal 0.02.

5. EXPERIMENTAL RESULT

This section illustrates the result achieved in simulation of the test images. From the Table 1 we can say that the system has shown the best performance for "coast" images and comparatively weak for mountains. For the first category out of 200 samples 162 are classified correctly, while. Similarly for the forest images 158 are classified correctly. But in the third category 200 samples only 152 are classified correctly. As shown in given below, Table 1 shows Feature value of sample images. It shows highest classification rate using hybrid feature.

Table 1: Classification rate of individual

S.no	**Category**	**RGB feature (Percent)**	**YCrCb feature (Percent)**	**HSV feature (Percent)**	**Hybrid feature (Percent)**
1	Coast	66	89	73	81
2	Forest	80	75	70	79
3	Mountains	76	69	54	76

Table 2: Classification rate using different feature

S.no	**Classification rate**	**Classification Rate**
1	RGB feature	74
2	YCrCb feature	66
3	HSV feature	65

4	Hybrid feature	78

As shown in Table 2 Classification Rate using RGB, YCrCb, HSV and with combination of all three Color feature is 74%,66%,65% and 78% respectively.

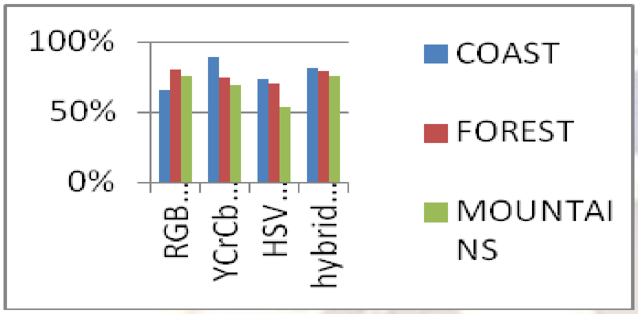

Figure 6: classification rate using different feature of various classes (Coast, Forest and Mountains)

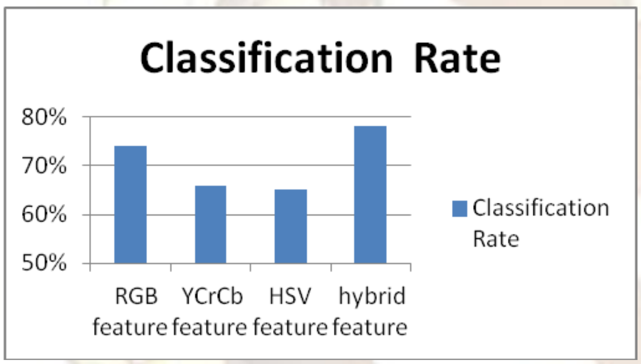

Figure 7: Classification Rate using different feature

6. Conclusion

This work proposed an efficient signature based approach for natural image classification using color moment of different color model. A feed forward neural network classifier is trained with sample pattern and shown the good results. This work can further be extended by comparing with other features of image with different classifier e.g. nearest neighbor, SVM etc.

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