Automated Color Logo Recognition Technique using Color and Hog Features

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ABSTRACT
This research work purposes an automated system for the identification of the color logo images. Color logo images are recognized using a color feature namely Color Moments and an Histogram Oriented Gradients feature. Color is modeled using Mean and Standard Deviation. Firstly we extract color moments feature from an image, and then we consider histogram analysis and make a summation of each color color bin. Classification is done using Support Vector Machine Classifier (SVM). Experimental verification is done using a dataset of 500 images divided into 10 classes

General Terms
Image processing, color based image classification.

Keywords
Logo recognition, color features, histogram features, SVM classifier.

1. INTRODUCTION
Logo sometimes so called as symbol. To advertise the product logo has serious importance in this recent marketing world. It is important because it takes the goodwill of the company and the product. Products can be identified by their brand logos. Logos, being a sign of recognition for companies, products and many more, which is very significant at different national and international incidents like football, cricket matches and others. Companies pay huge amount to advertise their brands, products, ideas and services. There are plenty of logos across the world. Identification of logos is a serious matter among business firms. In present days logo identification and recognition attracted the observation of pattern recognition. In recent days computer vision approaches and pattern recognition style have been tested towards automated method of logo recognition.

Computer aided technologies can make the procedures of identification of logo much effortless and simpler. Identification of logo has received a great importance as a major aspect in document distribution domain. After determining the logo, the origin of documents is placed which it will be appropriate in document arrangement. To retrieve correct information about the document over the recognition of logo, this may be helpful in concluding whether or not to evaluate the textual components. There are many different varieties of logos. Logos are structurally in a two dimensional format with several complications and dissimilar structures which may have sequence of textual part, graphical part and textual graphical part. Logos can be of a textual base, a graph, an image or an icon, characterized in various styles and color. For extracting the color based feature of training and testing logo images Mean and Standard Deviation are used. For extracting HOG (Histogram of Oriented Gradients) features of testing and training logo images Red, Green and Blue component are stored in three different ways. Finally SVM classifier is used to classify between the sample sets of training logo images and testing logo images of the class.

2. RELATED WORK
Previous literature study relevant to logos in document images have attracted most completely on logo recognition. In paper [1] the author presented an approach based on spatial and structural property of logo images. Logo recognition is one of the concerned facets of graphic identification sector. First of all normalization is done. After normalization steps, removes the reactivity of the logo identification process to dissimilar scale, a characteristic is extricated based on horizontal and vertical histograms of the logo image. The author used KNN classifier to identify logo images. In this paper verification is done using 105 logo images in TFF format. There are 5 main steps. The results show robustness in the logo recognition.

Another approach of the earliest work [2] appeared a multi level staged wayout utilizing geometric invariants to logo recognition which used global invariants to trim out the database and local affine invariants to acquire additional clear match. The difficulty of logo identification is of high attention in the document domain, particularly for the databases, in view of the fact that its potential for recognizing the origin of the document and its generalization as an identification difficulty. By means of identifying the logo, achieve the correct data about the documents and that may be helpful to get the conclusion whether or not to evaluate the text based documents. Achieve an invariant signature which can be used for coordination under a variety of transformations. A method is provided for measuring Manhattan invariants, and shows how to expand them to abduct the similarity, affine and projective invariants when required. This research executes feature detection, feature extraction and local invariant algorithm and strongly exhibit the approach on a short database.

In paper [3] the author proposed the two segmentation algorithm. In the first, wavelet based segmentation algorithm, the detected segments are separated from the document image and the other part of the image is segmented by the threshold based segmentation algorithm. In the second segment algorithm the non segmented regions from applying the first algorithm are separated to foreground and background categories by applying a threshold that is found from grey-level histogram. Later on, when both segmentation is done, MLP classifier is used. Lastly KNN classifier is used.

In paper [4] the author proposed an employment system to notice and identify video stream logos which have great interest in today's marketing. Logos are used to identify the different products, companies and different gaming league. So, the system uses two-way matching features. Feature set

using Scale Invariant Feature Transform (SIFT) key point is generated for each and every query logo and video frame is being processed. Model fitting is done using Random Sample Consensus (RANSAC) algorithm to subdue any outliers from two-way matching process. Finally the decision is made about the presence of logo the threshold scheme is used. Then boundary is identified around the matched logo. For experimental verification 13 different videos of 3146 frames of various resolutions were used. The results showed that the system reached the precision rate of 89% and a recall of 99%.

3. SYSTEM OVERVIEW

This system is designed to classify different logo images that belong to various classes by extracting some feature values. The overall process flow diagram is shown in the Figure 1.

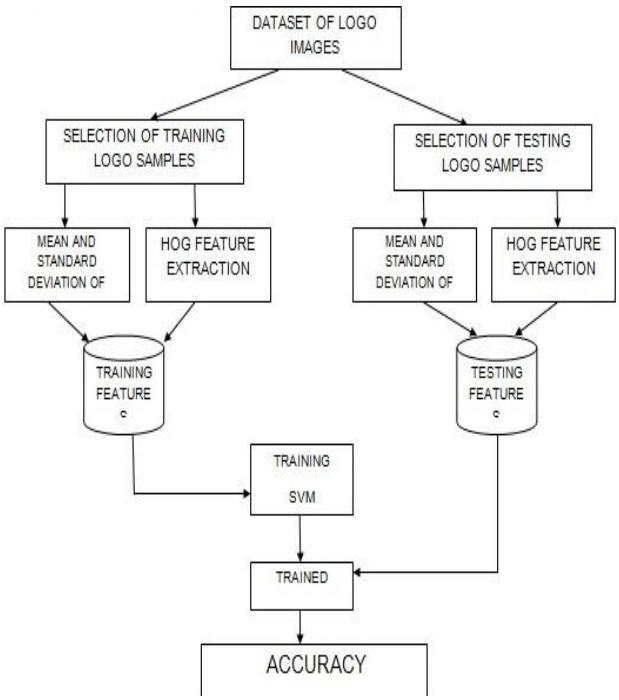

Fig 1: Process Flow Diagram of the proposed approach

3.1 Image Color Moments Analysis Method

Color moments are used to discriminate the different color logos depend on the features of the color. This moment is used to calculate the color closeness between images. Striker and Orengo[5] use two central moments of an image's color distribution. They are Mean, Standard deviation. A color can be defined by 3 or more values (Red, Green, and Blue).Moments are calculated for each of these channels in an image. An image therefore is characterized by 6 moments 2 moments for each 3 color channels.

We will define the i-th color channel at the j-th image pixel as *Pij*. The two color moments can then be defined as:

MOMENT 1 - Mean

MOMENT 2 - Standard Deviation.

3.2 Image Color Histogram Analysis Method

The color histogram of an image is constructed by quantizing the colors within the image and counting the number of pixels of each color. The histogram provides a compact summarization of the distribution of data in an image. The color histogram of an image is relatively invariant with translation and rotation about the viewing axis, and varies slowly with the angle of view. Color histogram of an image is a type of a bar graph and these acts as a graphical representation of the tonal distribution in a digital image.

The number of elements in a histogram depends on the number of bits in each pixel of an image. For E.g.: if we consider a pixel depth of n bit, the pixel values will be in between 0 and $2n-1$, and the histogram will have $2n$ elements. In our method we consider 8 bit image. So there are 256 different bins of color for three color space Red, Green and Blue.

In our proposed approach image histogram feature is extracted for three color space Red, Green and Blue. The histogram value matrix holds number of pixels of 256 different bins.

4. PROPOSED APPROACH

4.1 Preprocessing

To experiment the logo recognition technique, logo dataset of 10 classes are used which includes 50 logo images per class that is total 500 images in the JPG format. The images are all resized to standard dimensions 256 X 256 pixels.

4.2 Color Moments Feature Extraction

Color Moments are measures that represent the color distribution in an image in a scale in 3 different color channels R, G and B. For an RGB image 2 color moments are computed for each channel leading to a total of 6 color moments. These are:

I. Mean: The first color moment interpreted as the average value of an image channel and given by:

$$A_{i=\frac{1}{N}\sum_{j=1}^{N} P_{i,j}} \quad (1)$$

Using Equation (1) we can calculate the mean of the image channel. Here N is the number of pixels in the image and Pi, is the value of the *j*-th pixel of the *i*-th color channel.

II. Standard Deviation: The second color moment captured by taking the square root of variance of the color distribution.

$$S_{i=\sqrt{\frac{1}{n}\sum_{j=1}^{N}\left(p_{i,j-A_i}\right)^2}} \quad (2)$$

4.3 Histogram Feature Extraction

Our proposed approach to find the histogram of the color image is as follows:

i. Read the image file.

ii. Convert the image pixel to a double data class.

iii. Store the value of each Red, Green and Blue component in three different ways.

iv. Find the image histogram of Red, Green and Blue component by MATLAB's own histogram computational method.

v. Store the histogram value of Red, Green and Blue component in three arrays.

vi. Calculate the sum of 256 different bins of Red component. Apply this method for Green and Blue components also.

vii. Finally merge the value of Red, Green and Blue component in the previously created array.

viii. Step i-Viii is repeated for every image in the database.

4.4 Classification

After finding out the final feature vector, SUPPORT VECTOR MACHINE (SVM) is used as a classifier in this paper to classify various logo images belong to various classes. Support Vector Machine (SVM) is a supervised machine learning algorithm which can be used for classification purposes. It is a discriminative classifier formally defined by a separating hyperplane. However, it is mostly used in classification problems. In this algorithm we plot each data item as a point in a n-dimensional space (where n is number of features you have) with the value of each feature being the value of a particular coordinate. Then, we perform classification by finding the hyperplane that differentiate the two classes very well. SVM works really well with clear margin of separation. It is effective in high dimensional spaces. It is effective in cases where number of dimensions is greater than the number of samples. It uses a subset of training points in the decision function (called support vectors) so it is also memory efficient. In the case of support vector machines, a data point is viewed as a *p*-dimensional vector (a list of *p* numbers) , and we want to know whether we can separate such points with a (p – 1) dimensional hyperplane. This is called a linear classifier. There are many hyperplanes that might classify the data. One reasonable choice as the best hyperplane is the one that represents the largest separation, or margin, between the two classes. So we choose the hyperplane so that the distance from it to the nearest data point on each side is maximized. If such a hyperplane exists, it is known as the maximum margin hyperplane and the linear classifier it defines is known as maximum margin classifier.

5. EXPERIMENTS AND RESULTS

5.1 Dataset

For experimentations of logo recognition Logo dataset is used which includes 500 logo images in the JPG format. The dataset is divided into 10 classes. Each class consists of its own logo. There are 50 logo images as sample in each class named in numeric from 1 to 50. After downloading the logo images some preprocessing work have been done. Images are resized to 256 x 256 pixels. Among those 50 images per class, 30 logo images are used for training (TR) and 20 logo images are for testing (TS). For computing the recognition rate, comparison between training and testing sets are done using the SVM classifier. In fig: below sample images of each class are shown.

TRAINING DATASET OF 10 CLASSES

Fig2: Dataset of training classes

TESTING DATASET OF 10 CLASSES

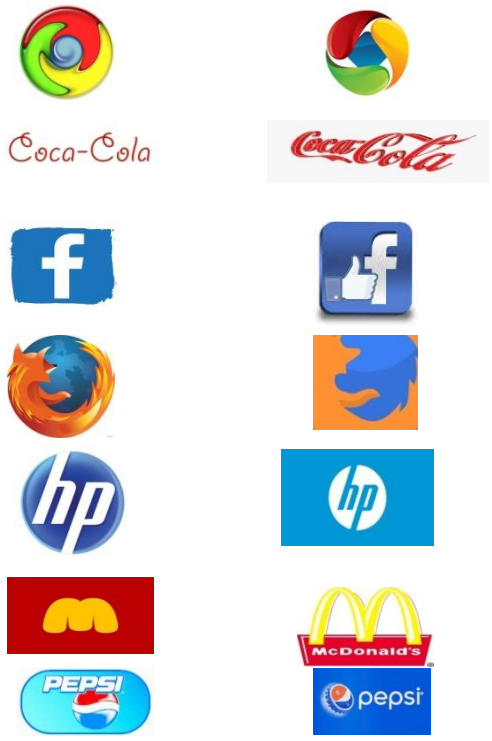

Fig3: Dataset of testing classes

So, the dataset is used to test the accuracy of the proposed approach. Logo images dataset consists of 500 images. 50 images per class, divided in 3:2 ratios for training and testing purposes, have been used to train and test the system. The size of each image is roughly 256 X 256 pixels.

5.2 Classification

Classification is performed by using Confusion Matrix for the proposed method showing the showing the performance of a classification model on a set of test data for which the true values are known. Confusion Matrix is a table layout that allows visualization of the performance of an algorithm. Each column of the matrix represents the instances in a predicted class while each row represents the instances in an actual class. It is a special kind of contingency table with two dimensions ("actual" and "predicted"), and identical set of "classes" in both dimensions.

Table 1: Confusion Matrix of the proposed approach

	1	2	3	4	5	6	7	8	9	10
1	18	0	0	1	0	0	1	0	0	0
2	0	19	0	0	1	0	0	0	0	0
3	0	0	16	0	0	0	4	0	0	0
4	0	0	0	20	0	0	0	0	0	0
5	0	0	0	0	20	0	0	0	0	0
6	1	0	0	0	0	14	0	0	5	0
7	0	0	4	0	0	0	15	1	0	0
8	0	0	0	0	0	0	0	20	0	0
9	0	4	0	0	1	0	0	0	15	0
10	0	0	0	0	0	0	0	0	0	20

Then the overall accuracy of the method is 88.50%.

6. ANALYSIS

Automated recognition of logo images have been done using combination of various methods. Using 6 Color Moments and Histogram features gives better result than the combination of Color Moments and Shape features i.e. Hu's Invariant Moments. So overall accuracy for all classes using the proposed approach i.e. using 6 color moments and histogram features is 88.50%. It has been checked that different feature extraction process and their combination gives different accuracy for all classes. But in all cases classifier is Support Vector Machine (SVM).

Table 2: the accuracy difference between different feature extraction process and their combinations

Approaches	Number of Images	Accuracy
Color Moments with Hu's Invariant Moments	500	69%
Color Moments with HOG	500	88.50%

So, from the above table it can be inferred that the proposed approach is good enough in terms of recognition accuracy and in terms of database size.

7. CONCLUSION AND FUTURE SCOPE

Image processing is an extensive scope with many utilization. There are many different types of logos in the worldwide. To recognize the logo is a main task. In this study various types of logos with transformation have been studied on for their recognition using the well known recognition techniques like Color Moments, Histogram of Oriented Gradient (HOG). After resizing the particular selected logos from the downloaded images from different websites the database is created. Then using the Color Moments, HOG descriptor feature values are extracted from all the logo images of training set and testing set and store it. Finally the Support Vector Machine (SVM) classifier is used to recognize the logo image. If we compare other existing methods this approach is fast in execution and easy in implementation.

Future work will be expanded in the following ways: (1) introducing various color variations such as changing the color tints or other color features and that might produce better results in image categorization. (2) Using other dataset or other logo images may increase the scalability. (3) Other classifier like Cityblock, Manhattan distance , Correlation, Chebychev distance can also be used to see how they act to discriminate the logos. (4) Other various features can also be used to recognize the images with a good accuracy.

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