SVM Based Classification Technique for Color Image Retrieval

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***Abstract*— Due to digitization of technology there is a large volume digital images available. In recent years, CBIR is a research field which includes quickly search field of images from large database. Among all the types available of CBIR technology, color based image retrieval is growing area of interest. The technique mentioned in this paper is to develop Support Vector Machine based classification system on image database to retrieve images. For the purpose of feature extraction Block Truncation Coding with 8 color clumps is used. For the purpose of experiment YCbCr color space is used.**

Index Terms — Block Truncation Coding, Content Based Image Retrieval , Support Vector Machine, One Against One

I. INTRODUCTION

Image retrieval is a kind of traditional information retrieval which includes images. The digitization of world created a huge amount image data. The storage of such a vast database is relatively easy as compared to retrieval. Thus the image retrieval becomes a vast research area[1,2,3].

The traditional textual retrieval techniques are not going to work efficiently and effectively on this large database. So content based image retrieval concept is originated, which works on feature of an image. The CBIR system are used in variety of application areas like medical images, military applications, photography, journalism, whether forecasting etc.

The CBIR systems divided into 3 types as shown in fig. 1 Any CBIR system involves at least four main steps, first is feature extraction and indexing of image database on chosen visual features, secondly feature extraction of query image, then matching the query image to the most similar images in the database according to some image similarity measures and last is the user interface and feedback which governs the display of the outcomes.

Out of above mentioned categories, color based image retrieval is research area for the proposed technique. Color is a basic property of image and also it enables to receive more visual information [6,7]. Classification of color image is done on its features which are extracted from histograms of color components.

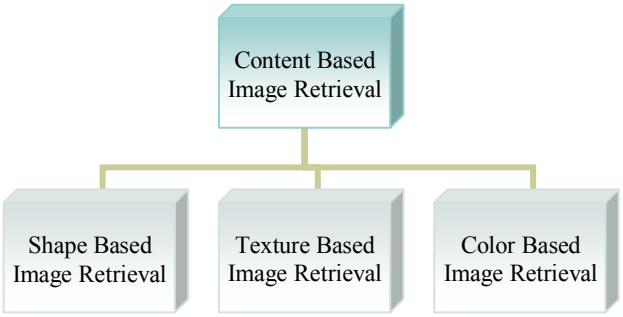

Figure 1: Classification of CBIR

II. RELATED WORK

The CBIR systems has been developed to address the issues deal with the manual image retrieval techniques. CBIR systems based on feature vector of an image, represents contained information, which are automatically produced through feature extraction algorithms[1]. For the color based retrieval systems, color histograms are the foundation. Color image is typically represented in RGB color model and histogram provides the description of color present in an image and their quantity.

Number of algorithms were developed earlier for color based image retrieval. In this era conventional histogram based matching and dominant color region based indexing technique was the early. The main drawback of these techniques is, it never retrieves the same objects of varying sizes as the similar image. In Enhanced color matching algorithm[2] color matching technique is used to find the similar value between query color image and database color image using histogram, and spatiogram and color bins[3]. But the output image precision and recall value are less than expected.

CBIR using Block Truncation coding [4] is the technique to retrieve a set of images from a collection of images such that this set meets the user's requirements. In this method R, G and B components are considered separately to calculate threshold values of each component. In Extended BTC with Color Clumps method Block Truncation Coding (BTC) is used which is one of the projecting methods for color feature

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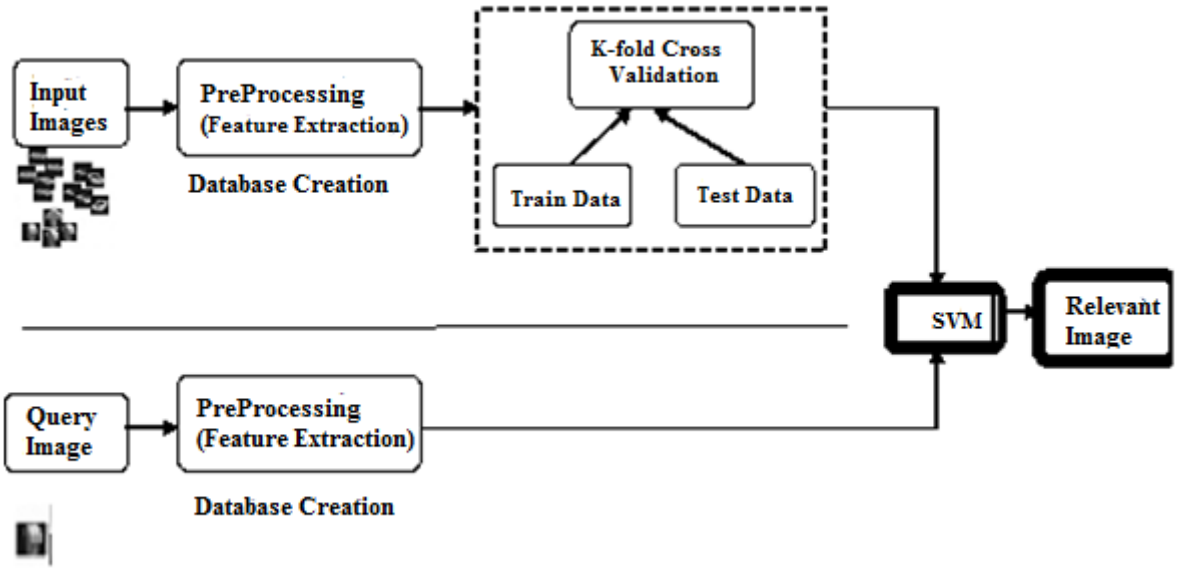

Figure 2: System Architecture

extraction [4]. To improve on color image classification the Support Vector Machine (SVM) concept is implemented, as SVM is computationally efficient[5]. So the proposed technique is a combined technique of extended BTC and SVM classifier. BTC is used to generate feature vector of an image and for the purpose of classification, the proposed system uses SVM.

III. PROPOSED SYSTEM

The block diagram of proposed system is as shown in figure 2. The proposed system is going to use Block truncation coding technique with 8 color clumps to generate feature vectors and support vector machine for image classification and retrieval.

A. Preprocessing Unit

In the preprocessing unit image feature Extraction is done using Block Truncation Coding with 8 color clumps and then that image is stored into database. The preprocessing unit first the raw image is converted into YCbCr Color Space. Then to generate feature vectors Block Truncation Coding with 8 color clumps is applied to an image.
Following algorithm is applied to generate feature vectors.

Step 1: First bit maps for individual color components are generated separately by clumping the pixel values the rage of of 0 to 31, 32 to 63, 64 to 95, 96 to 127, 128 to 159, 160 to 191, 192 to 223 and 224 to 255.

Step 2: Threshold values of each individual Y, Cb and Cr components are computed.

Step 3: With the help of above computed threshold values, 24 bit-maps are computed. Here if a pixel in each component (Y, Cb and Cr) is greater than or equal to the particular threshold, the that pixel position of the bit map will have a value 1 otherwise it will have a value of 0.

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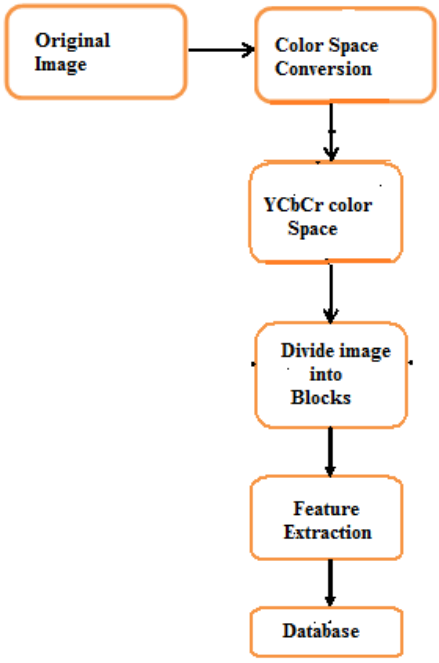

Figure 3: Preprocessing Unit

Step 4: Upper mean vector is computed from pixels greater than or equal to the respective threshold and the Lower mean is computed from the pixels smaller than the respective thresholds. Final feature vector for 8 Clumps is of size 48 having the upper and lower mean vectors.

The equation for YCbCr color space is as follows[4]

$$\begin{bmatrix} Y \\ Cb \\ Cr \end{bmatrix} = \begin{bmatrix} 0.2989 & 0.5866 & 0.1145 \\ -0.1688 & -0.3312 & -0.5000 \\ 0.5000 & -0.4184 & 0.0816 \end{bmatrix} * \begin{bmatrix} R \\ G \\ B \end{bmatrix}$$

For generating feature vectors 8 clumps block truncation is applied which ultimately gives 48 feature vectors. Eight clumps are formed as per the pixel values in the range. For each clump a mean threshold is computed. This is then stored in the database for further processing.

B. K fold Cross Validation

Basically the Cross validation goal is to define a dataset so that the model will be tested in the training phase. The main purpose is limit problems like over fitting, give an approaching on how the model will generalize to an independent data etc. Cross-validation does partitioning a sample of data into complementary subsets. Then performs the analysis on one of the training set. In K fold cross validation, the original sample is randomly partitioned into K equal size subsamples. out the K subsamples, a single subsample is retained as the validation data for testing the model, and the remaining K -1 subsamples are used as training data. The value of K is based on number of training images.

C. Support Vector Machine

They are the supervised learning models. They create good separating hyper plane in hyperspace with maximal margin. The basic SVM takes a set of input data. For each input given, this of two possible classes forms the output. That makes SVM a non-probabilistic binary linear classifier. Following fig. 4 shows the mapping of data by SVM into feature space.[5]

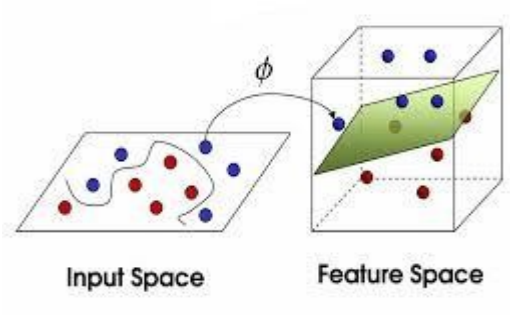

Figure 4 : SVM Mapping

There are two basic steps to use SVM as a classifier, first is training and second is Classification. In Training process contents are known along with specified classes. It creates a classifier on the basis of that known content. In Classification process a classifier is built with such a training content set and it is made runs on contents which are not known. This determines class for that content. SVM handles the nonlinear data by using kernel function. Kernel function maps the complex data in low dimension to some other higher dimension.

For the purpose of experiment, LIB SVM tool is used. LIBSVM implements the "one-against-one" approach for multiclass classification and RBF kernel for handling non linear data. If k is the number of classes, then k(k - 1)=2 classifiers are constructed and each one trains data from two classes.

Training of SVM is done by near about 600 images of 6 different classes. The classes used to train the SVM are flower, car, elephant, lion, African and rainbow.

The sample entry in LIB SVM for training set is as follows.

4 1:17.0 2:27.0 3:42.0 4:58.0 5:74.0 6:257.0 7:104.0 8:0.0 9:135.0 10:150.0 11:170.0 12:185.0 13:199.0 14:215.0 15:252.0 16:255.0 17:0.0 18:0.0 19:0.0 20:0.0 21:0.0 22:0.0 23:108.0 24:120.0 25:128.0 26:129.0 27:0 28:0.0 29:0.0 30:0.0 31:0.0 32:0.0 33:0.0 34:0.0 35:0.0 36:0.0 37:0.0 38:0.0 39:126.0 40:0.0 41:128.0 42:144.0 43:0.0 44:0.0 45:0.0 46:0.0 47:0.0 48:0.0

When train file is given as input to SVM, it generates its Model file. When an image is given for testing to the SVM, it will predict the class of image and then it will retrieve all the images from the database matching to

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that class. The SVM kernel generates an model and prediction file.

IV. Testing performance of the classifier

As the system is designed for SVM based classification of the images, it is also tested for the performance of the classifier. LIBSVM gives result of classification for testing data in the form of following parameters

- Accuracy is proportion to total number of predictions that were correct.
- Precision is proportion of the predicted positive cases that were correct.
- Recall is proportion of positive cases that are correctly identified.
- Post processing module of the system tests the performance of classifier. It gives the information about actual and predicted classifications by classification system. It retrieves all the images relevant to the given image.

For the purpose of testing of system the image database is created. The sample images are as show below in fig. 5.

Figure 5 : Sample Images from Database

V. RESULTS

In evaluating the performance of the CBIR systems precision and recall are widely used parameters. Precision is a measure of the number of retrieved images that are relevant to the search. And Recall is number of relevant images to the total images. The Following fig. 6 shows snapshot of GUI which shows , When an elephant image is given to the database, it retrieves all such elephant images.

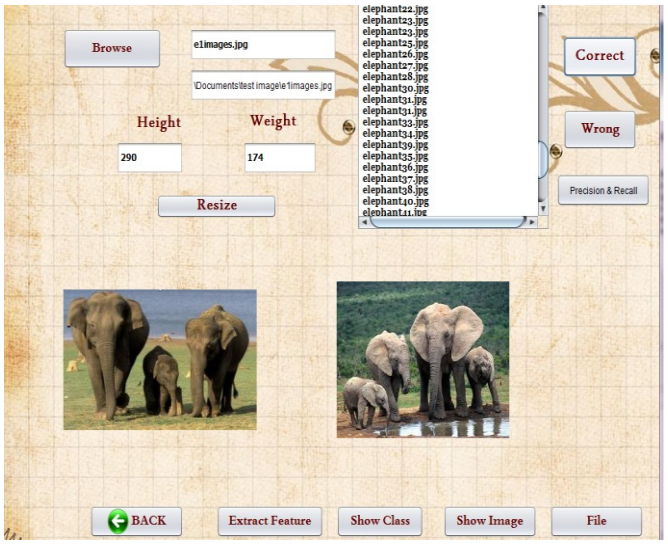

Figure 6 : Snapshot of Output Window

The precision and recall are calculated as per following formula.

$$\text{Precision} = \frac{\text{No. of relevant images retrived}}{\text{Total No. of images retrived}}$$

$$\text{Recall} = \frac{\text{No. of relevant images retrived}}{\text{Total No. of relevant images in the database}}$$

The following fig. 7 is a precision graph where accuracy of image retrieval in each class category is shown. This graph is drawn for all 6 classes. If the images retrived are correct then the precision is 100% .

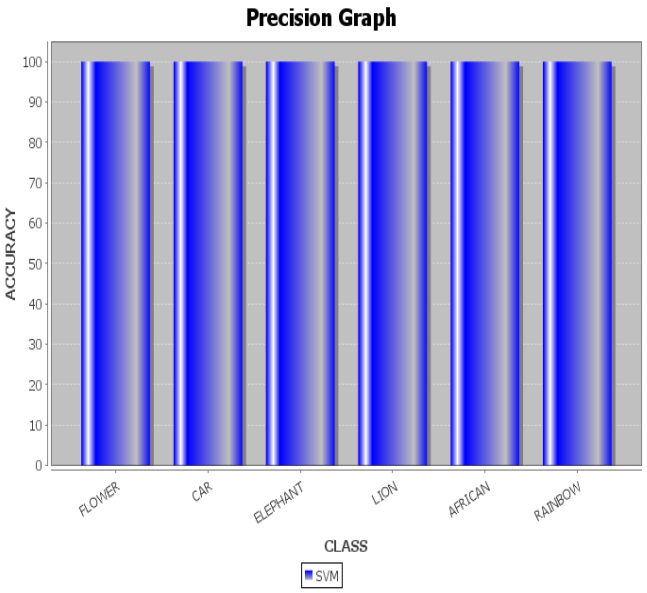

Figure 7: Precision Graph

The following table 1 shows accuracy of the proposed system. From each class ten images are tested and number of correct image retrieval and wrong image

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retrieval are calculated. The proposed system gives 94% overall accuracy.

Table 1: Accuracy Table

Class	No. of tests in each class	No. of correct retrievals	No. of wrong retrievals
Flower	10	9	1
Car		8	2
Elephant		10	0
Lion		9	1
African		8	2
Rainbow		10	0

VI. CONCLUSION

Out of all available techniques of CBIR, color based image retrieval is more efficient in variety of application areas. In the proposed system color image retrieval is done using Block Truncation Coding with 8 color clumps and SVM. As literature suggests, YCbCr color model gives better image retrieval accuracy, than any other color models, so that is referred for the purpose of experiment. For color based image retrieval systems image classification accuracy is one of the research area. So the Support Vector Machine technology in the era of classification is used in the proposed system. The result shows that proposed system gives better image retrieval accuracy. In future the system performance can be compared for OAO and DFG multiclass classifiers.

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