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Image Retrieval Comparisons Using Color Models

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Abstract: Most content-based image retrievals (CBIR) use color models in order to retrieve images. A color model is a specification of a coordinate system within which each color is represented by a single point. In this paper, we obtain the RGB values of an image and then convert these RGB values into color models such as YCbCr, YIQ, and YUV respectively and then apply Principle Component Analysis (PCA) for each color model. Finally, we analyse the obtained color models that provides higher rate of accuracy.

Keywords: CBIR, PCA, YCbCr, YIQ, and YUV.

I. INTRODUCTION

In recent times the CBIR system is regarded as one of the hot research area in image processing. Finding specific images in large photo collections is a critical task if we do it manually. To overcome this problem, several content-based image retrieval (CBIR) [1, 2, 3, and 4] techniques have come into existence. Generally in a CBIR system, an image is reduced to a feature vector which is derived from the image content. These features are then stored in a database and fetched during the retrieval process which calculates distances between feature vectors [5]. However, for larger image collections they are still not fast enough to support online image retrieval.

Inspite of its popularity there is still disadvantage in CBIR, as its speed in retrieving the images is comparatively slow. Thus, due to its disadvantage we are applying PCA [6] to CBIR to improve its performance. As PCA is a best known technique for dimensionality reduction. In this paper we use three color conversion models to covert from RGB to the respective Color model [7, 8, and 9] & they are:

A. RGB Color Model: This is an additive color model in which the three colors such as red, green, and blue are mixed together in several ways to reproduce a more range of color combinations. The RGB color model is mainly used in televisions and computers for representation of colors effectively. It can also be used in digital cameras for storing the images.

B. YCbCr Color Model: YCbCr, also represented as YC_BC_R or $Y'C_BC_R$, used in image representations, digital video, digital cameras, and film making systems. Y is the luminance signal and C_b and C_r are the chrominance values for the blue and red-differences.

C. YUV Color Model: YUV is used as part of a color image channel; in this the color differences are represented by U and V. Considering human perception into account, identifying all the colors by human eye is difficult so there is another alternative to produce the human perception colors by using YUV color model.

D. YIQ Color Model: YIQ is used to transmit TV signals in North America and Japan. Is used in NTSC color TV broadcasting. Here, I stands for *in-phase chrominance*, and Q stands for *quadrature chrominance*. The Y component gives the luma information, and is the only component used by black-and-white television systems.

E. Principal Component Analysis: **PCA** is to convert a set of recordings of possibly mutually inclusive variables into a set of values of linearly exclusive variables called **principal components**. The count of original components is not greater than the number of principle components. The first principal component value has the greatest probable variance, and next values are having lesser probable variance compared to the preceding values. Principal components are confirmed to be independent if the data set is together normally distributed.

II. ARCHITECTURE

The architecture gives the complete detail of the proposed algorithm.

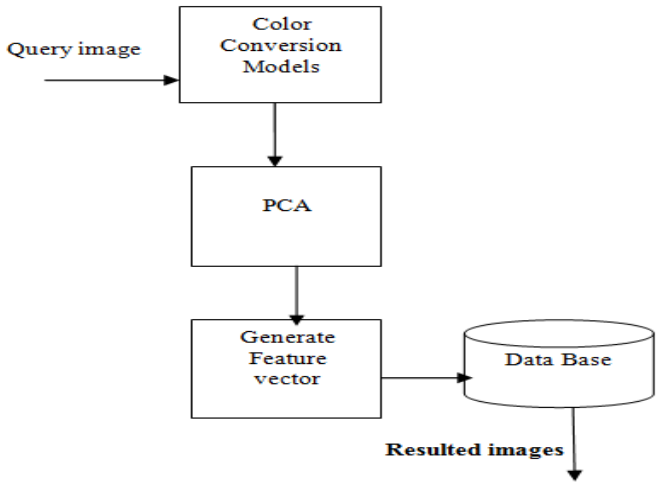


Figure1: Proposed Model Architecture

In the above architecture, we first give a query image as input to the system and then we convert it into color conversion models YIQ, YUV, and YCbCr. Second we apply PCA for each color model including RGB, then in the next step we are deriving feature vector. Third we compare the feature vector of a query image with the already derived feature vector data base images. Finally among all color models we retrieve set of images from which we are concluding which color model produces high accuracy of results.

III. PROCEDURE TO COMPARE COLOR MODELS

Follow the following steps to compare the color models

a. Obtain the RGB values for a given image.
b. Convert the RGB values of an image into three color models i.e.; YCbCr, YIQ, YUV respectively.
c. Apply Principle Component Analysis for the obtained color models including RGB color model.
d. Store the Eigen vectors of images in data base for each color model and compare the query image with the images in data base [10]. Display the resultant images to the user.
e. Finally, compare the three color models with thieir results. After comparing select the model which gives accurate results, is treated as the best color model.

A. Getting RGB values:

Converts the image into pixel values then converts all pixel values into RGB planes.

B. Converting RGB values to color models:

Converts RGB planes to the three color conversion models YIQ, YUV, and YCbCr. The formulas for these models are:

C. RGB to YIQ color model conversion:

$$Y = 0.299 * R + 0.587 * G + 0.114 * B$$
$$I = 0.595 * R - 0.274 * G - 0.321 * B$$
$$Q = 0.211 * R - 0.522 * G + 0.311 * B$$

D. RGB to YUV color model conversion:

$$Y = 0.299 * R + 0.587 * G + 0.114 * B$$
$$U = -0.147 * R - 0.288 * G + 0.436 * B$$
$$V = 0.615 * R - 0.514 * G - 0.100 * B$$

E. RGB to YCbCr color model conversion:

$$Y = 0.299 * R + 0.587 * G + 0.114 * B$$
$$Cb = 128 - 0.168 * R - 0.331 * G + 0.5 * B$$
$$Cr = 128 + 0.5 * R - 0.418 * G - 0.081 * B$$

F. Procedure to find Eigen vectors using PCA:

i. Convert the RGB planes of an image to YCbCr or YIQ or YUV color model using the above formulas. Then we get the data in YCbCr or YIQ or YUV matrix form.
ii. Find the mean of each column & subtract the respected column mean from each value in data (i.e. YCbCr or YIQ or YUV matrix), follow the same procedure with the remaining columns.
iii. Find the covariance matrix for the above matrices.
iv. Find the Eigen Vectors [10, and 11] & Eigen Values of covariance matrices of three color models.
v. Choose the principle component & form a feature vector and store it in database.

G. Choosing the principle components:

Choose the principal components among Eigen vectors to all the images for each color model then store them in data base & compare the given image with the components in the database for each color model separately. After comparing the input image with the database images display the results to the user. And finally compare the results of all the color models and choose the best color model that produces accurate results.

IV. COMPARITIVE RESULTS WITH GRAPHICAL ANALYSIS

Figure2 shows the comparitive results of all the color models in graphical representation.

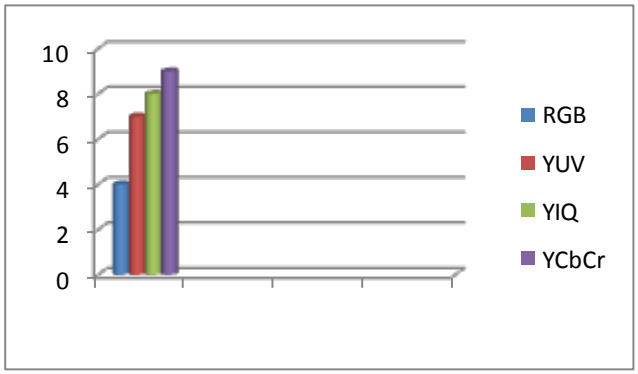


Figure2: Color models comparison with graphical representation

The above graph contains the output results of RGB, YUV, YIQ, and YCbCr color models. Here the output results indicates that the number of images we retrieved from the database compared with query image. Here, the RGB color model produces the less results compared to the remaining

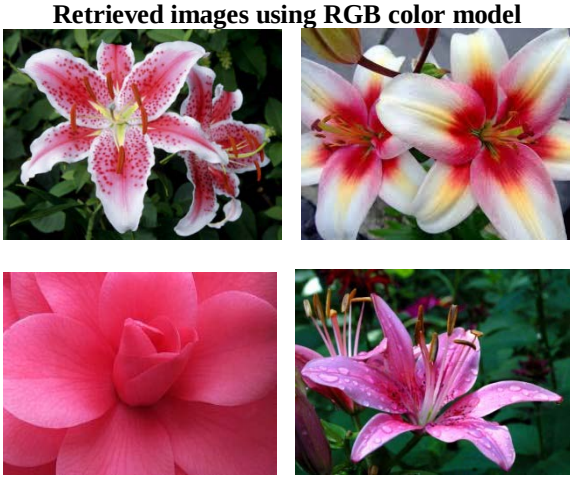
color models and YCbCr produces better results than the RGB, YUV, and YIQ color models.

V. RESULTS

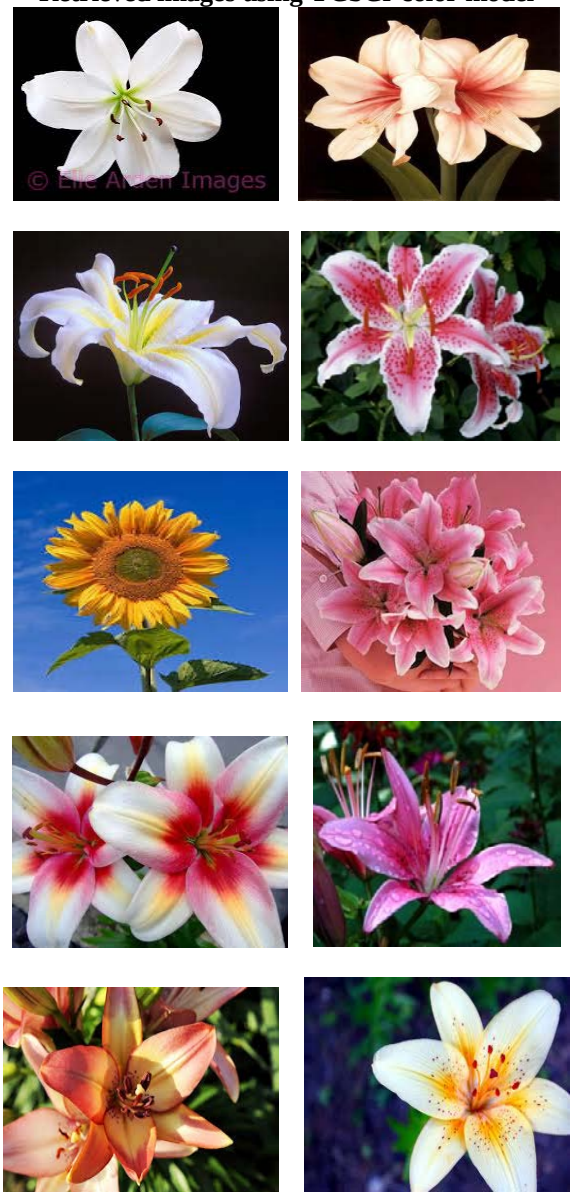
Here the experimental results showed for RGB and YCbCr color models. But we are not providing YIQ and YUV color model results. The lowest results produced by RGB and highest results produced by YCbCr are shown in this paper.

Query Image

Retrieved images using RGB color model



Retrieved images using YCbCr color model



VI. CONCLUSION

In this paper, we proposed a set of color conversion models in image retrieval. The objective of our work is to yield accurate images by using best color conversion model. Our experimental results indicate that the proposed color models are very promising in performing their tasks. From analyzing the results, we conclude that the performance of YCbCr is better when compared to other color models.

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[10]. M. Turk, and A. Pentland, "Eigenfaces for Recognition," Journal of Cognitive Neuroscience, vol. 3, no. 1, pp. 71–86, 1991.Figure 4. Classification accuracy of using LDA and Kernel LDA feature under naïve Bayes and SVM classification

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Short Bio Data for the Authors

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