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Image search algorithms

Visual processing and query databases after the color descriptor

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Abstract – **The color is one of the most important factors for an image description is a comparative study of color spaces RGB, HSV, XYZ, $l_1l_2l_3$, color image processing and analysis using main methods of transformation and exploitation of color type visual information from images, sets, color space appropriate for the purposes of information retrieval as accurate.**

The results are shown graphically processing statistically but not least through images.

One of the most basic operations you can do with images is to ask "how similar are two pictures?"

If we can reasonably answer such a question, the possibility of very many applications open: Internet image search, digital libraries or object recognition (by comparison with a prototype picture), which in turn allows then more sophisticated applications.

Algebra provides us with some very simple tools with which we can solve very effective even part of the problem.

For every image "measure" in some way a number of parameters that seem important for classification.

Keywords- query image, color space, recall, precision, similarity, RGB, XYZ, CIE L*a*b*, HSV, $l_1l_2l_3$

I. Introduction

In view of the fact that multimedia information is more difficult to retrieve as compared to the alphanumeric information (text), few systems database management took into consideration the necessity and usefulness of the information search multimedia databases.

Search for information characterized content in multimedia databases is laborious in terms of retrieval time and resource consuming and the results are not accurate but based on similarity, the match between the query and the resulting information.

However this is important because of the high interest in various fields such as medicine, security, arts, education, etc.

So far, there is no universally accepted color space and the human visual system perceives color and subjectively because of this, in practice it can use a variety of color spaces. The distinction between the search for an image by content and the image recognition is quite fine. Many recognition systems may be used to search for images in a database.

The distinction is that, in the case of databases, images are available before you start looking for so they can be pre-processed. We can create offline data structures too expensive for recognition algorithms interactive objects. The descriptions, indexing and retrieval is based on a sketch of color-texture-shape type.

The color, the distribution, saturation, etc. combination reflects the overall perception of the image which is considered as the most important criterion for grading human [1], [2].

II. Color spaces

Requirements for a SGBD of multimedia data are much better compared to what you can give a conventional SGBD.

This is obvious and Reese of requirements to which they have to cope query subsystem in such a SGBD. In an efficient way are searched those images that looks the best with the image provided by the user as query. It is the objective visual query-based content.

CIE (Comité Internationale de l'Eclairage) has recommended that mathematical transformations to be made on the basis of three primary standards X, Y, and Z. [3], [4], [5]. The primary standards are not real but imaginary.

There are different sources of light with different spectral power distributions of E(λ) [6], [7], [8]. To obtain comparative results, CIE recommends

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different bright objects. Light reflecting off objects S(λ) can be measured.

The color reflected by an object can be determined by means of the formula:

$$P(\lambda) = E(\lambda)\, S(\lambda) \quad (1)$$

The Center shall be charged as three color signals based on color theory threechromatice, as follows:

$$R = \int_\lambda E(\lambda)S(\lambda)f_R(\lambda)d\lambda$$
$$G = \int_\lambda E(\lambda)S(\lambda)f_G(\lambda)d\lambda \quad (2)$$
$$B = \int_\lambda E(\lambda)S(\lambda)f_B(\lambda)d\lambda$$

In relation to color matching functions ($\bar{r}, \bar{g}$ şi $\bar{b}$ sau $\bar{x}, \bar{y}$ şi $\bar{z}$), the amount of each equation is equal to the amount of p *The processing algorithms images - Visual processing and query databases after the color descriptor* rimary colors.

A. RGB color space

RGB color space represents this model in 256^3, over 16 million colors.

Using RGB system for querying images causes problems when the conditions are different for the base image and the images of questioning.

The intensity is given by:

$$I(R,G,B) = R + G + B \quad (3)$$

RGB projection of the triangle defined by rgb Chromac [9], [10]:

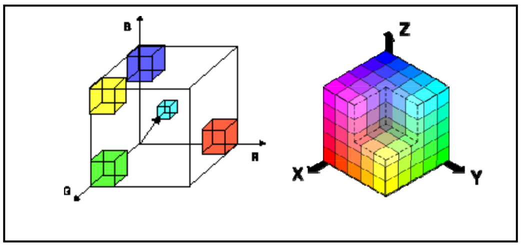

Figure 1. RGB cube

$$r(R,G,B) = \frac{R}{R+G+B}$$
$$g(R,G,B) = \frac{G}{R+G+B} \quad (4)$$
$$b(R,G,B) = \frac{B}{R+G+B}$$

B. XYZ color space

XYZ color space is a special place because it is based on direct measurements of the human eye and serves as a basis to define other color spaces [11], [12].

Featuring three color matching functions, deducting what one observer perceives:

$$R = \int_\lambda E(\lambda)S(\lambda)\bar{x}(\lambda)d\lambda$$
$$G = \int_\lambda E(\lambda)S(\lambda)\bar{y}(\lambda)d\lambda \quad (5)$$
$$B = \int_\lambda E(\lambda)S(\lambda)\bar{z}(\lambda)d\lambda$$

where: $\bar{x}(\lambda), \bar{y}(\lambda), \bar{z}(\lambda)$ is the CIE functions [5], [13], [14] color matching.

Calculate the tristimulus color values equivalent. These values are not relevant to humans. It is hard to infer threechromatic color. That is why the notion of color threechromatic is calculated using three axes:

$$x = \frac{X}{X+Y+Z}$$
$$y = \frac{Y}{X+Y+Z} \quad (6)$$
$$z = \frac{Z}{X+Y+Z}$$

Since chromaticity coordinates sum is equal to one unit, two of these three relationships are enough to describe the color. CIE XYZ system is introduced scientific basis of objective measurement of color. He allows us to calculate tristimulus values that describe the sensations of a human observer. This color space conversion matrix has the following:

$$X = 0.607R + 0.147G + 0.200B$$
$$Y = 0.299R + 0.587G + 0.144B$$
$$Z = 0.000R + 0.066G + 1.116B \quad (7)$$

XYZ and RGB spaces are not visual and uniform. In order to obtain uniform visual color systems have been proposed sequenced.

*C. Color Space CIE L * a * b **

L*a*b sistem, is calculated from the XYZ color space.

It is based on a three-axis coordinates:

- L * axis corresponds to the light L * = 100 where is white and L * = 0 is black
- a * ranges from red +a * and green -a *
- b * varies between yellow +b * and blue -b * [15], [16].

and is only representative colors RGB space.

The coordinates L *, a * and b * values are calculated based on tristimulus X, Y, and Z as follows:

$$L^* = 116 f\left(\frac{Y}{Y_n}\right) - 16$$
$$a^* = 500\left[f\left(\frac{X}{X_n}\right) - f\left(\frac{Y}{Y_n}\right)\right] \quad (8)$$
$$b^* = 200\left[f\left(\frac{Y}{Y_n}\right) - f\left(\frac{Z}{Z_n}\right)\right]$$

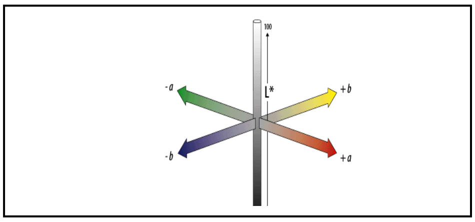

Figure 2. The system color L * a * b *

Area CIE L * a * b * is perfectly uniform.
Transformation relationships are:

$$L^* = 116\left(\frac{Y}{Y_n}\right)^{1/3} - 16 \quad \text{for } \frac{Y}{Y_n} > 0{,}008856$$

else

$$L^* = 903{,}3\frac{Y}{Y_n}$$

$$a^* = 500\left(f\left(\frac{X}{X_n}\right) - f\left(\frac{Y}{Y_n}\right)\right) \qquad (9)$$

$$b^* = 200\left(f\left(\frac{Y}{Y_n}\right) - f\left(\frac{Z}{Z_n}\right)\right)$$

$$\text{Where}: f(t) = t^{1/3} \quad \text{for } t > 0{,}008856$$

else

$$f(t) = 7{,}787t + \frac{16}{116}$$

where: Xn, Yn and Zn are tristimulus values of the white vote.

D. *HSV color space*

HSV color space HSV (hue, saturation, value) describes HSV color space in terms of natural transformation is a linear RGB color space [17], [18].

Transformation from RGB to HSV:

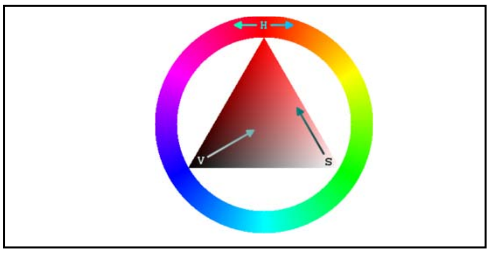

Figure 3. HSV sistem

$$H = \begin{cases} \text{Undefined}, & \text{if } MAX = MIN \\ 60^0 \times \frac{G-B}{MAX-MIN} + 0^0, & \text{if } MAX = R \\ & \text{°i } G \geq B \\ 60^0 \times \frac{G-B}{MAX-MIN} + 360^0, & \text{if } MAX = R \\ & \text{°i } G < B \\ 60^0 \times \frac{B-R}{MAX-MIN} + 120^0, & \text{if } MAX = G \\ 60^0 \times \frac{R-G}{MAX-MIN} + 240^0, & \text{if } MAX = B \end{cases}$$

$$S = \begin{cases} 0, & \text{if } MAX = 0 \\ 1 - \frac{MIN}{MAX}, & \text{else} \end{cases} \qquad (10)$$

$$V = MAX/255$$

where: MAX is maximum values (RGB);
MIN is equal to minimum value [17], [18].

E. *Color Space $l_1l_2l_3$*

Three color patterns l_1, l_2, and l_3 were found by means of experiments.

When RGB images are interrelated, it is preferable to ponder this correlation.

Color scenes have been digitized in spatial resolution 256 * 256 resolution and intensity of 6 bits for each R, G and B.

The orthogonal:

$$\begin{aligned} l_1 &= R + G + B \\ l_2 &= (R - G)/2 \\ l_3 &= (2G - R - B)/4 \end{aligned} \qquad (11)$$

Transformation:

$$\begin{aligned} l_1 &= \frac{(R-G)^2}{(R-G)^2 + (R-B)^2 + (G-B)^2} \\ l_2 &= \frac{(R-B)^2}{(R-G)^2 + (R-B)^2 + (G-B)^2} \\ l_3 &= \frac{(G-B)^2}{R-G)^2 + (R-B)^2 + (G-B)^2} \end{aligned} \qquad (12)$$

III. QUERY-BASED VISUAL CONTENT

The objective content-based visual query is to search and retrieve in an efficient manner those images in the database that most closely resembles the image provided by the user query [19], [20], [21], [22], [23], [24]. Content-based visual query differs from a regular query in that imply similarity search. Content-based Visual Search is an expensive process, because the information is not structured semantic multimedia, often has a considerable size, have preprocessed before the user to query the database. In most cases, multimedia data comprises fewer than complete capture. For different users, a multimedia object has multiple interpretations.

IV. EXPERIMENTS

It is a comparative study of methods for imaging using an image that is important characteristic color.

The methods presented are studied from two points of view:

- The quality retrieval by the system's ability;
- The execution time, the greater the higher the performance.

Color spaces used in the algorithm (Figure 4) processing are: RGB color space, the color space XYZ, color space CIE L * a * b *, HSV color space, color space $l_1l_2l_3$.

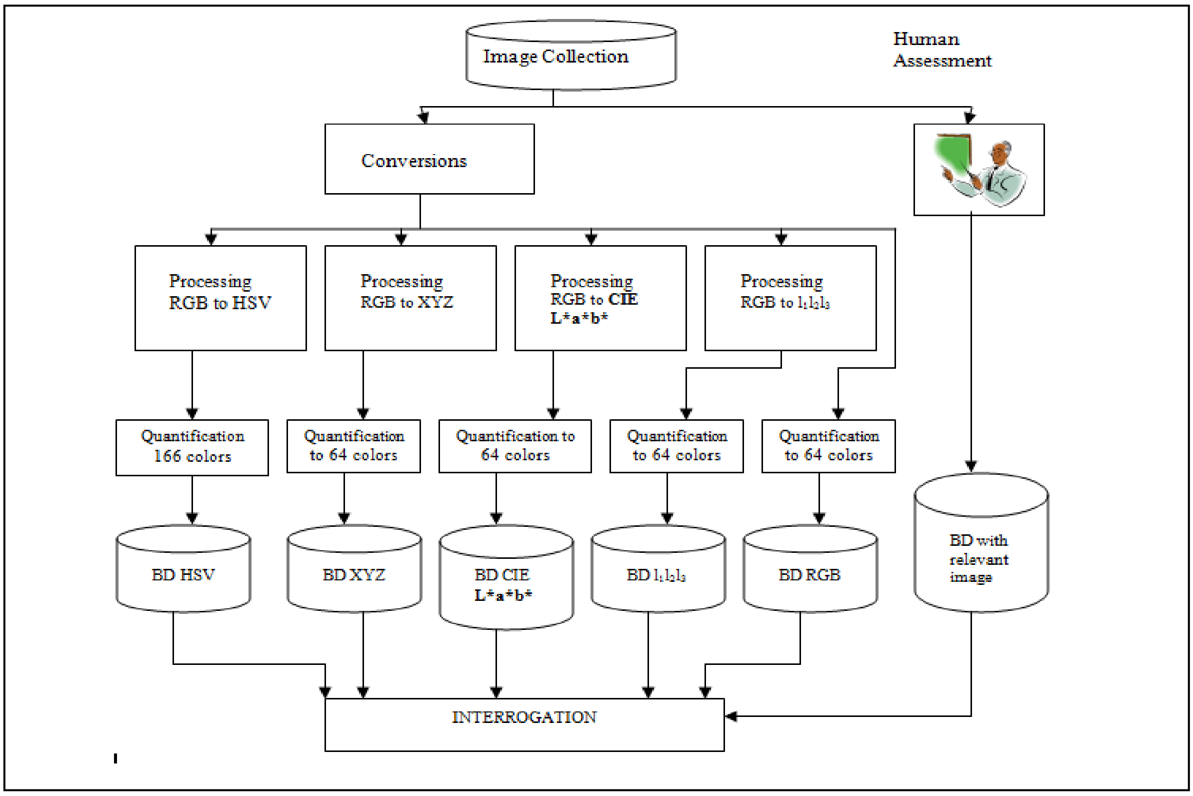

Figure 4. Synthetic Diagram processing algorithm

To be used color spaces, it is necessary to be uniform, complete and true-to-life.

As a result of processing and application system algorithm for self-discovery, by using color spaces on a series of images, I have selected for the comparison appropriate color spaces such as: RGB, HSV and $l_1l_2l_3$.

For reasons of space, we have chosen the number of images returned to be equal to 4.

The image query chosen for this category is as follows:

Figure 5. Image used to query

The results obtained for each color space are (Figure 6):

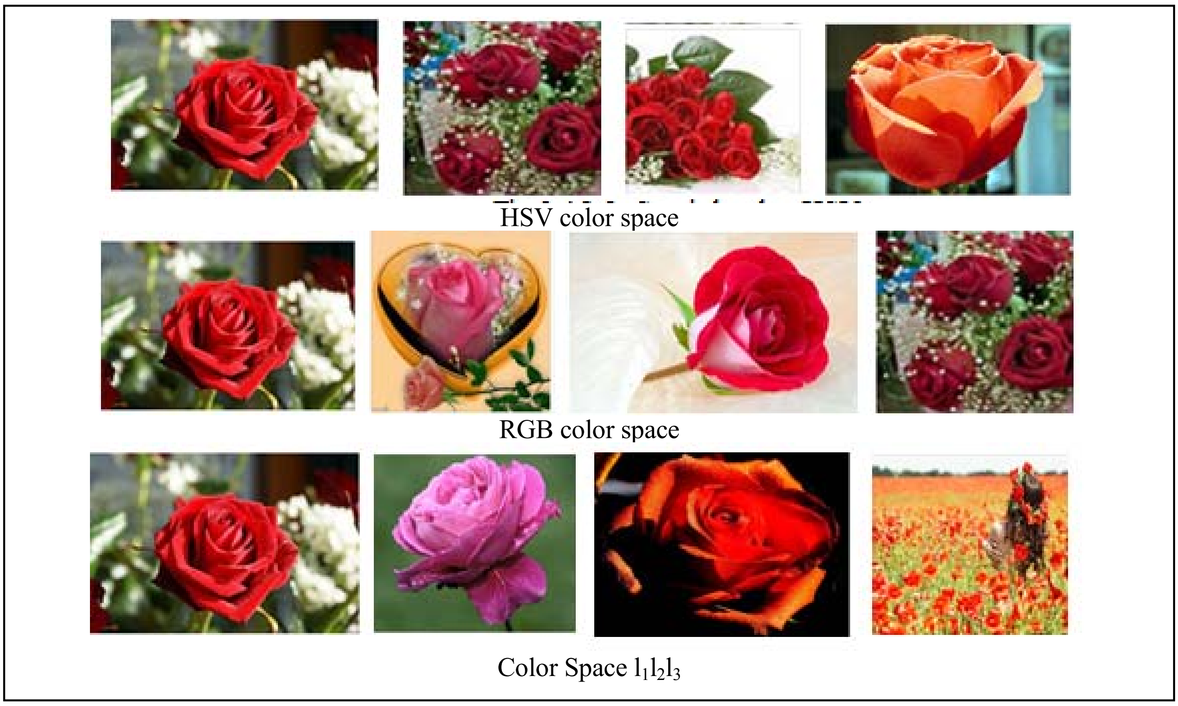

Figure 6. Experimental results

The purpose of the indexing operations and calculation of similarity is to obtain, for the operation of retrieving, a good performance. Performance operation of retrieving information is measured in the normal way using three parameters: speed, redial and precision.

These three parameters are determined on the basis of the indexing scheme and the method used for calculating similarity.

General graph obtained for the pairs precision-redial (Figure 7, 8).

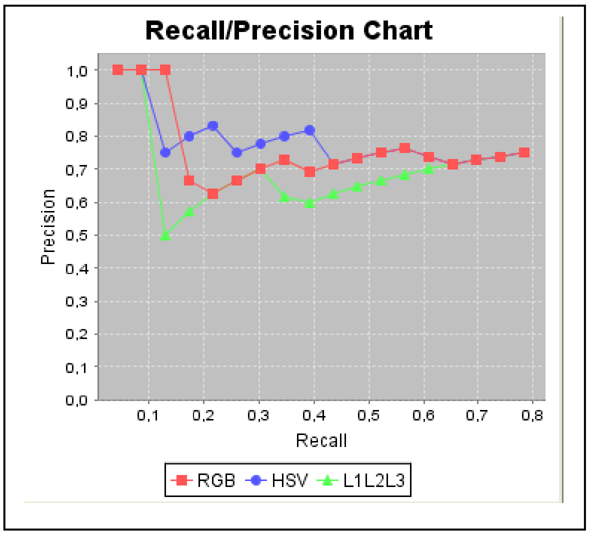

Figure 7. Graphical representation for accuracy and redial

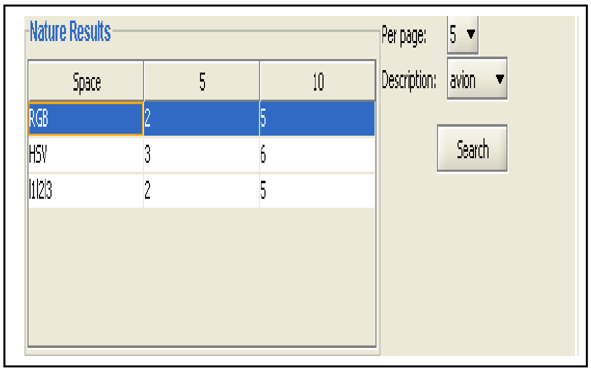

Figure 8. Number of relevant image for the selected image

V. CONCLUSIONS

It was made a comparative analysis of the implemented methods for color images using color descriptors.

These transformations are used as needed as color spaces are: uniforms, complete and natural.

Although RGB color space does not fulfill all these conditions, it was chosen because of its widespread use.

Tests are detailed, aiming at both global charts for each method results and graphs detailing the interrogation or observing also the relevant statistical tables for each query image.

In addition, we considered and concrete practical examples taking some relevant image as a query and displaying the first 4 similar images returned by the program for each method.

Besides these complete experiments, global chart is viewed to some general conclusions can be drawn.

By comparing the methods used color spaces HSV, RGB and $l_1l_2l_3$, first proved to be more efficient.

Each method has its own graphics drawn with a certain color to highlight better results.

As you increase the number of relevant images returned by the application, the increase redial (there are more and more relevant images are returned) and decreases accuracy (whose denominator is the total number of images even returned).

One method is the better chart how much is farthest from home or as it has higher accuracy value to a given value of the parameter recall.

In the experiment, the chart study, observed that HSV color space is located above other graphical chart.

One method is the most effective, since its graph lies on the origin of the axes, but also over all other graphics. In conclusion, we can say that HSV color space has better performance, were returned to 60% of the images.

From experiments, both in graphical displays and statistical may conclude that HSV color space has better performance, while $l_1l_2l_3$ RGB spaces provided poor results.

The study, based on visual search content can be expanded in many directions.

This study can select color spaces better and it applied successfully those methods that have given the best results in the search and retrieval.

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