Color Correlation

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Introduction

1.1 Color Correlation

Matching is an important task in computer vision because the accuracy of the 3D reconstruction depends on the accuracy of the matching. Color Correlation Focuses on matching using correlation measures whose main hypothesis is based on the similarity of the neighborhoods of the corresponding pixels. The objective is to retrieve image relevant to a query from a data base in rang order. In this paper, we propose a solution for retrieve the similarly images with RGB color correlation index. The proposed method retrieves the images on the basis of maximum correlation so that the images with more similarities and, hence, exhibiting maximum correlation with each image is the index for retrieved accordingly.

Mathematical Formulation

2.1 Proposed RGB Color Correlation Index

Correlation is basically used to show the similarities and relationship between two variables. It can be defined as a single number that describes the degree of relationship between two variables.

Here, correlation 'r' is correlation between query image and retrieved image. A is query image and B is retrieved image. These images are reduced to a matrix of the same size. The correlation 'r' can be defined as :

$$r = \frac{\sum_m \sum_n \left(A_{mn} - \bar{A}\right)\left(B_{mn} - \bar{B}\right)}{\sqrt{\left(\sum_m \sum_n \left(A_{mn} - \bar{A}\right)^2\right)\left(\sum_m \sum_n \left(B_{mn} - \bar{B}\right)^2\right)}}$$

Here **A'** is the average of matrix element A and **B'** is the average of matrix element B .

An RGB is stored in m-by-n-by-3 data array that defines red, green, blue colour components for each individual pixel.

Algorithm

3.1 Propose Algorithm

Let A = query language and B = retrieved image

$$\mathbf{A}=\begin{bmatrix} \boldsymbol{R} = \boldsymbol{f}(\boldsymbol{xi}, \boldsymbol{yi}) \\ \boldsymbol{G} = \boldsymbol{f}(\boldsymbol{xi}, \boldsymbol{yi}) \\ \boldsymbol{B} = \boldsymbol{f}(\boldsymbol{xi}, \boldsymbol{yi}) \end{bmatrix} \textbf{Size}(256\text{X}256)$$

(x_i, y_i) be the **i**th pixel of the classified image.

Bp = resize(retrieved image p order) ;

$$\mathbf{Bp}=\begin{bmatrix} \boldsymbol{R}=\boldsymbol{f}(\boldsymbol{xi},\boldsymbol{yi}) \\ \boldsymbol{G}=\boldsymbol{f}(\boldsymbol{xi},\boldsymbol{yi}) \\ \boldsymbol{B}=\boldsymbol{f}(\boldsymbol{xi},\boldsymbol{yi}) \end{bmatrix} \textbf{Size}(256\text{X}256)$$

for p = 1 to n (where n = number of picture)

Correlation(r) between A and Bp can be defined as follows:

$$\boldsymbol{correlation}(\boldsymbol{r})\boldsymbol{A},\boldsymbol{Bp} = \begin{bmatrix} \boldsymbol{R}=\boldsymbol{f}(\boldsymbol{xi},\boldsymbol{yi}) \\ \boldsymbol{G}=\boldsymbol{f}(\boldsymbol{xi},\boldsymbol{yi}) \\ \boldsymbol{B}=\boldsymbol{f}(\boldsymbol{xi},\boldsymbol{yi}) \end{bmatrix}, \begin{bmatrix} \boldsymbol{R}=\boldsymbol{f}(\boldsymbol{xi},\boldsymbol{yi}) \\ \boldsymbol{G}=\boldsymbol{f}(\boldsymbol{xi},\boldsymbol{yi}) \\ \boldsymbol{B}=\boldsymbol{f}(\boldsymbol{xi},\boldsymbol{yi}) \end{bmatrix} = \begin{bmatrix} r_R' \\ r_G' \\ r_B' \end{bmatrix}$$

RGB correlation can be defined as :
for q = 1 to n (where n = number of pixel)

$$\mathrm{r_R}=\sum_{q=1}^{q=n} r_{\mathrm{Rq}'}$$

$$\mathrm{r_G}=\sum_{q=1}^{q=n} r_{\mathrm{Gq}'}$$

$$\mathrm{r_B}=\sum_{q=1}^{q=n} r_{\mathrm{Bq}'}$$

Rindex is RBG color correlation index for a query and a retrieved image. Mathematically it is

$$\text{Rindex} = \sqrt{{r_R}^2 + {r_G}^2 + {r_B}^2}$$

The algorithm of RGB correlation index is shown in Figure

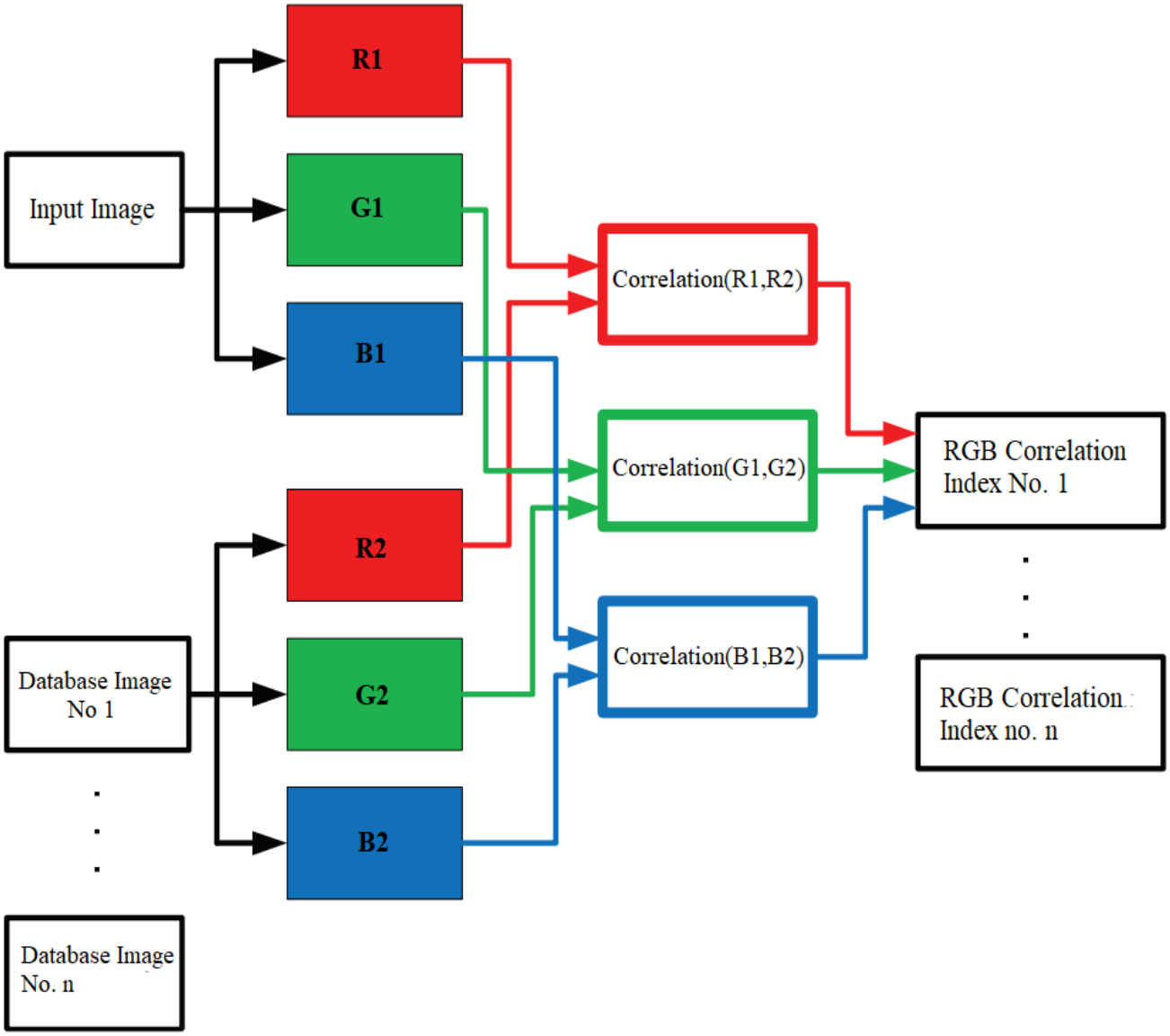

Image similarity measure

To measure similarities we use correlation. After mathematical calculations the value of correlation r will always be between -1.0 and +1.0. If the correlation is negative, we have a negative relationship; if it's positive, the relationship is positive.

Image retrieval system

The retrieved image were arranged by Rindex values in order i and the first order is the maximum value and image similarity for query image.
To measure CBIR system performance is based on two parameters recall and precision.
The recall rate of an image indicates the percentage of the relevant image retrieved. This parameter is defined as:

$$\textbf{\textit{Recall}} = \frac{number\ of\ relevant\ retrieved\ Images}{number\ of\ retrieved\ Image\ in\ the\ category}$$

The precision rate of an image presents the average rank of the retrieved relevant image . This parameter is defined as:

$$\textbf{\textit{Precision}} = \frac{number\ of\ relevant\ retrieved\ Images}{number\ of\ retrieved\ Images}$$

Documentation of API

Example

```
import numpy as np import matplotlib.pyplot as plt   import cv2

img = cv2.imread("1002.jpg")

img = cv2.cvtColor(img,cv2.COLOR_BGR2RGB)

original_img = img

histr = cv2.calcHist([img],[0],None,[256],[0,256])
```

Learning Outcome

1) Learned to make 'clusters' of image based on similarity.
2) Image Retrieval based on Correlation

References

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https://www.sciencedirect.com/science/article/pii/S187770581100021X
[2]:
https://www.researchgate.net/publication/251716272_RGB_Color_Correlation_Index_for_Image_Retrieval