MATCH OF THE IMAGE REFERENCE POINTS WITH THE USE OF THE CHROMATIC INFORMATION

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ABSTRACT

In the use of the image processing methods for biometrics aims in the matching of the reference point of the images is a very important task. In the identification and matching of the reference points of the image processing methods in the case of digitally made images their data-matrixes are going to be compared. The compare is made by the help of such as standard image identification methods as: identification of sample geometrical pattern, compare of pre determinate samples and examination of the brightness data.

It can happen that the success of the matching of the reference points can not be guarantied even after the use of several color matching methods one after another. That is the reason why it is very wish fool that by the image creation a lot of algorithms came out for using. In the matching process of the reference points beside the standard exanimation geometrical information some plus information can bring with themselves the color information inside the image to. On this way by the help of the color data of images and by the help of the use of some new methods, we can develop some more useful image processing methods.

KEY WORDS

reference points matching, color image processing, color systems

1. Introduction

The reference points of the images made by Biometric image processing [1] we can match with these methods: with analyses of the geometrical patterns [2], with looking for new samples [3], and with examination of the brightness values [4]. So it is very good to add to the data base of the processed image the digital color information of the vaunted image point. The right processing and sensing of the digital color information is good only in standard color space, so we need to convert the color space into a standard color space (for example: CIE). We can use these transformed color information in such as new image processing method, which can increase the effective search of the identification of the reference points.

This paper would like to show parts of an ongoing research project which main aim is performing the processes and possibilities of the identification of the reference points.

2. Methods

In the searching and identification of the reference points of the images with

image processing method, the digitally processed data matrixes were compared. [5] These data matrixes in standard cases orders one brightness data to one coordinate point. The conventional image processing methods with the analysis of this brightness value are processing image.
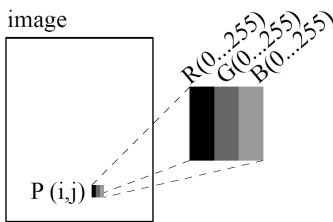

Figure 1: The basic data format of the digital images is the image point (P), which we can give with his position (i,j) and RGB color coordinates.

If for the period of the image processing method we beside the brightness data of the images we gives some color data about the data matrix of images we can get to such as information, which are increasing the effect of the image processing method. The analysis of the chromatic data can happen by the use of methods we usefully use in colorimetry. To involve these methods between the reference point identification image processing methods we have to do the next steps:

1. To create the RGB data matrix of colored digital images.
2. To convert the device dependent RGB color space into universal independent space.
3. Primary image process by the help of conventional methods for reliving the data set of reference point searching.
4. The filtering of the preliminary result of the reference point with color identification method with the help of color difference calculating methods $(\Delta E_{ab}{}^{*}, \Delta E_{94}{}^{*})$..

2.1 Color system of digital images

The digital creation and processing of color images according to the trichromatic color theory is using three kind of basic colors. These are red (R), green (G) and blue (B) primary colors.

The ingoing (camera side) and outgoing (monitor side) the imaging devices are using these R, G and B basic colors as color coordinate triplet [6, 7]. These so called DAC (Digital Analog Convert) values are created with the digitalization of standard photos (picture scanning) or with digital cameras image creation methods.

The 24 bits color image display in the RGB coordinate system for some primary color gives from 0 to 255 DAC value. The three DAC_R, DAC_G, DAC_B value is going to define that, the color which can be seen on the display in which number contains the RGB samples. With the change of three colors in 256 step we can create maximally $256^3=16.777.216=2^{24}$ kind of new colors. In the binary system of the computer this color system we can encode with 24 bytes so the name of this color system is 24 bytes RGB color system. On the side of the input the RGB data are creating by the A/D converter and color processing system of the camera or scanner detector.

The RGB color system is a universal system for receiving the color of the points (Figure 1). Because the RGB color system has different kind of input and output image creation systems, which all have their own color creational parameters, so unfortunately only one RGB color value cannot definite exactly the characterized color. This means that in the image creation one by other coming phases are giving to another RGB data but the real color values are modified to the characteristics of some image processing devices.

2.2 The characteristics of the image processing devices and the useful color system

For the universal use of the RGB data in the color processing methods, we must have the parameters of the image processing devices in our hands. This we can do with following methods:

- With measuring and with the mathematical correction of the measuring results.
- With calibration of our image creation devices (scanner, camera and monitor).
- With the use of color managing methods

By the measuring, calibration, and the color managing we have to take in consideration these parameters of the color weave techniques: gamma, color temperature, brightness conditions and the contrast.
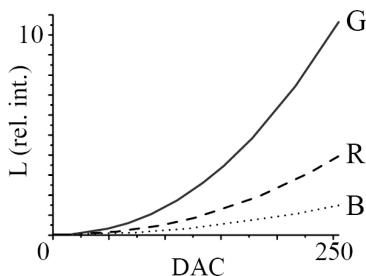
Figure 2: Gamma value of the digitally viewed images

We mean by the image viewing gamma that between the RGB intensity values and the physical viewed (and measurable) brightness values does not exist linear relationship, (Figure 2). This dependency is exponential and its value is around 2 and we can give it on this way:

$$L = O + G \cdot DAC^{\gamma}\big|_{R,G,B}$$

Where L is a relative brightness value, O the brightness value which belongs to totally black, DAC is the value of RGB (0...255), G constant which characterized the amplification, γ is the exponential outcome, the L=f(DAC) is the so called gamma diagram or gamma characteristic and it can be a lot of mathematically different kind of definition of this equation.

The keep of the color temperature of the viewing system is a very important fact too. The color temperature usually is the measure number of to the 255 DAC values belonged red and blue picks brightness-uniformity. With the addition of red color the color temperature is decreasing and with the addition of blue color the color temperature is increasing. We always give the value of the temperature in Kelvin, and its calculation and getting its value to the good number is always happening in down showed CIE color system (Figure 3).
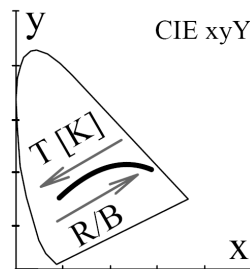
Figure 3: Showing the framing of color temperature in the CIE chromaticity diagram

For the measuring and calibration of the pick brightness value and contrast of the image processing device is also very important the color fidelity of image viewing. The brightness value of the (white) pick we are measuring are on 255, 255, 255 DAC RGB values. The maximum contrast uniformity we can give with this equation:

$$C = \frac{O}{L},$$

Where C is the contrast, o the value which belongs to the whole black brightness value, L is the 255 RGB white belonged color brightness-value. The right transfer of the chromatic data we can do with color management. The main aim of the color management is to enable the color fidelity transfer between the input and output image creational devices.

Beside this its task is to enable on some output devices equivalent color display. The basic of working of the color examination are the beside ordered ICC profiles of the input (scanner, digital camera), and output (monitor, printer) devices, which *.icc file formation contain the device characterized colorymetrical characteristics (Figure 4). The ICC profile is a sequent built file which construction is public and beside all these it contains the white point color temperature of device, the CIE color tristimulus values of its primers and the gamma parameters. Besides the knowing of these date we can create the profile all by ourselves.
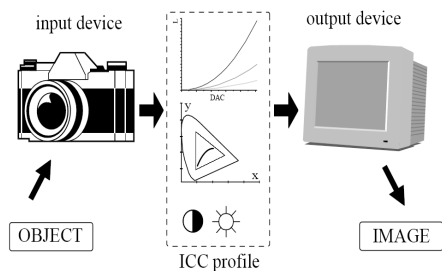

Figure 4: The icc profile contains the parameters,
which are needful to unite the color spaces of the input and output devices.

The ICC profiles are proceeding by the color processing modulo of operational system of the image producing computer. The color information of the image view by the input device with the help of the color profile of device and by the help of in fitting color processing converting methods converts the color space into a universal used color space, and from this color space with the help of the color profile of the output devices description of their own color weaving possibilities views the color right image. [8].

The advanced operation systems are enabling the readjuse of the ICC profile of input and output devices. The ICC profile of devices (made by the manufacturer) usually contains the production calibration data. The users own hardware configuration usually can give in spite of all this other calorimetrical qualities to the image processing systems, because of that for professional use they can create their own ICC profiles. The profiles of our own image processing system we can create by the help of the color measuring devices and by the help of the ICC profile creational software.

2.3 Color spaces which can be used in the color processing methods and their use

As we gave after the measurement characterizing parameters with correction or calibration of the gamma, color temperature, brightness and contrast parameters, with all this the real color information are given in use of the color processing methods in forth [9]. But how can we arrange the color information?

Because of the above mentioned deficiencies the RGB system cannot be used in whole for image processing aims, because of that we have to use such as united and universal color space in which the big part of the image processing symmetrical method can be used with success. The best solution for the problem is in the CIE (Commission Internationale de L'éclairage, International Commission on

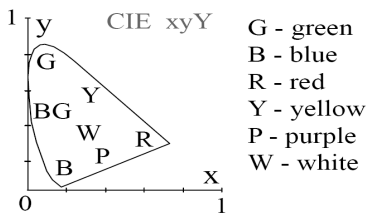Illumination) xyY color space happened data process. (Figure 5).

Figure 5: The CIE xyY color space

The CIE xyY and by the society insured other color spaces are reposed on the human seeing and according to the Grassman laws they have three chromatic coordinates. In the xyY system the x and y values are carrying the chromatic data, and the Y the brightness data, which is uniformity to the human (photometrical) brightness sense.

The big shortcoming of the color space is that it is not equally arranged in the strait line of the colors, so we aren't able count the result of the color difference. So on this way we can use it in color image processing for chromatic search and color identification on very hard and complicated way only.
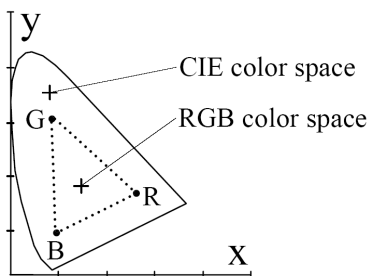

Figure 6: The interpretation of the RGB gamut in CIE xyY color space

We have to take into consideration that the trichromatic color system because of the three primary color occupies only a piece of the whole CIE color spaces (Figure 6). This can be concept like this too, that the color creation can memorize only one part of the true colors. On the figure this colors are inside the triangle. The colors in the outside of the triangle can be plotted only with mutilation. For the extermination of the effects of the mutilation we can use very well the color management methods.

If we characterized our color processing devices on above mentioned way than we can on really easy way go from the RGB color space into the CIE xyY color space. With the knowing of the gamma and the other parameters the method of the changing to the CIE color space goes on this way:

$$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = A \begin{bmatrix} R \\ G \\ B \end{bmatrix} = \begin{bmatrix} X_R & X_G & X_B \\ Y_R & Y_G & Y_B \\ Z_R & Z_G & Z_B \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix}$$

Where the R, G and B are the relative DAC values, A is the converter matrix X, Y and Z are the color components from which on this way we can count the chromaticity coordinates.

$$x = \frac{X}{X+Y+Z}$$
$$y = \frac{Y}{X+Y+Z}$$

$$Y = Y$$

Where the x,y and Y are the CIE chromaticity coordinates which are definitely giving the chromaticity data of the image point. The wished procured image processing method (which takes in option even the color data), with this converter method is enabling the function of the image processing matching algorithms in universal and standard color system [10].

The color data matrixes of the images created on this way after this are going for color matching. The color matching

can be done in universal CIE Lab color space (Figure 7) on most effective way. In Lab color the L value contains only the photometrical type of brightness information. The a and b parameters contain on very similar mode to the human watching mechanism the chromaticity information of green-red, (a) and blue–yellow (b) on axis. The match from the CIE xyY color space this time has happened only with the help of a simple mathematical conversion. [11].

$$L^* = 116\ (Y/Y_n)^{1/3} - 16$$

$$a^* = 500\ [(X/X_n)^{1/3} - (Y/Y_n)^{1/3}]$$

$$b^* = 200\ [(Y/Y_n)^{1/3} - (Z/Z_n)^{1/3}],$$

Where, the n-indexed color components are containing the chromaticity data of reference white color.
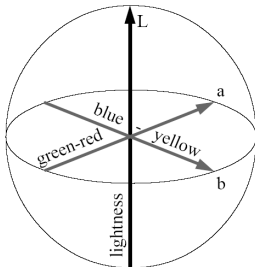

Figure 7: The CIE Lab color space

After the above written conversions we are able to do the color image processing of our pictures.

The matching of the reference points of the images is happening in two steps. In the first one is happening the identification of the reference point of the images with the help of the in the prologue introduced conventional image processing methods. With these methods filtered data's only after this day are doing color matching (color identification).
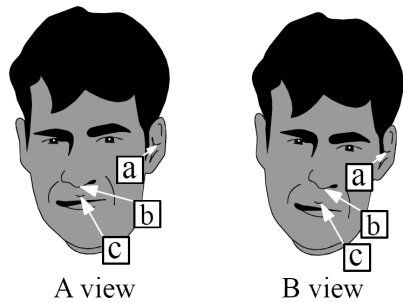

A view   B view

Figure 8: The shape and color identicication from human face in two views made color picture

The face (A and B) seen on the 8 figure was photographed from two views. The task was the identification of the position of the peak of the nose (as reference point). After we have done the geometrical analysis of the matching of the forms, we find a lot of similar points (a, b, c), from which ones we choose the right one with analysis of the chromaticity data. In the analyzing process of the color data the Lab chromaticity coordinates of the (a, b, c) points are matched. The similarity of the points we can examine by the help of the on Lab color system based ΔE_{ab}^* color difference counting method [12]. In universal Lab color space the difference of some chromaticity coordinates are equal with, in the coordinate system countable geometrical distance (for example A, B points on Figure 9):

$$\Delta E_{ab}^* = \sqrt{\left(L_A - L_B\right)^2 + \left(a_A - a_B\right)^2 + \left(b_A - b_B\right)^2}$$

From the reference point that one come for selection, which has the smallest color difference. With this we have found the searched reference point of two images.
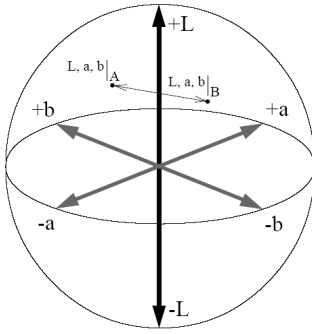
Figure 9: In CIE Lab color space definite color difference value, given by the help of the distance between the (AB) chromaticity coordinates.

For the searching and matching of the reference points in other definitions then this we can use for scenting the subjective color difference scale to [13]:

$\Delta E_{ab}*$	Difference seen with eye
< 0,5	Not visible
0,5 … 1,5	Hardly visible
1,5 … 3,0	Visible
3,0 … 6,0	Good visible
6,0 … 12,0	Big

If the $\Delta E_{ab}*$ color difference calculating method does not bring the wanted results, then we can use the CIE 1994 color difference counting method too where k_L, k_C and k_H parametrical factors we can make weighting or fining the process of the color difference.

$$\Delta E_{94}^* = \left[\left(\frac{\Delta L^*}{k_L S_L} \right)^2 + \left(\frac{\Delta C_{ab}^*}{k_C S_C} \right)^2 \left(\frac{\Delta H_{ab}^*}{k_H S_H} \right)^2 \right]^{1/2}$$

Where, we can calculate the value of $\Delta C_{ab}*$, $\Delta H_{ab}*$, S_L, S_C, S_H the colorimetrical parameters from Lab or xyY data. The ΔE_{94}^* color difference calculating process determinate in CIE LCH system, which one beside the L

brightness value with the help of the hue angle (H) and the chromatic (C) data is giving the chromaticity information of the color (Figure 10). In this color difference calculating process we have to take in consideration that, its use is connected to some in forth given display conditions [12].
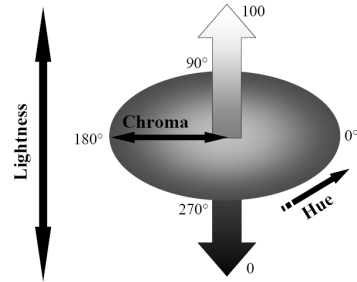

Figure 10: The CIE LCH color system

3. Conclusion

The measurement and the specification of the spectral characteristics of the cameras and display devices participated in color creation, is necessary for the colorimetrical and structural analysis of the scanned pictures. With the make of this, the digital chromaticity information becomes capable for matching into CIE color space and the chromaticity data become process able. The collective use of on this way created chromaticity data by the help of image processing algorithms and colorimetrical methods (color difference) improves the method of searching of the reference points.
It can be conclude, that by enabling the color fidelity transfer of whole image processing process and with the creation of the chromaticity information used color processing method we can do a very useful reference point matching on our images. And these methods are helping a lot the biometrical image processing.

Acknowledgements

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