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Analysis of color image features extraction using texture methods

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Abstract

A digital color images are the most important types of data currently being traded; they are used in many vital and important applications. Hence, the need for a small data representation of the image is an important issue. This paper will focus on analyzing different methods used to extract texture features for a color image. These features can be used as a primary key to identify and recognize the image. The proposed discrete wave equation DWE method of generating color image key will be presented, implemented and tested. This method showed that the percentage of reduction in the key size is 85% compared with other methods.

Keywords*: center-symmetric LBP, discrete wave equation DWE, key size, local binary pattern LBP, reduced LBP*

1. Introduction

The Digital color images (DCI) are the most important types of data currently being traded [1]; they are used in many vital applications such as military, civilian and medical applications. Digital color image is represented by a 3D matrix, the first 2D matrix represents the red color, the second 2D matrix represents the green color, the third 2D matrix represents the blue color [2-4]. DCI usually has a high resolution; this means that it has a huge size of data in terms of processing and manipulating. To reduce the complexity of processing, DCI can be represented by image histogram. Hence, each color in DCI consists of 256 elements array, where each element points to the repetition of a gray value (0 to 255) [5-7]. Figure 1 shows a sample of a color image and its histogram.

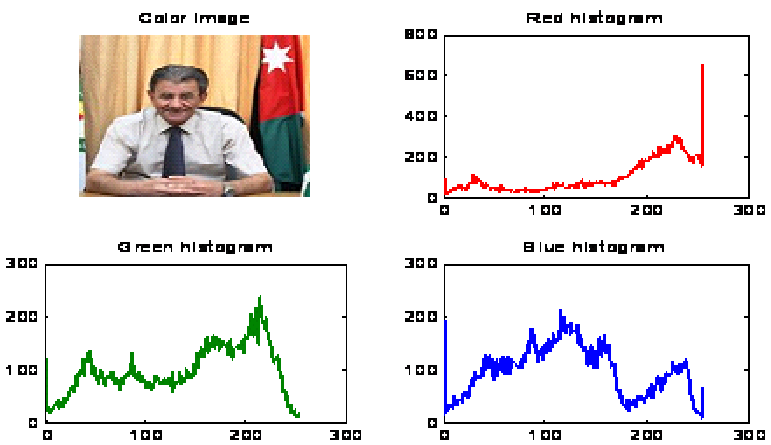

Figure 1. Color image and histograms.

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Color image histograms can be used as keys to retrieve the image. The key size is very small (6144=256*3*8 bytes) comparing to the color image size [8]. However, it is big in term of key representation. Hence, another method is needed to find a reduced key length. One of the simplest methods of reducing the image key (histogram) size is to reshape the 3D color matrix to 2D gray matrix. Here the key size is reduced from 6144 to 768 (256*3 bytes). Hence, reshaping the 3D color matrix to 2D gray matrix will result in reducing the key size 8 times. Figure 2 shows the histogram of the reshaped image shown in Figure 1.

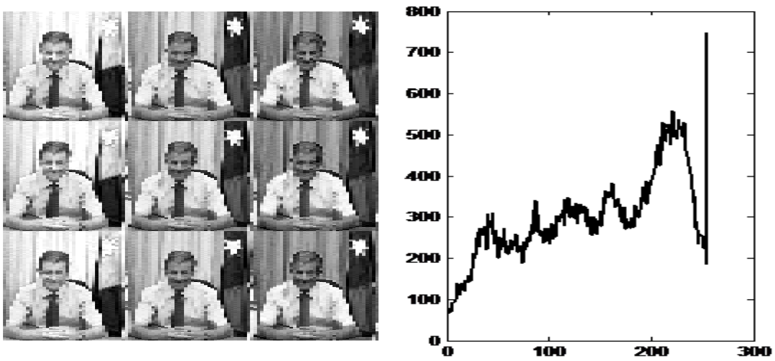

Figure 2. Reshaped color image and histogram

2. Color Image Texture Feature Extraction Methods

Explaining Color is a widely used image feature for image representation, while the use of color histogram is the most common way for representing color features [9]. A various methods used for color feature extraction and could be taken in account for key retrieving element [10]. Looking for a small size key element local binary based methods was tackled.

2.1. Local Binary Pattern Method

Local binary pattern (LBP) method creates a LBP operator for each pixel in the image [11, 12]. The binary value of this operator is to be converted to a decimal number, which will form a one repetition of a value from the range (0 to 255). This method works as shown in Figure 3.

120	115	90		1	1	0
199	110	80		1	x	0
130	70	78		1	0	0
LPB calculations for the pixel 110			→	LPB=11100001 binary Decimal=225		

Figure 3. LBP operator calculations

LBP method creates a new histogram (key) with 256 elements. As a result, it does not suit image retrieval or recognition [13, 14]. However, it could suite other image applications because the used key for image retrieval is still having a big size [15]. LBP methods can be implemented by reshaping the 3D color image to 2D gray image, then we have to calculate LBP operator for each pixel in the 2D matrix as shown in Figure 3. The calculated LBP key for the image shown in Figure 1 is demonstrated in Figure 4.

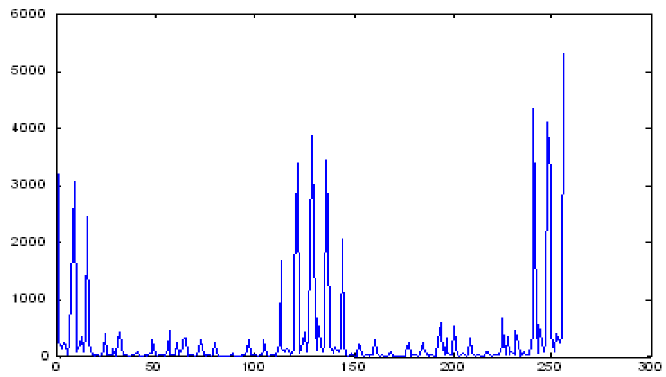

Figure 4. LBP key for the image in Figure 1

2.2. Center-Symmetric Local Binary Pattern Method

Center-Symmetric Local Binary Pattern method (CSLBP) of color image features extraction (key generation) is a modified version of the LBP method [11-14, 16] . This method is used to create a key for a color image by reshaping a 3D color matrix into 2D matrix [17]. Then a CSLBP operator must be calculated for each pixel in the 2D matrix as shown in Figure 5.

120	115	90		1	1	0
199	110	80		1	x	0
130	70	78		1	0	0
LPB calculations for the pixel 110			→	LPB=11100001 binary Decimal=225		

Figure 5. CSLBP operator calculations

This method reduced the key length to 16 elements and the size to 128 bytes. This means that the CSLBP method makes an improvement to generate keys. Figure 6 shows the key (histogram) for the image shown in Figure 1

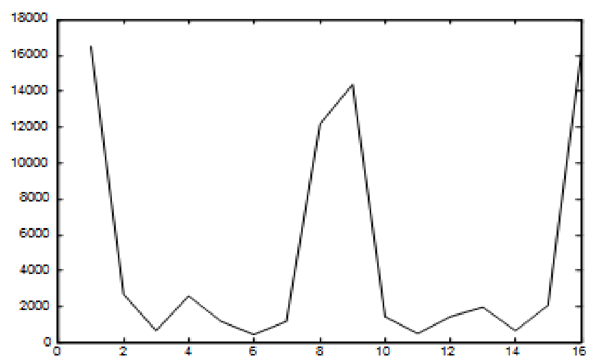

Figure 6. CSLBP key for the image in Figure 1

2.3. Reduced Local Binary Pattern Method

Reduced local binary pattern method (RLBP) acts as CSLBP method. However, the key will be reduced to 8 elements [18-20]. Figure 7 shows how to calculate RLBP operator for each pixel in the 2D matrix. Figure 8 shows the generated key for the image shown in Figure 1.

120	115	90		1	x	x
199	110	80		1	x	x
130	70	78	→	1	x	x
LPB calculations for the pixel 110				RLPB=1111binary Decimal=7		

Figure 7. RLBP operator calculations

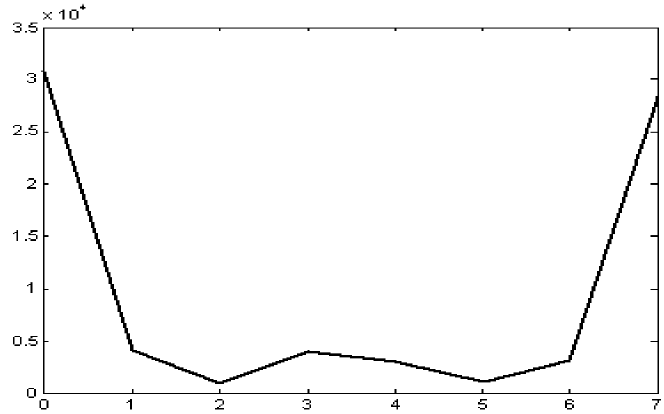

Figure 8. RLBP key for the image in Figure 1

2.4. The Proposed Method

Discrete wave equation DWE was used to reduce the key length in the smallest representation. DWE method is based on using wave equation to generate a key for a color image [21-23]. The wave equation takes the following form as shown in (1):

$$\frac{\partial^2 u(x,t)}{\partial t^2} = c^2 \frac{\partial^2 u(x,t)}{\partial x^2} \quad (1)$$

where $c = \sqrt{E/\rho}$ is the velocity.

Usually a discrete equation is considered in the form of the equation with finite difference of second order as shown in (2):

$$\frac{\partial^2 u_n(t)}{\partial t^2} = \frac{c^2}{h^2}\left(u_{n+1}(t) - 2u_n(t) + u_{n-1}(t)\right) \quad (2)$$

if we take c=1 and h=1, the (2) can be written as

$$\frac{\partial^2 u_n(t)}{\partial t^2} = \left(u_{n+1}(t) - 2u_n(t) + u_{n-1}(t)\right) \quad (3)$$

in (3) can be solved by applying convolution between the array x= [1 -2 1] and the voice signal (Laplace operator).This method can be implemented by applying the following steps:

1. Get the original color image data matrix.
2. Reshape the 3D data matrix which represents the color image to one row array.
3. Apply convolution between Laplace operator and the row array.
4. Check each value in the convolution results:
   a. If the value is greater than zero add 1 to local minimum count.
   b. If the value is equal to zero add 1 to stable count.
   c. If the value is less than zero add 1 to local maximum count.
5. Save the 3 counts as a features array (key) for the certain voice signal.Using this method, the color image key reduced to 3 elements (size of 24 bytes).

3. Implementation

The proposed DWE was implemented in Matlab environment using different color images type with different size, for each color image we create features key, the results of implementation are shown in Table 1. From Table 1, it can be concluded the following facts:

– DWE method can be used to generate a key for any color image with any type and size.
– The key is a unique, thus we can use it as a primary key to retrieve or recognize the image.
– The key values are very sensitive to any changes in the image, any change in the image, even it is a very small change will cause a change in the key.
– The generated key is small in size and contains the values with total size equal 24 bytes.

The other conventional methods of color image key creation were also implemented and each method gave a unique key. The key generation time for each method was programmable calculated and the results are shown in Table 2. From Table 2, it can be noted that the DWE has good timing characteristics. The generated key can be used to identify or recognize a certain color image. Hence, the key size plays an important role. Table 3 shows a comparison between the key (size and length) generated by different methods.

From Table 3, it can be concluded that the generated key using DWE method has the minimum number of size and length compared with other methods. Hence, using the proposed method will reduce the efforts of dealing with a recognition tool such as artificial neural network (ANN) [24, 25]. This will result in reducing ANN architecture, reducing memory space size and reducing ANN training time.

Table 1. Results of DWE Implementation

Image	Size(pixels)	Feature array		
1	76800	34360	6492	35948
2	270948	110441	54446	106061
3	151875	62371	26119	63385
4	49152	23633	1324	24195
5	1125600	547680	34365	543555
6	540000	254064	35688	250248
7	3396069	1569304	296553	1530212
8	2359296	1050979	288046	1020271
9	928800	456157	35177	437466
10	432000	203944	23608	204448

Table 2. Key Generation Time (Seconds) For Various Methods

Image	LBP	CSLBP	RLBP	DWE
1	0.009000	0.005000	0.004000	0.019000
2	0.031000	0.017000	0.013000	0.032000
3	0.016000	0.010000	0.007000	0.020000
4	0.007000	0.004000	0.003000	0.012000
5	0.136000	0.077000	0.064000	0.096000
6	0.062000	0.038000	0.029000	0.051000
7	0.393000	0.262000	0.191000	0.270000
8	0.280000	0.169000	0.134000	0.194000
9	0.107000	0.062000	0.049000	0.081000
10	0.050000	0.029000	0.024000	0.042000

Table 3. Key Length (Elements) and Size (Byte) for Various Methods

Method	Key length	Key size
LBP	256	2048
CSLBP	16	128
RLBP	8	64
DWE	3	24

4. Conclusion

Different methods of color image key generation were implemented and tested for various color images with various types and sizes. The obtained results show that by using the LBP method the key size is 256 elements, while the key size is reduced to 16 elements by using CSLBP method. By using the RLBP method, the key size is reduced to 8 elements. The interesting finding is that the proposed DWE method achieves the minimum key size of 3 elements. It was shown that the proposed DWE method is the best among conventional methods in terms of the generated key. Hence, the complexity of the image recognition process will be minimized using the proposed method.

References

[1] M Kriss, M Kriss. Ed. Handbook of Digital Imaging. United Kingdom: John Wiley & Sons, Inc, 2015. 1824.
[2] Z AlQadi and HM Elsayyed. Window Averaging Method to Create a Feature Victor for RGB Color Image. *International Journal of Computer Science and Mobile Computing*. 2017; 6(2): pp. 60-66.

[3] M AlZudool, S Khawatreh, Z Alqadi. Efficient Methods used to Extract Color Image Features. *International Journal of Computer Science and Mobile Computing*. 2017; 16(12): 7-14.
[4] J Nader, Z Alqadi, B Zahran. Analysis of Color Image Filtering Methods. *International Journal of Computer Applications.* 2017; 174(8): 12-17.
[5] Z Alqadi, A Moustafa, M Alduari, R abuZneit. True Color Image Enhancement Using Morphological Operations. International Review on Computers & Software, vol. 5, no. 4, pp. 557-562, 2009.
[6] M. Al-Dwairi, Z. Alqadi, A. AbuJazar, and R. A. Zneit, "Optimized True-Color Image Processing," World Applied Sciences Journal vol. 8, no. 10, pp. 1175-1182, 2010.
[7] A. Sakila and S. Vijayarani, "Image Enhancement using Morphological Operations," International Journal of Scientific Research in Science, Engineering and Technology, vol. 3, no. 2, pp. 685-698, 2017.
[8] R. AbuZneit, Z. AlQadi, and M. AbuZalata, "A Methodology to Create a Fingerprint for RGB Color Image," International Journal of Computer Science and Mobile Computing, vol. 16, no. 1, pp. 205-212, 2017.
[9] G. Tripathi, "Review on color and texture feature extraction techniques," International Journal of Enhanced Research in Management & Computer Applications, vol. 3, no. 5, pp. 77-81, 2014.
[10] D. Srivastava, R. Wadhvani, and M. Gyanchandani, "A Review: Color Feature Extraction Methods for Content Based Image Retrieval," International Journal of Computational Engineering & Management, vol. 18, no. 3, pp. 9-13, 2015.
[11] R. Gupta, H. Patil, and A. Mittal, "Robust order-based methods for feature description," in IEEE conference on computer vision and pattern recognition (CVPR), USA, 2010.
[12] X. Hong, G. Zhao, M. Pietikäinen, and X. Chen, "Combining LBP difference and feature correlation for texture description," IEEE TRANSACTIONS ON IMAGE PROCESSING, vol. 23, no. 6, pp. 2557–2668, 2014.
[13] J. Meng, Y. Gao, X. Wang, T. Lin, and J. Zhang, "Face Recognition based on Local Binary Patterns with Threshold " presented at the IEEE International Conference on Granular Computing, USA, 2010.
[14] M. Pietikäinen, A. Hadid, G. Zhao, and T. Ahonen, "Local Binary Patterns for Still Images," in Computer Vision Using Local Binary Patterns, vol. 40: Springer-Verlag London Limited, 2011, pp. 13-47.
[15] K. Arai, Y. Herdiyeni, and H. Okumura, "Comparison of 2D and 3D Local Binary Pattern in Lung Cancer Diagnosis," International Journal of Advanced Computer Science and Applications, vol. 3, no. 4, pp. 89-95, 2012.
[16] H. Rami, M. Hamri, and L. Masmoudi, "Objects Tracking in Images Sequence Using Center-Symmetric Local Binary Pattern (CS-LBP)," International Journal of Computer Applications Technology and Research, vol. 2, no. 5, pp. 504-508, 2013.
[17] R. Davarzani, S. Mozaffari, and K. Yaghmaie, "Image authentication using LBP-based perceptual image hashing," Journal of AI and Data Mining, vol. 3, no. 1, pp. 21-30, 2015.
[18] A. Porebski, N. Vandenbroucke, and L. Macaire, "Haralick feature extraction from LBP images for color texture classification," presented at the First Workshops on Image Processing Theory, Tools and Applications, Tunisia, 2008.
[19] Y. Zhao, W. Jia, and H. Min, "Completed robust local binary pattern for texture classification," Neurocomputing, vol. 106, pp. 68-76, 2013.
[20] J. Kwak, S. Xu, and B. Wood, "Efficient Data Mining for Local Binary Pattern in Texture Image Analysis," Expert Syst Appl, vol. 42, no. 9, pp. 1-29, 2015.
[21] A. Fichtner and S. Hanasoge, "Discrete wave equation upscaling," Geophysical Journal International, vol. 209, no. 1, pp. 353–357, 2017.
[22] V. E. Tarasov, "Discrete Wave Equation with Infinite Differences," An International Journal of Applied Mathematics & Information Sciences Letters, vol. 5, no. 2, pp. 41-44, 2017.
[23] E. Vega, A. Orozco, L. Villalba, and J. Castro, "Digital Images Authentication Technique Based on DWT, DCT and Local Binary Patterns," Sensors, vol. 18, no. 10, pp. 1-18, 2018.
[24] K. Matrouk, H. Alashaary, A. Alhasanat, and Z. Alqadi, "Investigation and Analysis of ANN Parameters," European Journal of Scientific Research, vol. 121, no. 2, pp. 217-225 2014.
[25] O. Abioduna, A. Jantana, A. Omolarac, K. Dadad, N. Mohamed, and H. Arshad., "State-of-the-art in artificial neural network applications: A survey," Heliyon, vol. 4, no. 11, pp. 217-225, 2018.