Window averaging to create LBP features for a color image

Ghazi. M. J. Qaryouti[1], Monzer M. Krishan[1], E. Monther A. Kanan[1], E. Ziad M. Alasmer[2]
[1]Department of Mechatronics Engineering, Faculty of Engineering Technology, Al Balqa Applied University, Salt, Jordan
[2]Department of artificial intelligent, Faculty of artificial intelligent, Al Balqa Applied University, Salt, Jordan

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ABSTRACT

Digital color images are widely used in various computer applications. Some of these applications such as digital image recognition systems require dealing with image classifiers which can be formed as a set of values representing the image. In this paper a simple method of image features victor creation will be proposed, the method will be tested and implemented, the obtained experimental results will be analyzed to ensure that each generated features victor is unique. The proposed method will be based on a window averaging, the window size can be easily changed without affecting the features victor size.

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Corresponding Author:

Ghazi M. J. Qaryouti
Department of Mechatronics Engineering, Faculty of Engineering Technology
Al Balqa Applied University
Salt, Jordan
Email: ghazi_qaryouti@bau.edu.jo

1. INTRODUCTION

The colored digital image is represented by a three-dimensional matrix [1], where the first dimension is allotted to represent the red color [2], [3], the second dimension is allotted to represent the green color, while the third dimension is allotted to represent the blue color, and each of these three colors is represented by a two-dimensional matrix, which consists of a set of pixels and which take values between 0 and 255 (Figure 1 shows an example of color images and the associated histogram) [4]-[6]. Colored digital images are considered one of the most widely used and widespread types of data, as they are used in many applications, the most important of which are protection systems, which depend on the process of image recognition and recognition [7]-[9]. The image size is very large, because modern digital images have a high resolution, which makes them a huge data collector consisting of a huge number of pixel values.

The fact that the digital image contains a large number of data elements makes the process of identifying and distinguishing them by performing the exact match process is a difficult process that requires great time and effort [10]. [11]. Therefore, it is essential to search for a way through which we can represent the image with a small number of values. It is called the features vector of the images [12], [13], which must be inimitable and not be repetitive for another image as shown in Figure 2. Created image features victor must be unique for each image, image features must be stored in a features database as shown in Figure 3, this database can be used later on as an input data set to train and build a recognition system, and the image features can be used as a classifier to identify the image using this system [14]-[16]. To simplify the process of image pixels manipulation the image can be reshaped by converting the 3D color matrix into one row or one column matrix as shown in Figure 4 [17], [18].

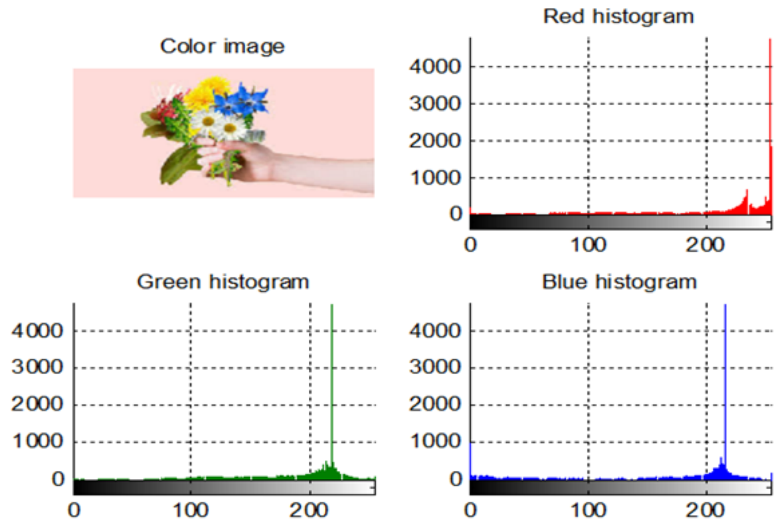

Figure 1. Color image example and histograms

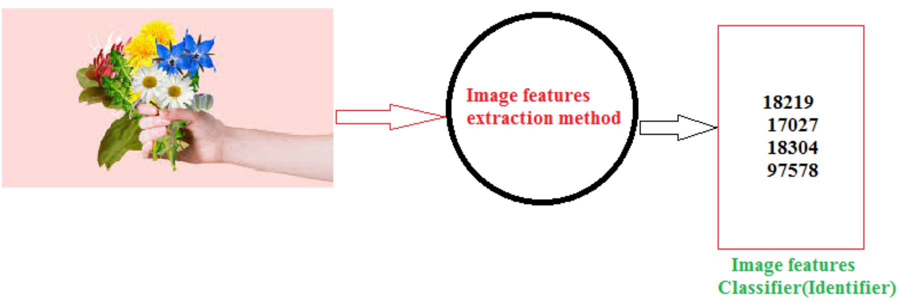

Figure 2. Image features

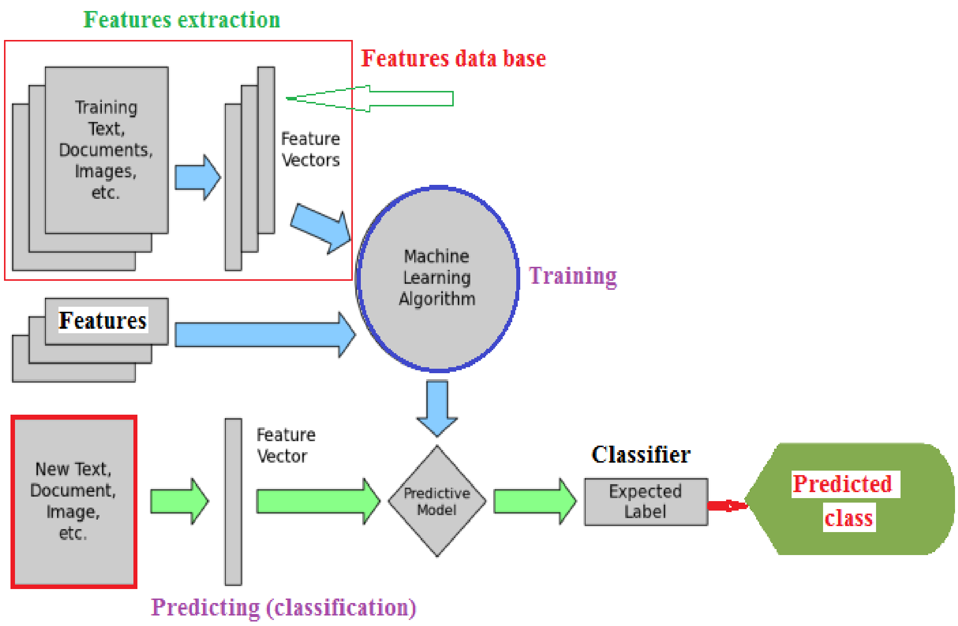

Figure 3. Image identification system

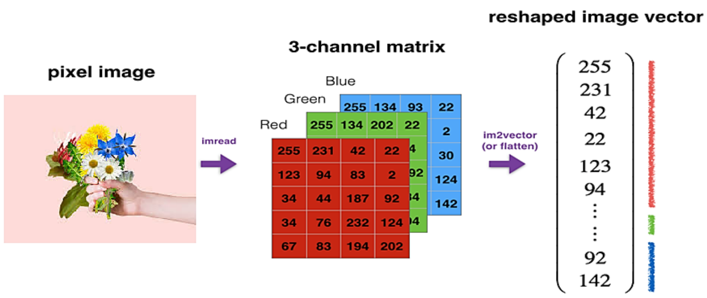

Figure 4. Image reshaping

2. IMAGE FEATURES EXTRACTION

Multiple methods [19]-[21] are used to extract the features of the digital image, and what we are interested in here is the methods based on the local binary byte (LBP) method [22]-[24]. LBP method can be used to extract a unique features victor for each color image, this method can be implemented by comparing each pixel with the 8_neighbors, and depending on the results of comparison generate a binary number, this number then is to be converted to decimal, then 1 must be added the repetition of this number to form a features victor with values point to the repetition of each decimal value (from 0 to 255) as shown in Figures 5 and 6.

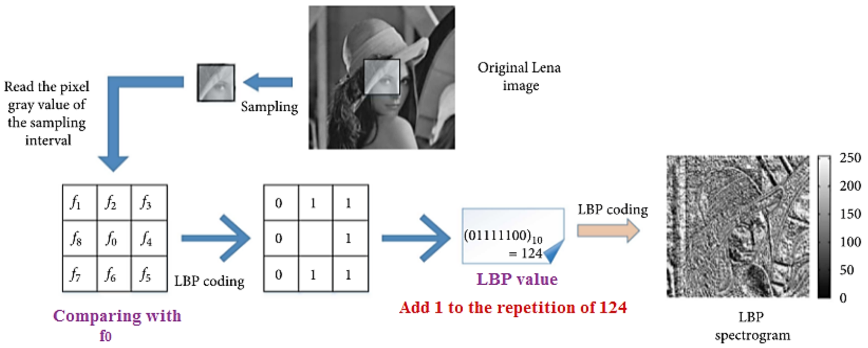

Figure 5. LBP calculation

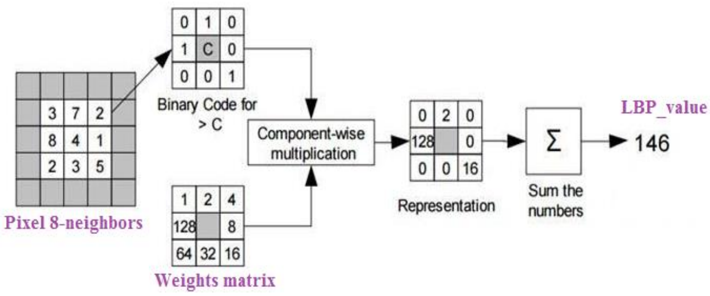

Figure 6. LBP calculation example

To reduce the number of elements in the features victor we can use another method based on LBP method, this method is called center-symmetric LBP (CS_LBP) [25]. Using CS_LBP we can generate a unique features victor for each image [26], [27], this victor contains 16 elements, and each element points to the replication of values 0 to 15. this method (as shown in Figure 7) can be implemented by using 4 comparisons, and depending on the results of comparison generate a binary number, this number then is to be converted to decimal, then 1 must be added the repetition of this number to form a features victor with values point to the repetition of each decimal value (from 0 to 15) as shown in figures 5 and 6. LBP and CS_LBP methods are simple methods, but the extracted features victor is long (see Figures 7 and 8), and this will lead to increasing the features database and complicating the recognition tool used in the image identification system.

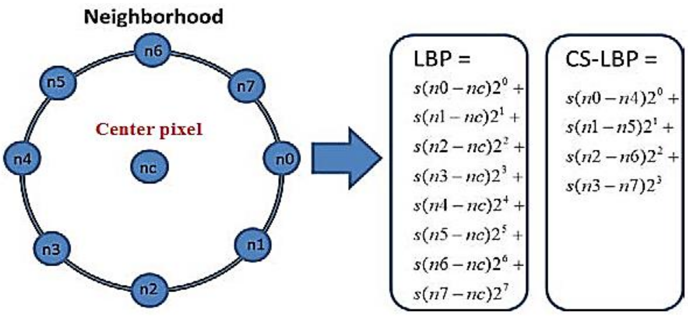

Figure 7. LBP and CS_LBP calculation

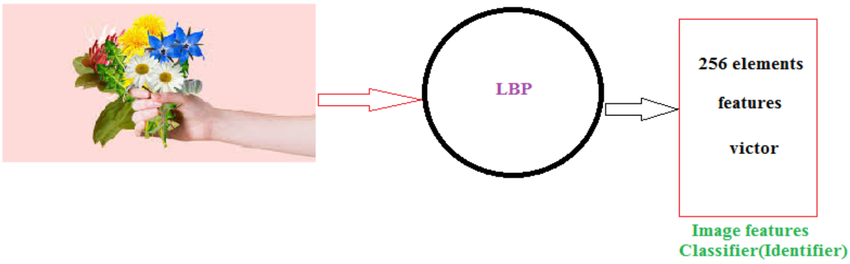

Figure 8. CS_LBP features

3. THE PROPOSED METHOD

The proposed method is based on LBP method and it can be implemented applying the following steps:

Step 1: Get the color image, retrieve the image size and reshape the image matrix into one row matrix.
Step 2: Select the window size (w>=1).
Step 3: Initialize a 4 element features victor (f) to zeros.
Step 4: For each pixel in the image row matrix do the following:

a. Find the average on the pixels covered by the lower windows (av0).
b. Find the average on the pixels covered by the upper windows (av1).
c. Set a0 to 1 if av0 >= the pixel.
d. Set a1 to 1 if av1 >= the pixel.
e. Calculate LBP operator by adding a0 to a1 multiplied by 2, this operator will point to an index in the features array.
f. Add 1 to the features victor index (see Figure 9).

Step 5: Save the features victor for later use.

Averaging   Window=3   Averaging

	...	S(i-3)	S(i-2)	S(i-1)	S(i)	S(i+1)	S(i+2)	S(i+3)	...
Value		100	110	120	100	50	60	70	
Average			110				60		
Comparing			A0=1				A1=0		
Binary number					01				
Decimal					1 So add 1 to the repetition of 1				

Figure 9. Proposed method process

4. IMPLEMENTATION AND EXPERIMENTAL RESULTS

A Matlab code shown in Figure 10 was written, this code was implemented using various color images (image sizes were around 151 k bytes) and various window size, Tables 1, 2 and 3 show the obtained experimental results:

```
a=imread('C:\Users\win 7\Desktop\images\a3.jpg');
[n1 n2 n3]=size(a);d=n1* n2 *n3;
a=reshape(a,1,n1*n2*n3);
f=zeros(4,1);w=9;
tic
for i=w+1:d-w
            a0=mean(a(1,i-w:i-1));
            a1=mean(a(1,i+1:i+w));
            s0=a0>=a(1,i);
            s1=a1>=a(1,i);
            ind=s0+2*s1;
            f(ind+1,1)=f(ind+1,1)+1;
end
toc
f
```

Figure 10. Proposed method Matlab code

Table 1. Image features (w=2)

Image number	Extracted features victor				Extraction time(seconds)
1	39514	34173	35561	42389	3.535000
2	36370	37281	35766	42265	3.551000
3	14175	15007	16182	105778	3.543000
4	40840	33204	35624	41528	3.474000
5	24739	37753	29944	59435	3.546000
6	47111	27025	28050	49010	3.514000

Table 2. Image features (w=3)

Image number	Extracted features victor				Extraction time(seconds)
1	42990	32130	33393	43122	3.605000
2	39997	34432	33165	44086	3.560000
3	15263	15050	16398	104429	3.562000
4	43845	30571	32762	44016	3.555000
5	27043	40681	32089	52056	3.565000
6	49091	25063	26900	50140	3.545000

Table 3. Image features (w=9)

Image number	Extracted features victor				Extraction time(seconds)
1	52378	26243	26478	46524	3.590000
2	47121	27629	26201	50717	3.582000
3	18219	17027	18304	97578	3.520000
4	50253	25580	25444	49905	3.551000
5	35126	39825	36964	39942	3.602000
6	53659	21593	23014	52916	3.539000

From the found results shown in Tables 1, 2, and 3 the following facts can be seen:

a. Comparing with LBP methods of image features extraction, the proposed method reduced the size of the features victor to 4.
b. Reducing the features victor size will reduce the features database and simplifies the model used for image identification.
c. The extracted image features victor is unique for each image, thus it can be easily used as an images identifier.
d. The extracted features require a small amount of time.
e. Changing the window size will change the contents of the features victor, and it remains unique as shown in Table 4.

Table 4. Image1 features

Window size	Extracted features victor				Extraction time(seconds)
4	45483	30437	31677	44036	3.577000
5	47479	29079	30176	44897	3.655000
6	49014	28085	28890	45640	3.674000
7	50460	27292	27916	45959	3.662000
8	51417	26683	27246	46279	3.733000
10	53190	25834	25936	46661	3.699000

5. CONCLUSION

A method of color image characteristics extraction was proposed, this method was applied and tested and the gained experimental results showed that this method can be easily used as a good method of features extraction. This method is flexible using a simple window to create the image features. The proposed method generates a unique features array for each method using a selected size of the window, the size of the features victor was reduced to 4 making the process of image identification simpler by reducing the size of the features database and the complicity of the recognition tool architecture.

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BIOGRAPHIES OF AUTHOR

Ghazi M. J. Qaryouti received his B.Sc. in electrical Engineering from Damascus university in 1982, and M.S in Mechatronics Engineering from Al-Balqa Applied University Jordan in 2006, and Ph.D. degrees in Mechatronics Engineering from De Montfort University in Leicester, UK in 2015 His research interests are in Power Electronics and Electric Machines and Drives, Energy Efficiency and Management, image processing, control systems, and Renewable energy Systems. He can be contacted at email: ghazi_qaryouti@bau.edu.jo.

Monzer M. Krishan Associate Professor of Mechatronics Engineering received Ph.D. degree in Informational-Measuring System/Mechatronics Engineering from National Aviation University, Kiev, Ukraine, in 2001. Now I am working at Department of Mechatronics Engineering, Faculty of Engineering Technology (FET), Al-Balqa Applied University, Amman, Jordan. Research interests: instrumentation and measurement, sensor technology, control and instrumentation, measurement and metrology, measuring devices, control, dynamics and fault diagnosis. He can be contacted at email: drkrishan@bau.edu.jo.

Monther A. Kanan received his B.Sc in Electromechanical Systems- Engineering (Mechatronics) from Al-Balqa Applied University –Jordan 1999, and M.S in Computer Science from Al-Balqa Applied University –Jordan 2007. His research interests in Algorithms, AI, image processing, control systems, process control, measuring devices. He can be contacted at email: kananmonther@bau.edu.jo.

Ziad M. Alasmer received his B.Sc in Electromechanical Systems- Engineering (Mechatronics) from Al-Balqa Applied University –Jordan 2000, and M.S in Computer Science from Al-Balqa Applied University –Jordan 2007. His research interests in Algorithms, AI, image processing, control systems, microprocessors, and embedded systems. He can be contacted at email: ziad_alasmer@bau.edu.jo.