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Analysis of Objects Information to Create Unique Features for Color Images

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Abstract: Color digital images are widely circulated in various means of communication, and these images are used in multiple and vital applications, which forces us to search for easy and effective ways to represent the digital image with a set of unique values that facilitate the process of retrieving or recognizing the digital image. A digital image is mostly made up of a group of objects that can be used to generate a features vector for an image that can be used as an image identifier. In this paper, we will present a set of easy procedures through which it is possible to retrieve objects in a digital image and how to use the information of these objects to form the properties of the image. We will also demonstrate the flexibility of the presented procedures in using a wide range of object information to formulate unique image values that can be used as properties for digital image retrieval or recognition.

Keywords: Digital image, object, features, area, centroid, extrema.

1- Introduction

The digital image[1], [2] is known as a three-dimensional matrix, where the first dimension is allocated to the red color, the second dimension to the green color, and the third dimension is allocated to represent the blue color (see figure 1)[8], [9]. Digital images are used in many vital and important applications for humans [3], [4], [5], especially in protection systems, by recognizing a person's fingerprint or recognizing his face or his eye in banking systems or in various police systems [6], [7].

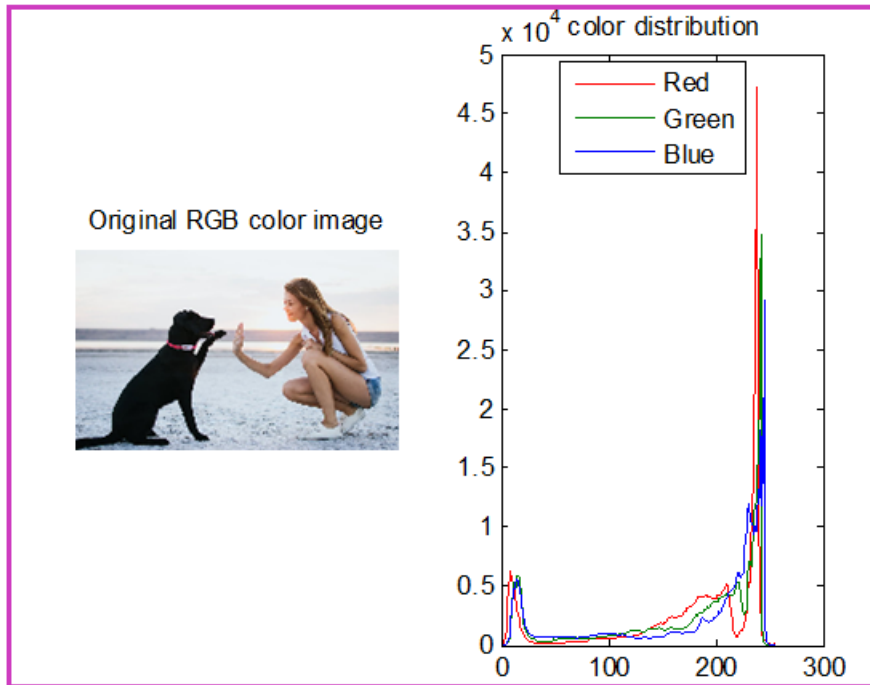


Figure 1: Color image example (Image 2)

Every color image consists of some objects[10], [11], [12], each object is defined as set of connected points, and it is easily to extract these objects based on the edge detection methods. Any object within the image has a valuable information such as area, coordinates of object centroid, extrema, which is defined as a set of points describe the edge points as shown in figure 2:

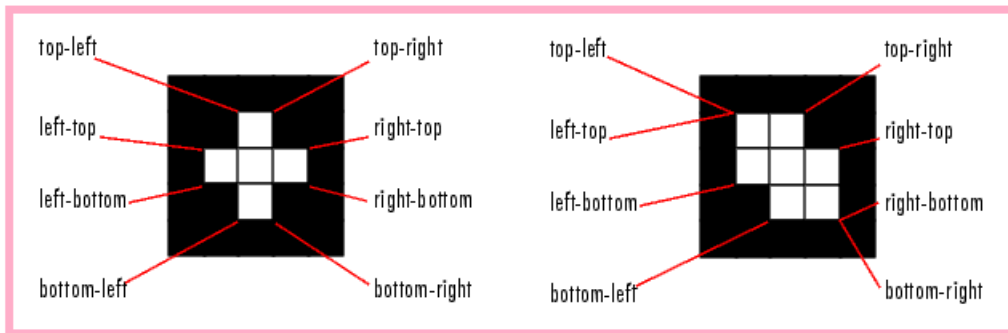


Figure 2: Object extrema

2- Related Works

Color images have a high resolution, thus they have a huge sizes which make the process of matching color images byte by byte a process that requires great effort and time, which force us to seek a method capable to generate a few unique values to represent any color image. Many texture methods are now used to create color image features [13], [14], many of these methods are based on local binary pattern (LBP) method such as modified LBP method, these methods provide high efficiency by requiring a small extraction time [15], [16], but these methods are sensitive to image rotation, any image rotation will generate new different features, broking the features stability condition [17].

Some of the methods used in extracting the image features depend on statistically treating the image matrix and calculating some statistical parameters such as the arithmetic mean and standard deviation, and using the values of these parameters as the image features. Some other method such as k_mean clustering method to group the image intensity values into groups or clusters, and the center of the defined number of clusters can be used as features [18], [19]. These methods are flexible by giving the user the ability of forming the features (clusters centers or within clusters sums or the counts of data items in each cluster). Clustering based method are not efficient because they require a long time of features extraction.

Other used methods are based on wavelet packet tree (WPT) decomposition [20], [21], [22], these methods are efficient, but it is difficult to select the number of decomposition levels required to form a fix number of feature values, because the images sizes are not fixed and change from image to another .

Any method used for image features extraction must satisfy the following requirements:

- Simple and easy procedures.
- For each image the features must be unique.
- Small number of values used to represent the image features.
- Fixed number of values in each image features victor.
- Small features extraction time.

3- The Proposed Method

The proposed method is composed by a set of simple procedures; the proposed steps can be summarized as follows:

```

%% step 1 Get the color image
ziad=imread('C:\Users\win 7\Desktop\images\z10.jpg');
[nn1 nn2 nn3]=size(ziad);

%% step 2 Convert to gray scale

if size(ziad,3)==3 % RGB image
imagen=rgb2gray(ziad);
end

%% step 3 Convert to binary image

threshold = graythresh(imagen);
imagen =~im2bw(imagen,threshold);

%%step 4 Remove all object containing fewer than 30 pixels

imagen = bwareaopen(imagen,100);
[L Ne]=bwlabel(imagen);

%%step 5 Measure properties of image regions

propied=regionprops(L,'BoundingBox');
prop=regionprops(L,'Area','Centroid','Extrema','Image');

%% step 6 Objects extraction

for n=1:Ne
    dd(n)=prop(n).Area;
end
ff(1,1)=Ne; ff(2,1)=max(dd'); ff(3,1)=min(dd'); ff(4,1)=mean(dd');
    
```

4- Implementation and Experimental Results

The proposed method was implemented using various images; figure 3 shows the used image 9, while figure 4 shows the extracted objects from this image:

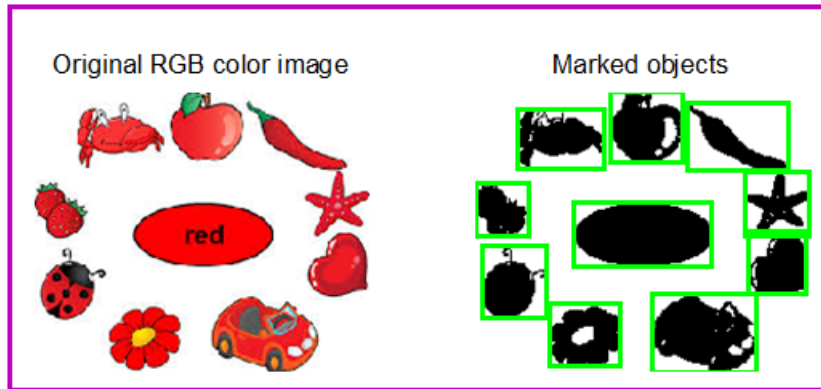


Figure 3: Image example (image 9)

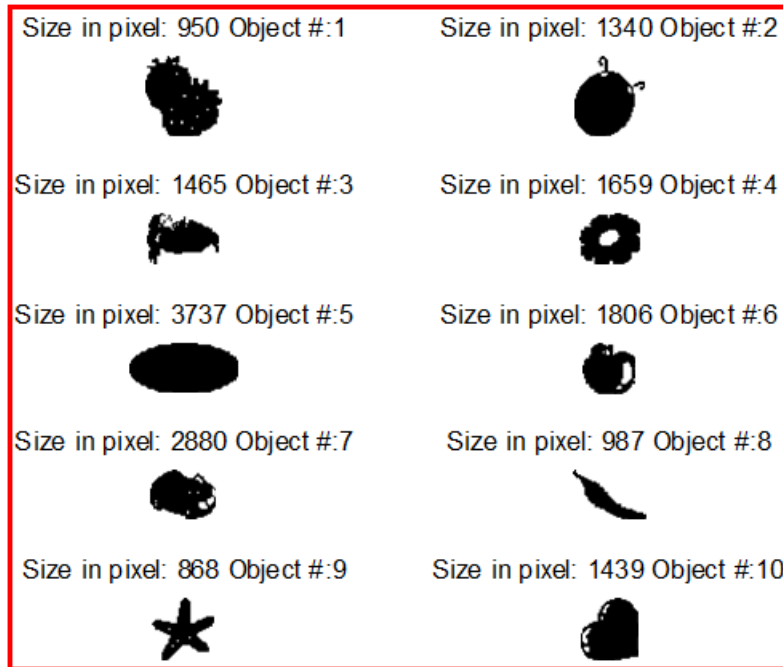


Figure 4: The extracted objects for image 9

Table 1: Objects count and areas for the first 6 images

1	2	3		4	5	6
Object counts	Object counts	Object counts		Object counts	Object counts	Object counts
8	10	60		16	3	8
Objects sizes(byte)	Objects sizes(byte)	Objects sizes(byte)		Objects sizes(byte)	Objects sizes(byte)	Objects sizes(byte)
1739	1138	170305	220	59798	58009	73567
122604	432	660	121	276	133	20727
221	67868	111	22600	4761	116	2020
663	5547	114	232	152		8141

245	8072	366115	242572	109		108
1433	36206	45689	6355	535		602
125	342	128	151	876		765
321	400	140	290	1760		200
	206	106	20731	235		
	116	511	150	191		
		6153	232	357		
		130	353	176		
		111	2869	387		
		1570	536	294		
		151	1386	102		
		138	112	166		
		10719	116			
		487	185			
		436	265			
		7459	633			
		116	520			
		302	225			
		406	173			
		225	159			
		167	415			
873		310				
163	635					
163	103					
10730	123					
199	4862					

The proposed method is very flexible by allowing use to use a wide range of bojects information to generate a unique features for each color image, table 1 shows the objects count for each color image and the areas(sizes in points) for each object.

The centroids for each object is a part of the provided information, these centroids or a part of them can also be used to form a color image features, table 2 shows the obtained centroids of each object using imahe 1, while table 3 shows the objects centroids for image 6.

Table 2: Centroids for image 1 objects

Object number	Center coordinates(Centroids)	
	X-coordinate	Y-coordinate
1	251.928	182.516
2	237.016	199.089
3	209.986	31.588
4	256.571	30.095
5	363	357

6	459.745	45.786
7	476.944	9.776
8	495	187

Table 3: Centroids for image 1 objects

Object number	Center coordinates(Centroids)	
	X-coordinate	Y-coordinate
1	109.102	188.151
2	363.107	166.142
3	308.038	366.165
4	534.756	35.889
5	443.759	328.703
6	555.490	237.818
7	550.950	183.496
8	570.8	386.765

Other valuable information is the object extrema(see figure 2), table 4 shows the extrema for the objects of image 8.

Table 4: Extrema for image 8 objects

POINT	Object 1		Object 2		Object 3		Object 4	
	X_coor	Y_coor	X_coor	Y_coor	X_coor	Y_coor	X_coor	Y_coor
top-left	0.5	0.5	91.5	298.5	162.5	0.5	320.5	0.5
top-right	98.5	0.5	101.5	298.5	229.5	0.5	320.5	0.5
right-top	512.5	170.5	104.5	300.5	229.5	0.5	320.5	0.5
right-bottom	512.5	342.5	104.5	339.5	229.5	2.5	320.5	166.5
bottom-right	512.5	342.5	104.5	339.5	202.5	14.5	320.5	166.5
bottom-left	0.5	342.5	97.5	339.5	190.5	14.5	511.5	166.5
left-bottom	0.5	342.5	64.5	332.5	162.5	1.5	207.5	34.5
left-top	0.5	0.5	64.5	331.5	162.5	0.5	207.5	32.5

From the obtained objects information we can use various combinations to form the features for each color image, table 5 shows how we can use the object counts, maximum object size, minimum object size and the average of the objects sizes to form a unique features vector for each color image.

Table 5: One variant of the color images features

Image number	Size(byte)	Features				Extraction time(second)
		Objects count	Max object size(byte)	Min object size(byte)	Average objects sizes(byte)	
1	565404	8	122604	321	125	0.315000
2	1746000	10	67868	116	12032.7	0.399000
3	4915200	60	366115	103	15536.85	2.661000
4	499500	16	59798	102	4385.9375	0.311000
5	725400	3	58009	116	19419.333	0.352000
6	720000	8	73567	108	13266.25	0.431000
7	275400	24	20948	103	1773.5	0.340000
8	525312	4	88104	648	29840.25	0.333000
9	151290	10	3737	868	1713.1	0.306000
10	151110	16	1131	409	802.25	0.153000

From table 5 we can see the following facts which satisfy the requirement of good method of features extraction:

- Simple and easy implementation of the proposed method steps.
- The features vector for each image is unique, thus it can be used as an image signature, classifier or primary key.
- The number of values used to represent the image features is small.
- The number of values in each image features vector is fixed and equal four.
- The features extraction time is acceptable.

5- Conclusion

A simple and easy to implement method of color image features extraction was proposed, implemented and tested. The obtained experimental results showed that the proposed method satisfies the requirement of good method of features extraction, The method provides us with several combinations to form the image features vector, which makes it very flexible by providing the user a freely choice of selected the needed objects information to form the features.

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