IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Vol. 9, Issue 12, December 2020

DOI 10.17148/IJARCCE.2020.91208

Objects information as a source of image features

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Abstract: Digital color images are the most important data types used in various vital applications, some of these applications required image features. Digital images contain variable number of objects with variable sizes. Each object contains valuable information which can be used to construct image features. In this paper research we will analyze a variety of information which are used to describe any object in the image, a methodology of objects extraction and the associated with each object will be proposed, a way of forming the image features will be discussed.

Key words: Digital image, object, features, centroid, area, extrema, orientation, convex Hull, Euclidian distance.

I.INTRODUCTION

Color digital images [1], [2] are one of the most common types of data in circulation [24], [25], [26]. This wide spread is due to the large number of vital applications that use digital images as image recognition systems, for example [6]. Digital images are characterized by their high resolution, which leads to an increase in their size to reach millions of values [15], which makes processing this huge amount of data not easy because it requires high processing time[11], [12].

To increase the efficiency of many systems that use digital images, a small set of values called image features can be used, which has the advantage of being unique to the image and can be used as a distinction to recognize the image [13], [14].

Digital images consist of a group of objects that can be easily discovered and retrieved. Each of these objects possesses a large amount of information that can be used or part of it can be used to form the features of the image. The process of detecting objects in the digital image is an easy process, as the edges of the image can be easily identified and thus objects can be identified and retrieved [4]. Getting the objects we can use the associated information to form the image features [5].

Many method are used to create digital image features victor, local binary pattern (LBP) method[8], [9], [18] and its modifications, statistical [3], K_mean clustering[20], [19], [21], linear prediction code (LPC)[7] and wavelet packet tree (WPT) decomposition[10], [22], [23] are the famous methods which are used to calculate any image features. But in our research paper we will introduce different methodology to create the features based on the extracted objects information [16], [17].

II.OBJECT INFORMATION

An object in the image is a set of 4 or 8_connected points. Here we will describe the information associated with each object; this information contains the following data items:

- Object centroid: the center of mass of the region. The first element (as shown in figure 1) of Centroid is the horizontal coordinate (or x-coordinate) of the center of mass, and the second element is the vertical coordinate (or y-coordinate).

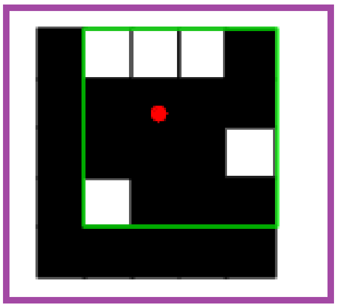

Figure 1: Object centroid

- Object area: the actual number of pixels in the region.

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- Object extrema: the extrema points in the region. Each row of the matrix contains the x- and y-coordinates of one of the points. The format of the vector is [top-left top-right right-top right-bottom bottom-right bottom-left left-bottom left-top] as shown in figure 2.

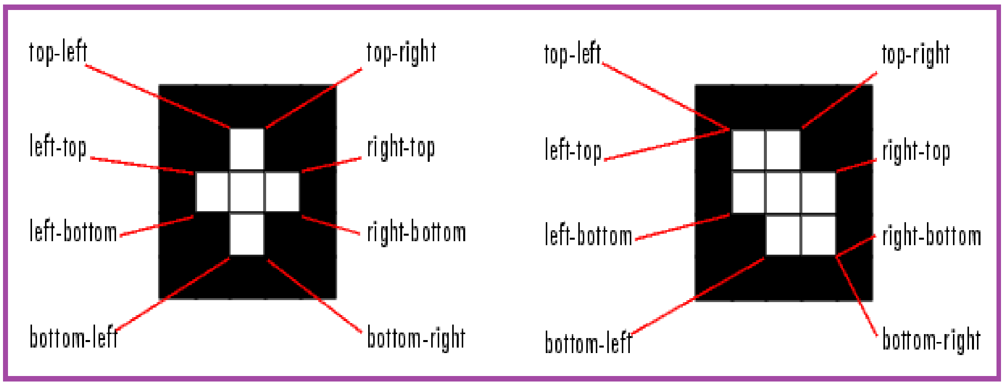

Figure 2: Object extrema

- Object orientation: the angle (in degrees) between the x-axis and the major axis of the ellipse that has the same second-moments as the region as shown in figure 3.

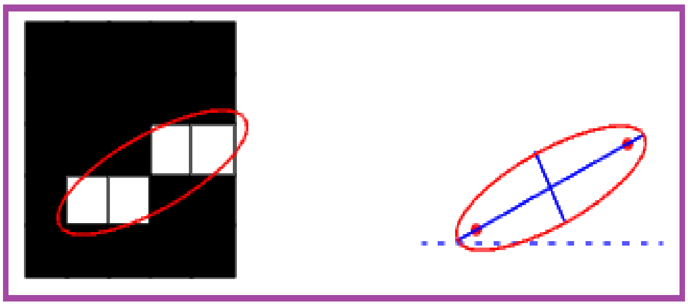

Figure 3: Object orientation

- Object Convex Hull: the smallest convex polygon that can contain the region. Each row of the matrix contains the x- and y-coordinates of one vertex of the polygon.
- Object Major Axis Length: the length (in pixels) of the major axis of the ellipse that has the same normalized second central moments as the region.
- Object Minor Axis Length: the length (in pixels) of the minor axis of the ellipse that has the same normalized second central moments as the region.
- Object Eccentricity: the eccentricity of the ellipse that has the same second-moments as the region. The eccentricity is the ratio of the distance between the foci of the ellipse and its major axis length. The value is between 0 and 1.
- Object Euclidian distances: the distance between any two any two points (points coordinates) p and q, the distance can be calculated using equation 1.

$$d(\mathrm{p},\mathrm{q}) = \left((p_1 - q_1)^2 + (p_2 - q_2)^2 + (p_3 - q_3)^2\right)^{1/2} \quad \textbf{(1)}$$

III.PROPOSED METHODOLOGY

The proposed methodology as shown in figure 4 can be easily implemented applying the following steps:

1. Get the image.
2. If the image color then convert the image to gray color.
3. Covert the gray image to binary image.
4. Remove all objects with size less than a selected one bwareaopen matlab function.
5. Retrieve the objects number in the image applying bwlabel matlab function.
6. Apply objects labeling using and get the necessary objects information using regionprops matlab function.

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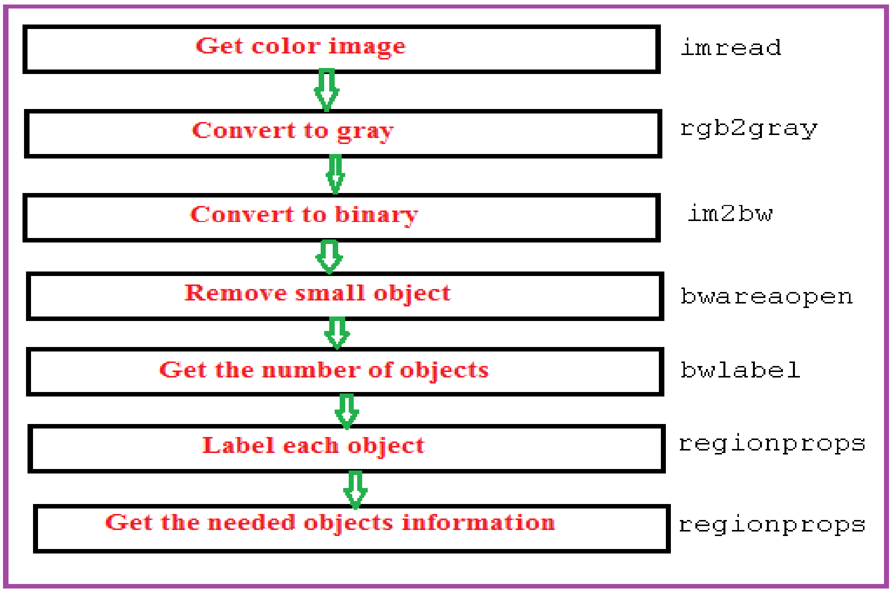

Figure 3: Proposed methodology

IV.IMPLEMENTATION AND EXPERIMENTAL RESULTS

The proposed methodology was implemented using matlab, several objects properties were measured, the obtained experimental results showed that each image has different properties, allowing us to form the image features and giving us the flexibility to select any number of these properties to create image features victor, figures 4 and 5 show the extracted objects of the used image 1.

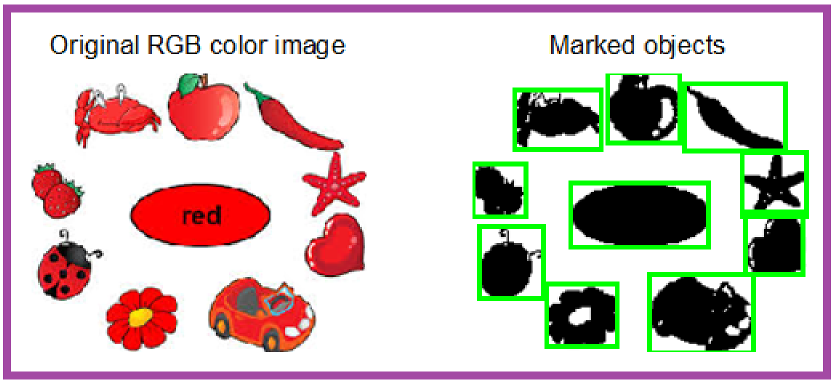

Figure 4: Objects in image 1

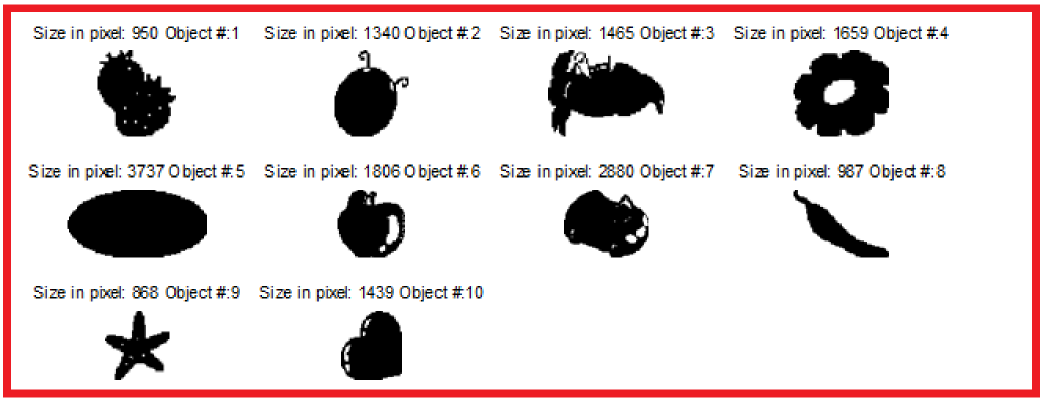

Figure 5: Objects sizes (Image 1)

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For image 1 we retrieve the objects centroids, here we can use the Euclidian distance of centroids as a value of the image features (see table 1).

The object extrema property can be used to form the image features, figure 6 shows the extremas for the first 4 objects of image 1.

Object 1		Object 2		Object 3		Object 4	
X_coor	Y_coor	X_coor	Y_coor	X_coor	Y_coor	X_coor	Y_coor
11.5000	66.5000	23.5000	113.5000	42.5000	12.5000	84.5000	156.5000
17.5000	66.5000	25.5000	113.5000	45.5000	12.5000	90.5000	156.5000
39.5000	87.5000	52.5000	130.5000	94.5000	34.5000	107.5000	167.5000
39.5000	88.5000	52.5000	133.5000	94.5000	40.5000	107.5000	183.5000
24.5000	106.5000	26.5000	165.5000	40.5000	56.5000	79.5000	201.5000
14.5000	106.5000	18.5000	165.5000	39.5000	56.5000	69.5000	201.5000
0.5000	84.5000	5.5000	153.5000	31.5000	37.5000	54.5000	179.5000
0.5000	78.5000	5.5000	140.5000	31.5000	31.5000	54.5000	176.5000

Figure 6: Extremas of the first 4 objects of image 1

Table 1: Some properties of image 1 objects

Object number	Centroid		Euclidian distance of Extrema	Area	Orientation
	X_coordinates	Y_coordinates			
1	87.7453	18.3916	73.6614	950	-50.1719
2	143.6366	25.2746	125.8730	1340	60.2454
3	32.9556	59.1686	44.5982	1465	-0.3009
4	179.2194	81.5467	97.6729	1659	18.3825
5	104.4549	123.8416	62.1772	3737	-0.0050
6	26.9707	124.4358	164.7938	1806	-25.5614
7	176.8076	167.3549	14.7648	2880	-12.3192
8	38.1621	189.7143	212.1367	987	-33.5448
9	83.1613	221.9747	232.6478	868	33.8817
10	127.8610	224.3419	176.1051	1439	57.2337
Euclidian distance of centroids		137.1841			

Other valuable information are Major Axis Length, Minor Axis Length, Eccentricity, and Euclidian distance of convex Hull , these information can also be used to form the image features (see table 2); figure 7 shows the extracted convex Hull coordinate for the first two objects of image 1:

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ConvexHull

Object 1

X_coor	Y_coor
17.0000	66.5000
12.0000	66.5000
6.0000	67.5000
1.5000	72.0000
0.5000	79.0000
0.5000	84.0000
3.5000	90.0000
10.5000	103.0000
13.0000	105.5000
15.0000	106.5000
24.0000	106.5000
27.0000	105.5000
32.0000	102.5000
35.5000	99.0000
39.5000	88.0000
36.5000	84.0000
31.0000	78.5000
17.0000	66.5000

Object 2

X_coor	Y_coor	X_coor	Y_coor
24.0000	113.5000	52.5000	131.0000
22.0000	114.5000	51.0000	129.5000
21.5000	115.0000	25.0000	113.5000
8.5000	134.0000	24.0000	113.5000
6.5000	138.0000		
5.5000	141.0000		
5.5000	153.0000		
8.5000	159.0000		
9.0000	159.5000		
14.0000	163.5000		
16.0000	164.5000		
19.0000	165.5000		
26.0000	165.5000		
29.0000	164.5000		
33.0000	162.5000		
36.0000	160.5000		
39.5000	157.0000		
41.5000	154.0000		
52.5000	133.0000		

Figure 7: Convex Hull coordinates of the first 2 objects of image 1

Table 2: Properties averages as a features part

Object number	Major Axis Length	Minor Axis Length	Eccentricity	Euclidian distance of convex Hull
1	43.5833	29.3228	0.7398	73.6240
2	46.3202	38.9219	0.5422	128.7109
3	66.9359	32.9937	0.8701	44.5702
4	56.1328	45.3814	0.5885	128.0566
5	102.4994	46.4369	0.8915	37.1012
6	52.6359	48.9882	0.3658	173.3335
7	77.3234	50.5356	0.7569	14.5774
8	83.1386	18.8326	0.9740	219.2955
9	43.1214	37.3140	0.5012	175.3981
10	49.2243	39.1725	0.6056	165.4766
Average	62.0915	38.7900	0.6836	111.1123

Using some of the objects properties we can construct a features victor for each image, the victor value will be unique for each image and they can be used as a classifier to retrieve or recognize the image, table 3 shows an example of how to form a features victor for each image:

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Table 3: Example of images features victors

Image number	Features			
	Number of objects	Euclidian distance of centroids	Average area	Average eccentricity
1	10	137.1841	1713.1	0.6836
2	16	62.9931	802.2500	0.7616
3	9	144.9173	1834.7	0.8254
4	6	128.9015	1315	0.7905
5	3	56.5730	14343	0.4021
6	139	332.3075	1165,5	0.7627

V.CONCLUSION

A simple methodology was proposed to create image features victors to be used for image retrieval or image recognition. Based on the extracted object properties we can construct the image features victor, the objects properties provide us with a variety of information which can be used as an excellent source to form the image features. Getting th image objects information is very simple and useful, and it was shown that for each image (color or gray) we can easily for a unique values to be used as image classifier or identifier.

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ISSN (Print) 2319-5940

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