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Detecting, Counting Objects to Form Color Image Features

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Abstract: Color image features are very important victor of values. Which is used as an image identifier or primary key which can be used easily in a color image retrieval system, the features victor can be used also as an image signature to compute image classifier in a color image recognition system. In this paper research we will introduce a texture method to create color image features. This method will have based on using crossing number to detect some objects in the image, the detected objects where isolated, ending, connected and crossing points. The idea of the proposed method is to find the count of each objects, these counts will form the image features. The proposed method will be implemented and the experimental results will be analyzed to prove the efficiency, accuracy, and stability of the proposed method.

Keywords: Features, crossing number, isolated point, ending point, connected point, crossing point.

I. INTRODUCTION

Digital color images [1], [2], [3] are the most popular data types used by human[23], [24], they are used in various application such image retrieval systems and image recognition system, these systems are used in many industrial and business applications [4], [5], [6].
Digital images can be represented by a 2D matrix (gray image), or 3D matrix (RGB color image) [9], theses matrices can be easily implemented applying various arithmetic and logical operation. In this research paper we will focus on color images because they are used in various important and vital applications [7], [8].
Digital color image usually has a high resolution which leads to dealing with a huge size consisting of megabytes, thus the process of image matching will require long time and a poor efficient retrieval or recognition system, table 1 shows various images with different sizes, these images will be used later in the proposed method implementation [10], [11], [12].

Table 1: Example of used images

Image number	Resolution(pixel)	Size(byte)
1	151 333	150849
2	152 171	77976
3	360 480	518400
4	1071 1600	5140800
5	981 1470	4326210
6	165 247	122265
7	360 480	518400
8	183 275	150975
9	183 275	150975
10	201 251	151353
11	600 1050	1890000
12	1144 1783	6119256

To overcome the previous mentioned problem, we can use the image features to deal with the image. Image features can be defined as a set of values (victor); these values must satisfy the following:

- THE FEATURES VALUES MUST BE NUMERIC TO SIMPLIFY THE PROCESS OF IMPLEMENTATION.
- THE NUMBER OF ELEMENTS MUST BE SMALL TO MINIMIZE THE FEATURES DATABASE SIZE.
- FOR EACH IMAGE THE FEATURES MUST BE UNIQUE AND CAPABLE TO BE USED AS A PRIMARY KEY OR SIGNATURE.
- THE FEATURES MUST DEPEND ON THE IMAGE TEXTURE.
- THE FEATURES MUST BE STABLE FOR EACH IMAGE, AND DOES NOT CHANGE FROM ONE RUN TO ANOTHER.

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- Features extraction time must be minimal and small.

II. RELATED WORKS

Many methods were proposed to create color image features [13], [14], many of these methods are based on local binary pattern (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 methods were based on using statistical parameters to generate the features; these methods require bigger time of features extraction. Some other method such as k_mean clustering method to group the image intensity values into groups or clusters, and the centre 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 centres 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 (see table 1).

III.THE PROPOSED METHOD

The proposed method detects some objects in the color image and counts them, these counts are to used as an image features, these objects are four: isolated, ending, connecting and crossing points as shown in figure 1.

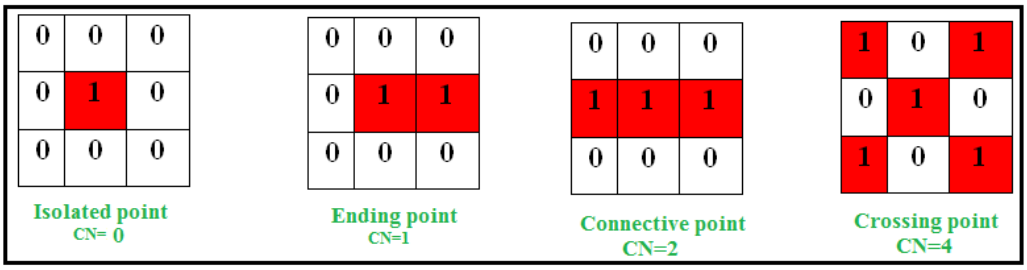

Figure 1: Objects to be detected

The proposed method can be implemented applying the following steps:
1) Color image preprocessing:
This step must be implemented using the following sequence of operations:
- Select the color image.
- Convert the color image to gray image.
- Convert the gray image to binary image.
- Apply image thinning using morphological thinning.
-

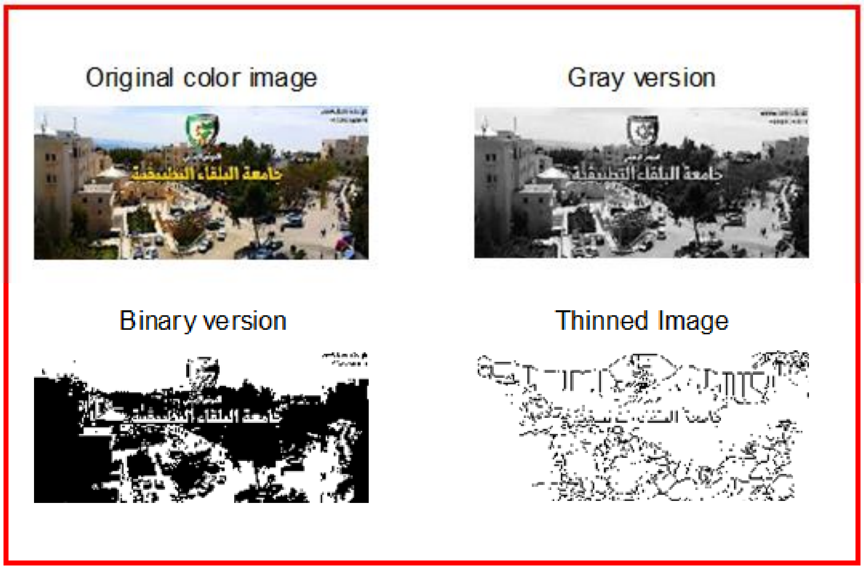

Figure 2: Step 1 outputs (image 1)

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2) For each pixel in the binary image, detect the object based on the 8-neighbor value (eq. 1) and referening to the calculated value of the crossing number as shown in figure 3, for the detected object add one the object count.

P_4	P_3	P_2
P_5	P	P_1
P_6	P_7	P_8

$$CN = \frac{1}{2} \sum_{i=1}^{8} |P_i - P_{i+1}| \quad \text{Eq. 1}$$

Figure 3: Crossing number calculation

IV. IMPLEMENTATION AND EXPERIMENTAL RESULTS

Images shown in table 1 were proccessed using matlab, figure 4 shows image 2 versions, while figure 5 shows the connective points to this image:

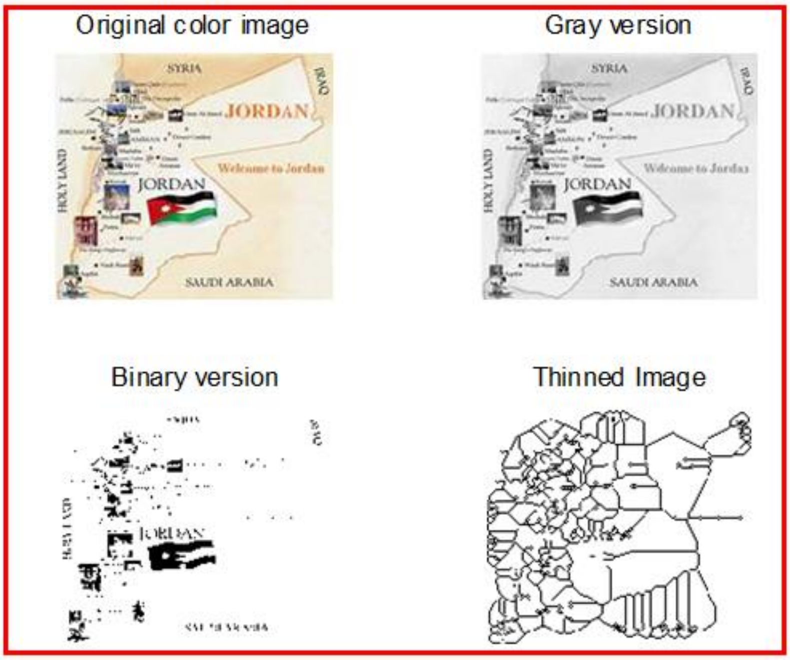

Figure 4: Image 2 versions

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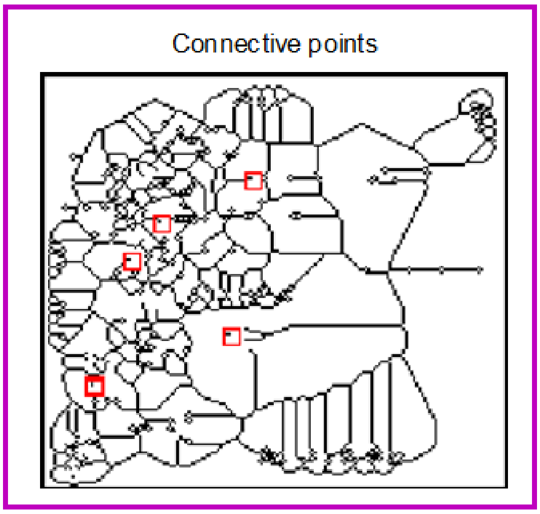

Figure 5: Connecting points for image 2

Each of the detected points has an x and y coordinates, figure 6 shows the coordonates for the connected points of image 2.

X	Y
117	21
118	21
71	35
57	46
99	72
41	80

Figure 6: Connecting points coordinates (image 2)

Figure 7 shows the ending points for image 1, while figure 8 shows the coordinates of these points:

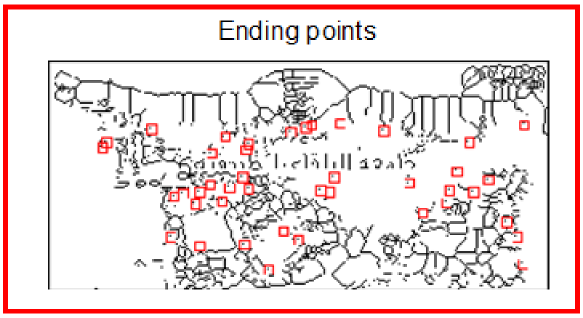

Figure 7: Ending points (image 2)

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59	38
56	41
47	71
119	84
92	86
90	92
97	100
89	103
125	103
84	110
63	111
95	118
52	120
86	123
79	132
124	133
61	134
57	136
87	136
141	149
115	159

Coordinates of points from 1 to 21

49	164
121	169
46	174
44	178
88	184
89	190
79	193
43	197
48	226
83	243
103	252
96	268
88	270
75	275
56	283
89	286
81	296
109	308
119	315
137	319
44	320

Coordinates of points from 22 to 42

Figure 8: Ending points coordinates (image 1)

The 4 selected objects were detetected for each image, and the count of each object was finded, table 2 shows the obtained experimental result.
From table 2 we can see that the proposed method satisfies the requirements of good method of features extraction by providing the following advantages:
- It requires an average extraction time of 0.8583 seconds, thus we can cosider it as an efficient method comparing with other mentioned existing methods of features eaxtraction.
- The features for each are unique, thus we can use these features as an imgae primary key or signature.
- The features victor contains small number of elements, which leads to minimizing the size of the features database.
- The features are stable and do not change fron run to run.
- The features remain without change even if we rotate the image.

Table 2: Objects counts (features) for each image

Image	Points counts				Extraction time(seconds)
	Isolated	Ending	Connecting	Crossing	
1	48003	42	131	314	0.083249
2	24726	0	6	115	0.045659
3	165611	89	423	878	0.277279
4	1628423	980	3698	7561	2.777550
5	1390886	1050	3691	5310	2.227815
6	39503	18	78	188	0.070951
7	166018	119	366	770	0.271745
8	50403	13	41	150	0.072149
9	49272	68	127	254	0.077176
10	48273	54	150	349	0.083784
11	612392	71	549	1815	0.945822
12	1935214	728	1748	5057	3.366517
Average					0.8583

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V. CONCLUSION

A method of color image features extraction was proposed, implemented and tested. The obtained experimental results showed that based on objects counts in any image with any size we can create a small features victor. This victor is unique for each image and can be easily used in an image retrieval or recognition system. Base on the obtained average extraction time we can consider the proposed method as efficient method of image features extraction.

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