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Procedural Analysis of RGB Color Image Objects

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Abstract: Many applications which are dealing with digital image processing require retrieving information about the objects within the color image such as: number of objects, object location, objects area, object center and object matrix. This information is very valuable to any specialist using digital color images. This paper will produce a procedure to be used to manipulate color images in order to retrieve the needed information about each object in the image, this procedure can be used in various forms such as getting information about the object, selecting an object or a group of object, extracting an object or a group of objects, deleting an object or a group of objects.
Key words: color image, object, area, centroid, extrema, procedural analysis.

1- Introduction

Digital image is a two (gray image, binary image) or three dimensional matrix (RGB color image) [1], [2]. The matrix element is called a pixel and some pixels may have the same features, or some of the pixels form an object which is defined as a set of connected pixels [3]. In General an object within an RGB color image is a set of pixels which have the same values from a selected rang and are *4-neighbor* or 8- *neighbor* connected.[3][4],[5].
A pixel, Q, is a *4-neighbor* of a given pixel, P, if Q and P share an edge. The 4-neighbors of pixel P (namely pixels P2, P4, P6 and P8) are shown in *Figure 1* below.

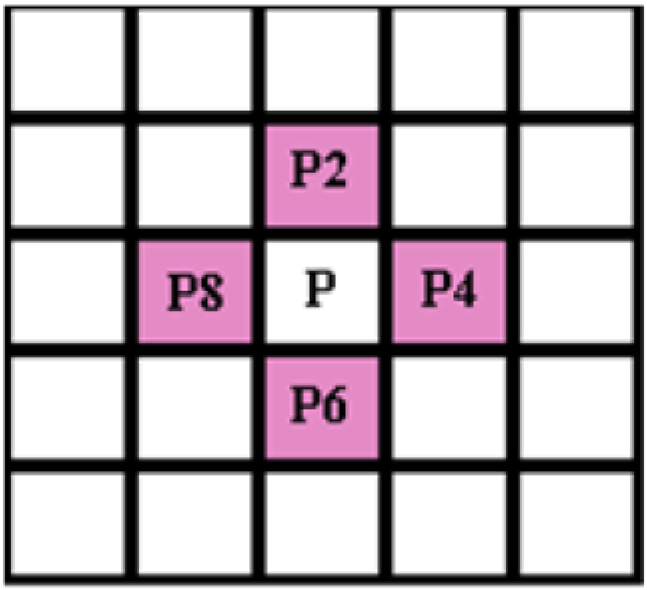

Figure 1: 4-connected pixels

A set of pixels, P, is an *8-connected component* (or simply a *connected component*) if for every pair of pixels pi and pj in P, there exists a sequence of pixels *pi... pj* such that [6], [7]:
All pixels in the sequence are in the set P, and every 2 pixels that are *adjacent in the sequence* are *8-neighbors [8]*.

In different fields of digital image processing applications, it still remains a challenging task to segment objects from its background and count them automatically [9].[10]. The differences between the objects within a digital image lie on the texture, color, size, location and morphology of objects. Many digital image processing applications require object treatment such as: object counting, object indexing and labeling, object detection and extraction, object specification such as object size, object grouping object depletion and so on. So the need of a simple, easy, swift and effective procedure for object counting is Very important and necessary procedure of life and need to human applications.[11].

2- Required matlab functions

To implement the proposed procedure which analyzes the feature of the objects within RGB color image the following matlab functions are required:

- rgb2gray: To convert RGB color image to gray image.
- im2bw : To convert gray image to binary.
- imfill: To fill image regions and holes.
- bwareaopen: To remove an object based on the object size.
- bwlabel: To count and label the image objects.
- Regionprops: To show each object in a box.
- Regionprops: To measure properties of image objects such as area and coordinates, location. This function can be used to retrieve the following object features:

✓ Object area-- the actual number of pixels in the region. (This value might differ slightly from the value returned by bwarea, which weights different patterns of pixels differently.)

✓ Centroid-- 1-by-ndims (L) vector; the center of mass of the region. Note that the first element 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). All other elements of Centroid are in order of dimension. Figure 2 illustrates the centroid and bounding box. The region consists of the white pixels; the green box is the bounding box, and the red dot is the centroid.

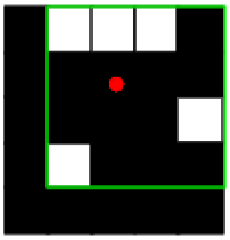

Figure 2: Object centroid

- ✓ Extrema -- 8-by-2 matrix; 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]. This property is supported only for 2-D input label matrices. Figure 3 illustrates the extrema of two different regions. In the region on the left, each extrema point is distinct; in the region on the right, certain extrema points (e.g., top-left and left-top) are identical.

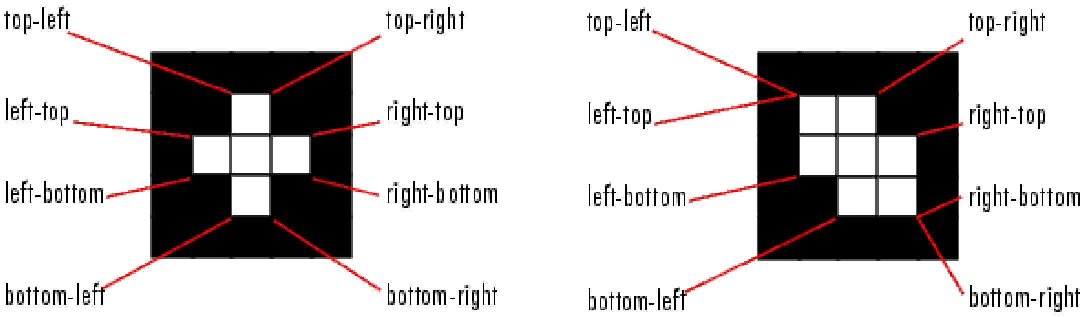

Figure 3: Object extrema

- ✓ Image -- Binary image (logical) of the same size as the bounding box of the region; the on pixels correspond to the region, and all other pixels are off.

3- The proposed procedure to analyze objects

The proposed procedure can be implemented applying the following steps:

1. Read the input RGB color image.
2. Convert the input image to gray image.
3. Convert the gray image to binary image.
4. Execute the matlab function bwareaopen to eliminate the un needed objects from the image. Here the function parameter points the objects with size less or equal to be eliminated. This function can be used to eliminate the noise or to delete an object or a set of objects from the image.
5. Execute the matlab function bwlabel to count and label the objects within the image.
6. Execute the matlab function regionprops to mark the boundaries of each object.
7. Execute the matlab function regionprops with the parameters area, centroid, extrema and image to retrieve the necessary objects information.

4- Implementation and experimental results

A matlab code was written to implement the proposed procedure, the image shown in figure 4 was taken as an input image:

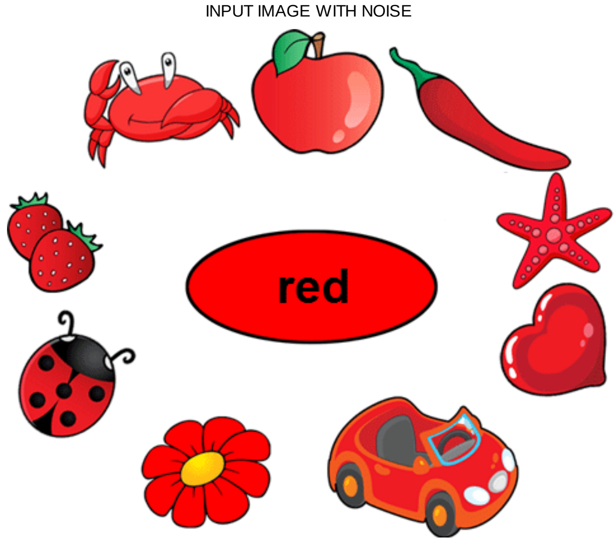

Figure 4: The input RGB color image

Figure 5 illustrates the input image and color distribution (histogram).
The parameter of the function bwareaopen was set to 30 to eliminate all object with size less or equal 30 pixels, Figure 6 shows the process of objects labeling after applying the matlab function regionprops.

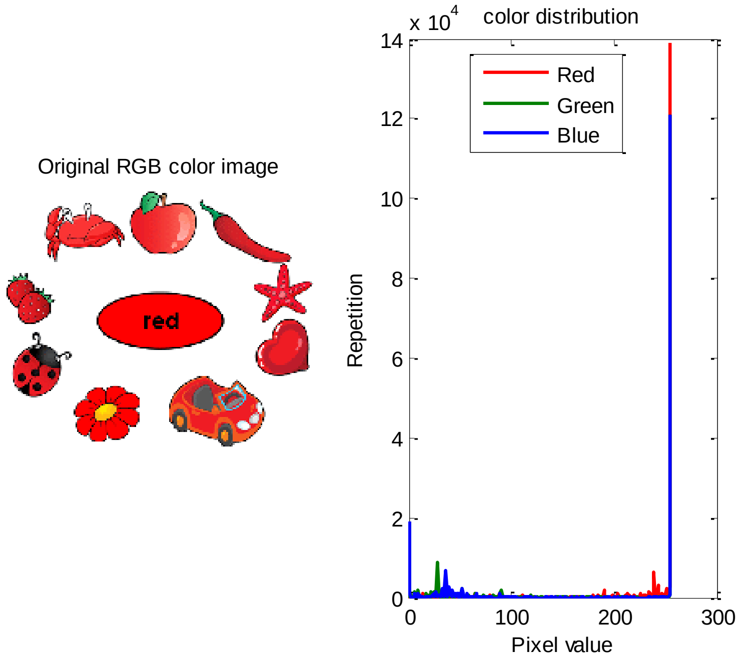

Figure 5: Input image and histogram

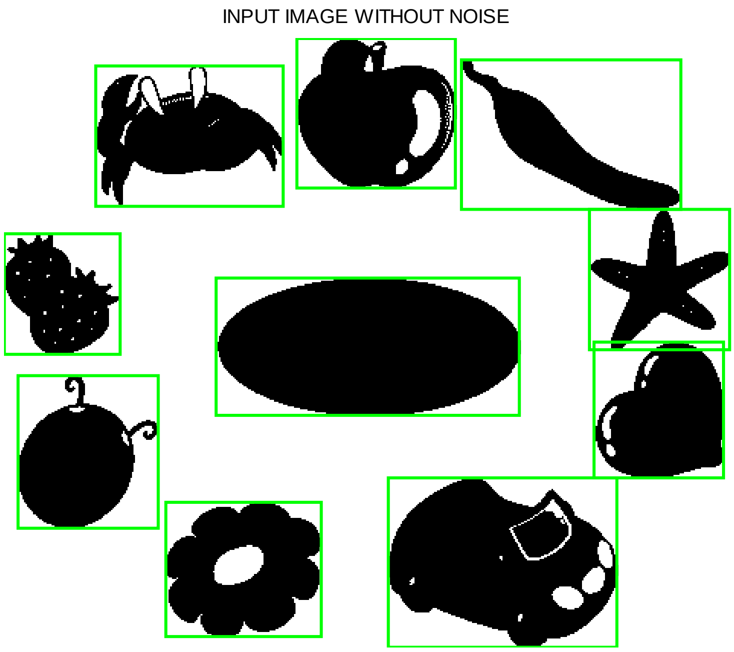

Figure 6: Objects labeling

The proposed procedure for image objects analysis can be executed with various parameter, thus giving the users different options to analyze the objects and here are some results of the procedure options:

1. Retrieving the number of objects and for each object determine the size and the center coordinates as shown in table 1:

Table 1: Objects and there sizes and center coordinates.

Object number	Area in pixels	Center X coordinate	Center Y coordinate
1	3559	35	170
2	5061	49	279
3	5550	115	63
4	6231	158	348
5	14124	240	203
6	6736	241	52
7	10781	324	344
8	3736	368	74
9	3286	431	162
10	5433	435	248

2. Get individual objects as illustrated in figures 7 and 8

Figure 7: Object 4

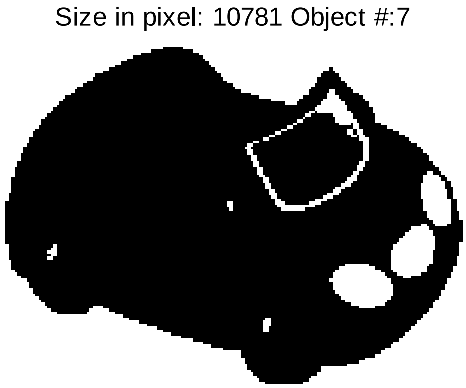

Figure 8: Object 7

3. For each object get the object resolution(number of rows and number of columns), this information is listed in table 2:

Table 2: Object resolution

Object number	Rows	Columns
1	79	76
2	100	92
3	924	124
4	88	102
5	90	199
6	98	105
7	111	151
8	98	143
9	92	91
10	89	84

4. **For each object get the boundary pixels coordinates: This information is listed in tables 3 and 4:**

Table 3: Boundary pixels for object 4

Point	X coordinate	Y coordinate
top-left	165	305
top-right	176	305
right-top	209	328
right-bottom	209	334
bottom-right	150	393
bottom-left	141	393
left-bottom	107	351
left-top	107	342

Table 4: Boundary pixels for object 7

Point	X coordinate	Y coordinate
top-left	305	289
top-right	312	289
right-top	404	346
right-bottom	404	353
bottom-right	351	400
bottom-left	339	400
left-bottom	253	354
left-top	253	340

5. Get the binary image of each object as illustrated in figure 8.

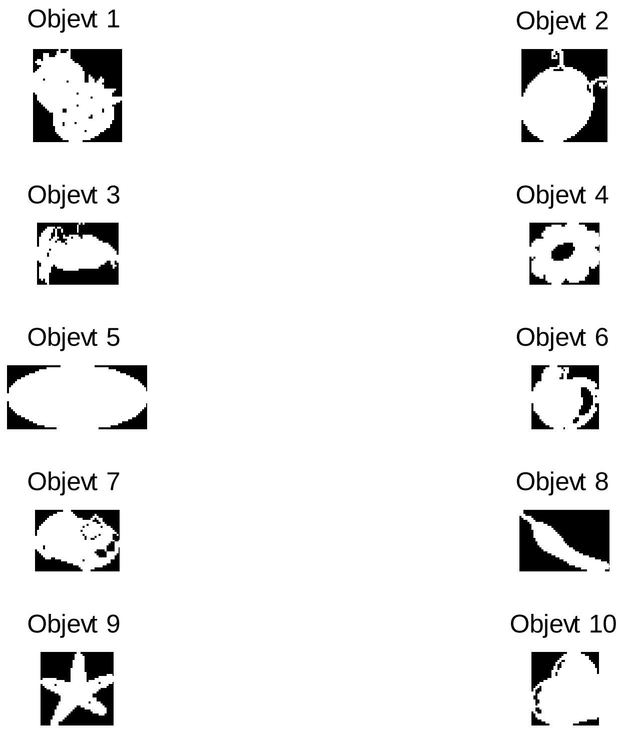

Figure 8: Binary image of each object

6. Eliminate objects based on size, as illustrated in figure 9, here we eliminate all objects with size less or equal 6000 pixels:

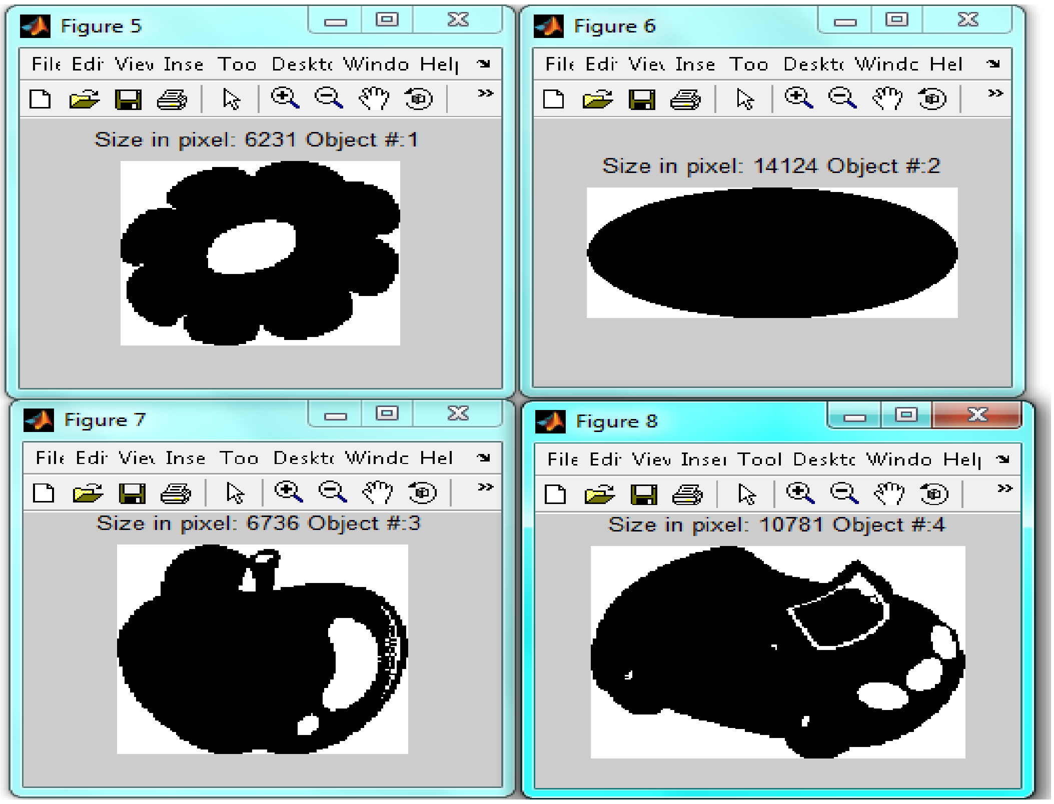

Figure 9: Leaving objects with size greater than 6000 pixels

Conclusions

A procedure for objects analysis was proposed implemented and the obtained experimental results shows that this procedure can be used for various applications dealing with digital image processing. This procedure can be used to:

- Eliminate noise from the image,
- Count the object within the image,
- Retrieve valuable information for each object such as size, center coordinates, boundary pixels coordinates, binary image of the object.
- Classify the objects into groups.
- Delete an object or a group of objects.
- Extract each object.

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