Region properties[*]

Leonardo Rezende Costa - RA262953[**]

I. Introduction

This report describes the work done related to the third project proposed on class. The aim of this project is to segment disconnected regions in an image and calculate properties like area, perimeter, eccentricity and solidity. The input images have different distribution of shapes and all of them have a white background.

II. Script execution

This section describes how to execute the script and it's dependencies.

The ***t3.py*** file has the script used in this work to generate the results. It's made statically to process the images in the project's folder. It can be executed by ***python t2.py*** in an environment with all the dependencies listed on subsection II-A

A. Dependencies

The dependencies to run the python3 script are:

- Numpy
- Opencv-python

III. Implementation

This section describes how each of the property extraction functions works and what was the approach to develop the script.

A. Global threshold

As all input images have an white background, this pattern is used to segment the images by applying a global threshold with t=230. This is the first step and the output is used as input to the next step.

B. Borders

For doing this task, a morphology approach was chosen. To calculate the border three approaches was implemented:

- Apply a dilatation and subtract the image from it
- Apply an erosion and subtract it from the image
- Apply a dilatation and an erosion and subtract the erosion from the dilatation

All three was tested and the result is discussed on Subsection IV-A

C. Contours, Moments, Areas and Perimeters

The contours, moments, areas and perimeters information was get with OpenCV functions. The contours is used to get the areas, perimeters,moments and solidities.

IV. Results

For each of the approaches, the images represented on Fig. 1 was used as input[1].

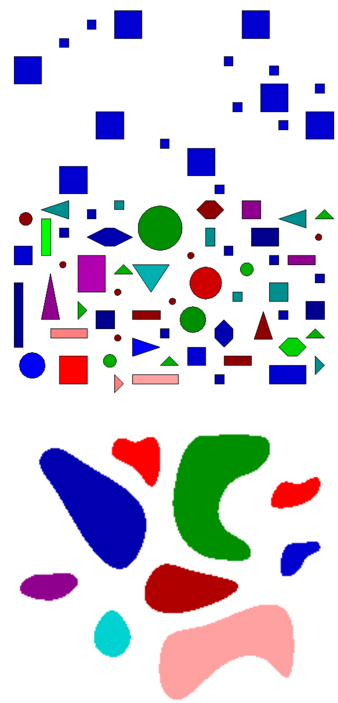

Fig. 1: Original images used as input

A. Borders

As described at Section III-B, the borders were extracted using morphology. Fig. 2 shows the difference between using dilatation, erosion and dilatation-erosion. The bottom images looks quite the same, but they represent the outer border (dilatation - image) and the actual border (image - erosion) and, because of that, the properties slightly changes between each approach.

[*]MO443 report - Introdução ao processamento de imagens digitais

[**]Instituto de Computação - Mestrado, Universidade Estadual de Campinas

[1]All those images was get at <https://www.ic.unicamp.br/~helio/imagens_pgm/>, accessed in 11/09/2019

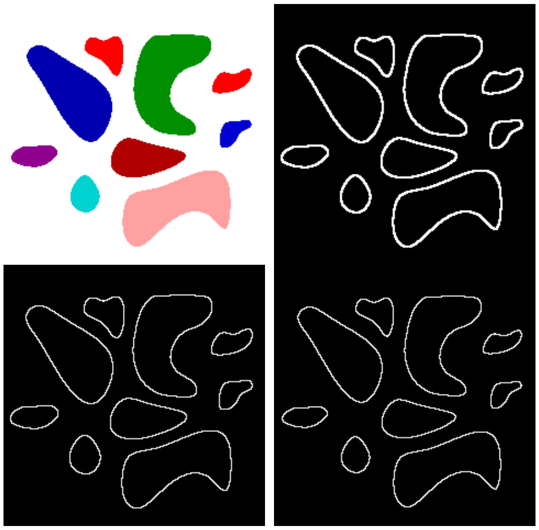

Fig. 2: Borders extracted from input *objeto3.png*. Top left: original image. Top right: dilatation - erosion. Bottom left: dilatation - image. Bottom right: image - erosion

B. Centroids

The centroids are calculated using the moments. Fig. 3 shows two examples of regions labeled using the centroid to write the number inside the region.

C. Properties

Using the contour object and the moments extracted from each region, the properties **area**, **perimeter** and **solidity** was calculated and the result for image *objetos3.png* is showed on TABLE I. The results match with the expected values. We can notice that the bigger regions get the bigger area and perimeter. Also, the concave regions have a lesser solidity value, as the area of the convex hull are bigger than the region area.

Region	Area	Perimeter	Solidity
0	633	96	0.977
1	3801	305	0.768
2	595	103	0.968
3	1606	174	0.969
4	398	88	0.905
5	496	99	0.900
6	3477	259	0.976
7	738	119	0.890
8	3831	313	0.739

TABLE I: Caption

D. Region areas

As defined in the project proposal, the threshold values to calculate the areas histogram are:

- Small:$a < 1500$,
- Average: $1500 < a < 3000$,
- Large: $a > 3000$.

Fig. 4 shows the histogram for inputs *objetos1.png*,*objetos2.png* and *objetos3.png*.

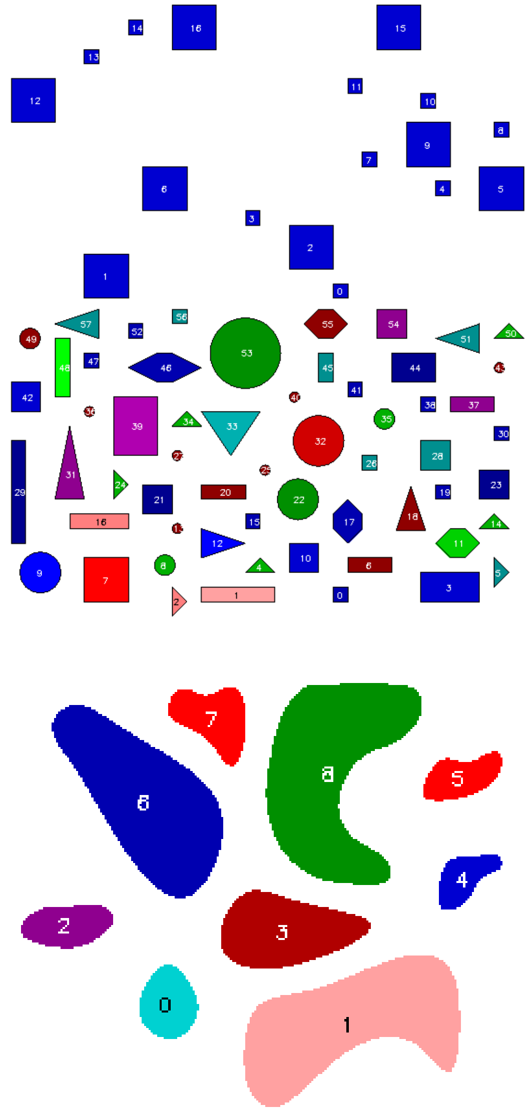

Fig. 3: Labeled centroids of each region on input images *objetos1.png*, *objetos2.png* and *objetos3.png*, respectively

V. Conclusion

Each one of the input images have different shapes and patterns. The properties calculated matched with the intuitive assumption and they can tell us a lot of the region shape. For example, inputs *objetos1.png* and *objetos2.png* have some regions with equal shapes but different colors and the area and perimeter are the same between each other. As well the input *objetos3.png* has some concave shapes that could be identified with the solidity property. This last property, for example, could be used to identify the same region in a transformed version of the input, even rotated or scaled.

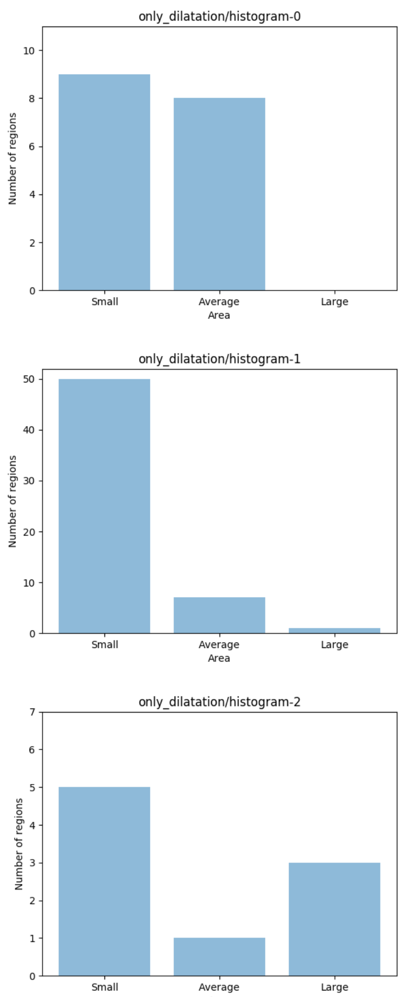

Fig. 4: Area histograms of all the inputs with border defined as **dilatation - image**