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Automatic Detection and Recognize Different Shapes in an Image

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Abstract

Vision is the most advanced of our senses, so it is not surprising that images contribute important role in human perception. This is analogous to machine vision such as shape recognition application which is important field nowadays.

This paper introduces a new approach for recognizing two-dimensional shapes in an image, and also recognizes the shapes type. The algorithm recognizes all the known shapes basis on segmenting images into regions corresponding to individual objects and then determine the shape factor which is use to recognize the shape type. Algorithm tested with many images with different shapes and recognizes all.

***Keywords**: shape; detection; recognition; image processing;*

1. Introduction:

Doing image processing and especially blob analysis it is often required to check some objects' shape and depending on it perform further processing of a particular object or not. For example, some applications may require finding only circles from all the detected objects, or quadrilaterals, rectangles, etc [Kirillov,2010].

Human vision seems to make use of many sources of information to detect and recognize an object in a scene. At the lowest level of object recognition, researchers agree that edge and region information are utilized to extract a "perceptual unit" in the scene. Some of the possible invariant features are recognized and additional signal properties (texture or appearance) are sent to help in making the decision as to whether a point belongs to an object or not.

In many cases, boundary shape information, such as the rectangular shapes of vehicles in aerial imagery, seems to play a crucial role. Local features such as the eyes in a human face are sometimes useful. These features provide strong clues for recognition, and often they are invariant to many scene variables [Moon, 2002].

The study of shapes is a recurring theme in computer vision. For example, shape is one of the main sources of

information that can be used for object recognition. In medical image analysis, geometrical models of anatomical structures play an important role in automatic tissue segmentation. The shape of an organ can also be used to diagnose diseases. In a completely different setting, shape plays an important role in the perception of optical illusions (we tend to see particular shapes) and this can be used to explain how our visual system interprets the ambiguous and incomplete information available in an image.

Characterizing the shape of a specific rigid object is not a particularly hard problem, although using the shape information to solve perceptual tasks is not easy [Felzenszwalb, 2003].

Content based image retrieval is one of the topics of interest in the computer vision field which nowadays is at its very peak, due to the growth in the last years of the amount of stored graphical information. For this kind of data, underlying analysis processes mainly lie on graphics recognition, allowing then classification of the images, typically in terms of available symbols. From a general viewpoint, several kinds of recognition approaches can be involved, according to data representation.

Bitmap images are usually analyzed with statistical methods, which are time-consuming and quite accurate, but can also be analyzed with structural methods, faster but requiring a pre-vectorization step. In the context of content based image retrieval, the last approach is usually preferred, as the amount of considered data implies the use of efficient processes. One of the most important visual features when classifying images is shape of the represented objects and subsequently a lot of literature deal with object recognition by shape [Rusi˜nol, 2007].

2. Related Works

Zakaria et. al. 2012. proposed shape recognition method where circle, square and triangle object in the image will be recognizable by the algorithm. This proposed method utilizes intensity value from the input image then thresholded by Otsu's method to obtain the binary image. Median filtering is applied to eliminate noise and Sobel operator is used to find the edges. Thinning method is used to remove unwanted edge pixels where these pixels may be counted in the parameter estimation algorithm, hence increase the false detection. The shapes are decided by compactness of the region. The experimental results show that this method archives 85% accuracy when implemented in selected database.

Singh et. al. 2012. presents new approach of shape recognition from the tactile images by touching the surface of various real life objects. Here four geometric shaped objects (viz. a planar surface, object with one edge, a cubical object i.e. object with two edges and a cylindrical object) are used for shape recognition. The high pressure regions denoting surface edges have been segmented out via multilevel thresholding. These high pressure regions hereby obtained were unique to different object classes. Some regional descriptors have been used to uniquely describe the high pressure regions. These regional descriptors have been employed as the features needed for the classification purpose. Linear Support Vector Machine (LSVM) classifier is used for object shape classification. In noise free environment the classifier gives an average accuracy of 92.6%. Some statistical tests have been performed to prove the efficacy of the classification process. The classifier performance is also tested in noisy environment with different signal-to-noise (SNR) ratios.

Kulikova, 2009 study the shapes of tree crowns extracted from very high resolution color aerial infra-red images. For this study, they choose a methodology based on the shape analysis of closed continuous curves on shape spaces using geodesic paths under the bending metric with the angle-function curve representation, and the elastic metric with the square root q-function representation. A necessary preliminary step to classification is extraction of the tree crowns. In the second part, they address thus the problem of extraction of multiple objects with complex, arbitrary shape from remote sensing images of very high resolution.

Schindler, and Suter, 2008. present a method for object class detection in images based on global shape. A distance measure for elastic shape matching is derived, which is invariant to scale and rotation, and robust against non-parametric deformations. Starting from an over-segmentation of the image, the space of potential object boundaries is explored to find boundaries, which have high similarity with the shape template of the object class to be detected. An extensive experimental evaluation is presented. The approach achieves a remarkable detection rate of 83%-91% at 0.2 false positives per image on three challenging data sets.

3. Methodology

A proposed algorithm was suggested for automatically detecting shapes in the images. The algorithm was developed to detect and recognize of the different shapes in any colored and non colored images.

This algorithm deal with gray scale images, then any color image will be converting to gray scale image.

A contrast-limited adaptive histogram equalization (CLAHE) was applied for contrast enhancement. CLAHE operates on small regions in the image. The contrast of each small region is enhanced with histogram equalization.

First step in this process is the image enhancement by using contrast-limited adaptive histogram equalization (CLAHE); the techniques of (CLAHE) are well-known for the local contrast enhancement of the images and facilitate the task of image analysis. Enhancement constitutes the first step towards automatic analysis of the images.
We have applied "CLAHE" technique to the gray scale image.
The second step after performing the equalizations is a Gaussian filtering operation which then applied on resulted image from enhancement to reduce the noise, the Gaussian filter for noise reduction achieved by the relation:

$$G(x,y) = \frac{1}{2\pi\sigma^2} \exp\left(\frac{x^2+y^2}{\sigma^2}\right)$$

To increase the contrast of the output image resulted from the above steps, we perform the adjustment for the image intensity (i.e. adjust image in intensity value or color map).

After we enhance the image, the image will be converts to binary image by changing each pixel equal or smaller than threshold to white color with value 1, while the other pixels will change to black color with value 0.

At this case the image background are changed as black color, while the white pixels represent the objects. Fig. 1. shows the image in different stages.

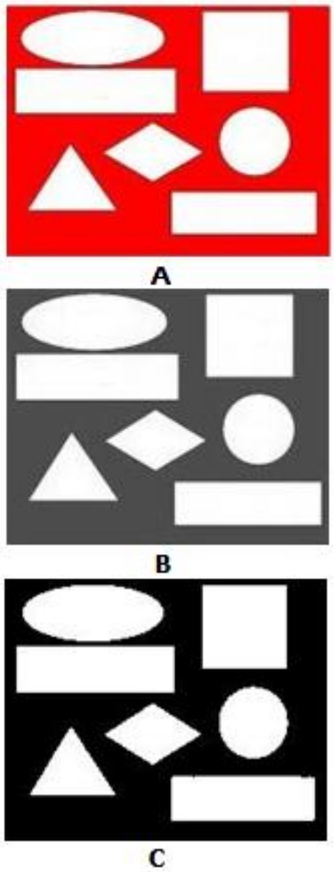


Fig. 1: A- origin image (colored image). B- gray scale image. C- binary image.

In the binary image the algorithm traces the exterior boundaries of each objects.

This step is to label all the components (regions) in the binary image by using image label algorithm as in figure 2, which scan all image pixels, assigning preliminary labels to nonzero pixels and recording label equivalences in a union-find table. Then, resolve the equivalence classes using the union-find algorithm (The Union- Find algorithm is used for maintaining a number of non-overlapping sets from a finite universe of elements). Finally, re-label the pixels based on the resolved equivalence classes.

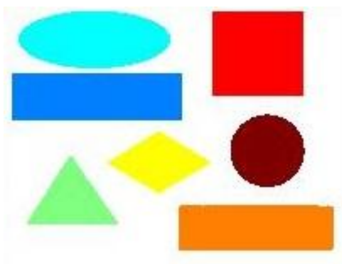
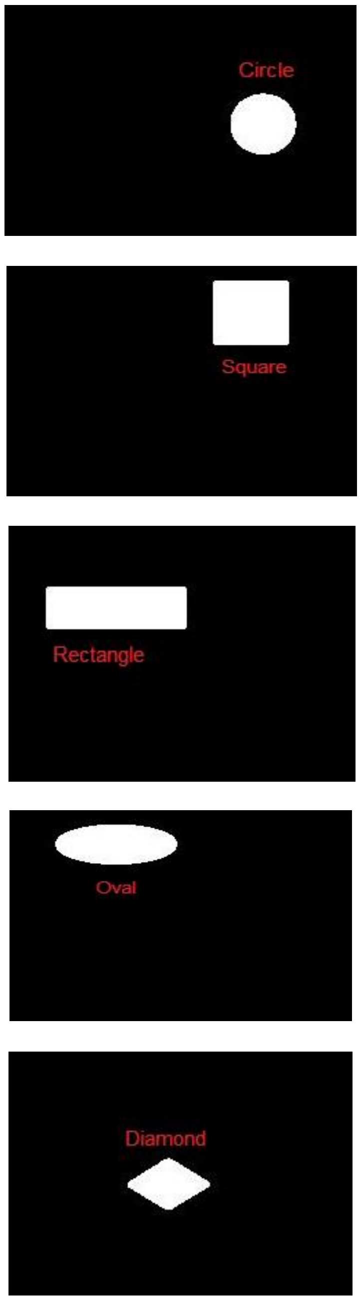


Fig. 2: Image with labeling

The final step is to recognize each labeled region from the other similar regions by counting the shape factor parameter, shape factor use to recognizes the labeled region whether it is regular shape or not, and what is the type(s) of this shape(s) if it is regular shape. This can be achieve by using the following relation:

$$\textbf{shape factor } (\boldsymbol{SF}) = \frac{\textbf{area}}{(\textbf{diameter})^2}$$

Where the area is the area of labeled region, and the diameter is the maximum distance between two pixels in a labeled region (in the boundary of labeled region). Value of shape factor indicates a specific type of shape according to **Table 1**. **Fig. 3** shows how the proposed algorithm recognized the shapes in **Fig. 1**.



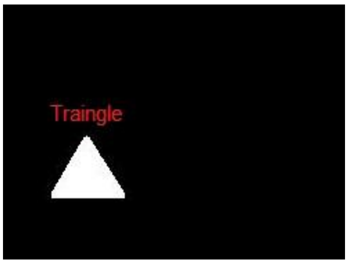


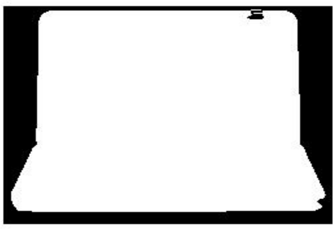
Fig. 3: Shape recognition

Table 1: some of shape factor values

Shape Type	Shape Factor (SF)
Circle	0.7≤ SF ≤0.8
Square	0.484≤ SF ≤0.55
Rectangle	0.2≤ SF ≤ 0.3
Triangle	0.44≤ SF ≤0.483
Oval	0.32≤ SF ≤0.34
Diamond	0.36≤ SF ≤0.38

Other examples, in the first one the algorithm detected and recognized two shapes, square and circle as shown in figure 4, while in the second example the algorithm detected and recognized two circle shapes as shown in figure 5.

A



B

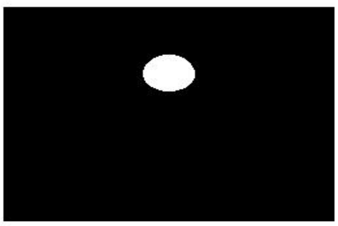
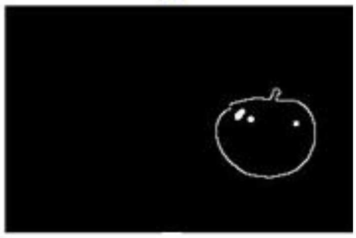
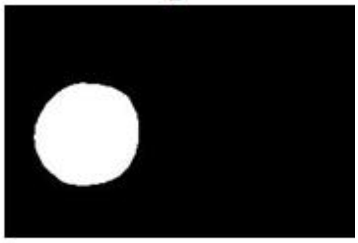


Fig. 4: A- origin image. B- First shape recognize as square. C- Second shape recognized as circle.

A



B



C

Fig. 5: A- the origin image. B- First shape recognized as circle. C- Second shape recognized as circle.

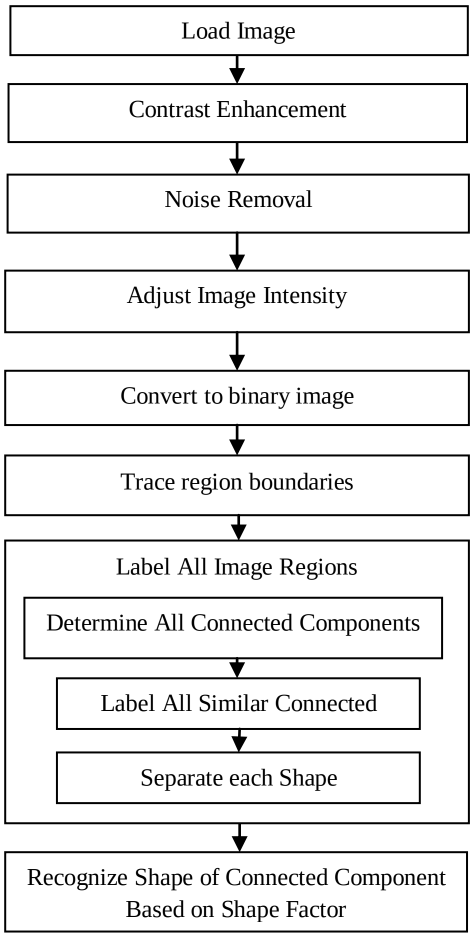


Fig. 3: Shape recognition algorithm

4. Conclusion

In this paper we suggested new algorithm to detect the shape(s) in an image, also the algorithm recognize the type of shape(s).
The algorithm has good ability to detect most shapes in image and separate its prior to recognize.
This work have ability to recognize all the known (regular) shapes via determine the shape factor which suggested for this purpose. In comparing with other works this algorithm recognize almost all shapes type, while most of other works focuses on recognizing specific shapes.
The algorithm work fine and give very promise results.

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