Object Detection using simple contour based description

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Abstract

The topic of this assignment is simple object detection. The task is to try to detect an object in a scene using a simple contour-based description. The scene consists of many objects, some of which are scaled or rotated versions of the object to be detected. Such detection is trivial for a human, but can be difficult for a computer vision system, even in this simple case. Hence this term project would discuss the implementation of contour based object detection using fourier descriptors.

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0.1 Introduction

The topic of this assignment is simple object detection. The task is to try to detect an object in a scene using a simple contour-based description. The scene consists of many objects, some of which are scaled or rotated versions of the object to be detected. Such detection is trivial for a human, but can be difficult for a computer vision system, even in this simple case. In the following, working with images in matlab, Thresholding and morphing of an image is studied. border tracing using contours and calculating the fourier descriptors for the object detection in images is studied. The main task here is to find a cup (Fig 1) in the scene (Fig 2).

Figure 1: Cup as an object to be detected

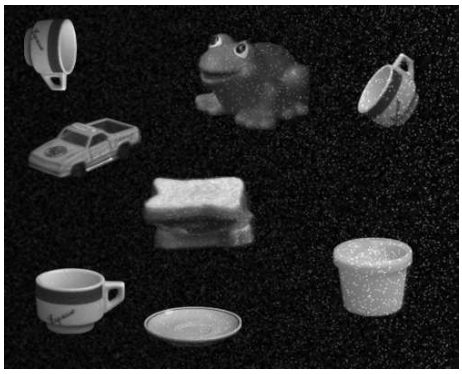


Figure 2: Scene where cup is to be indentified

0.2 Segmentation

Segmentation is a process applied to extract features in the images, here we discuss about the concepts of thresholding, usage of morphological operators and labelling of an image.

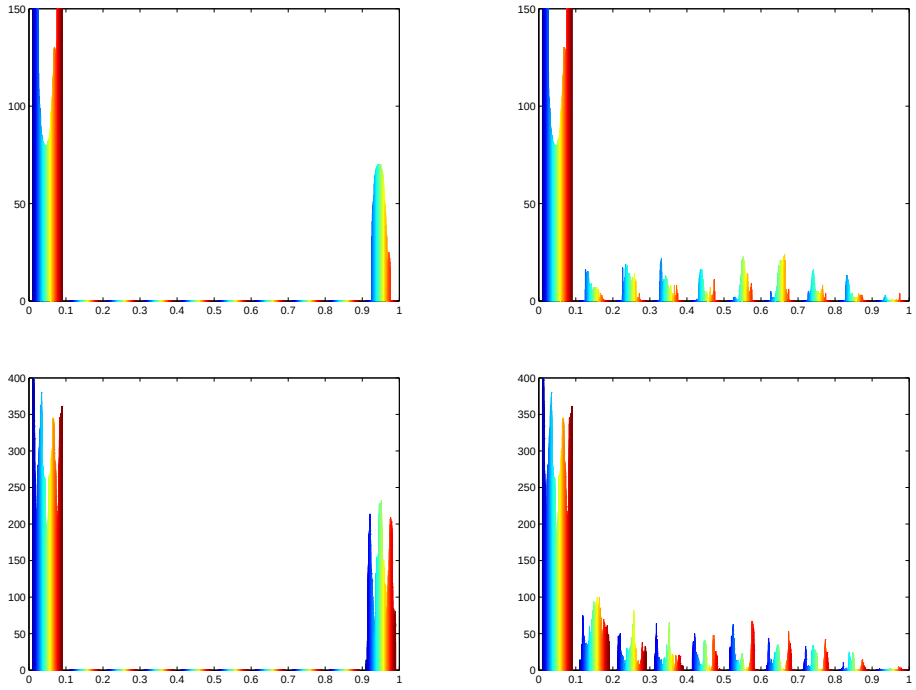
0.2.1 Thresholding

Before we proceed for thresholding, we normalize the image and convert to gray scale level. Thresholding on a gray scale image is simple and easy to implement. The algorithm given in the text book is implemented in the project and is given below.

Search all the pixels $f(i,j)$ of the image f . An image element $g(i,j)$ of the segmented image is an object pixel if $f(i,j) \geq T$, and is a background pixel otherwise.

After experimenting the T values, I have chosen T = 0.1 for the cup and scene images. The histograms of the images before and after thresholding is shown in Table 1

Table 1: Histograms of Images cup and scene before and after thresholding



Images of cup and scene after thresholding is shown in table 2

0.2.2 Morphological operators

Matlab in built functions imclose and imopen are used in this task. Images of cup and scene after application of morphological operators is shown in table 3

Table 2: Images cup and scene after thresholding

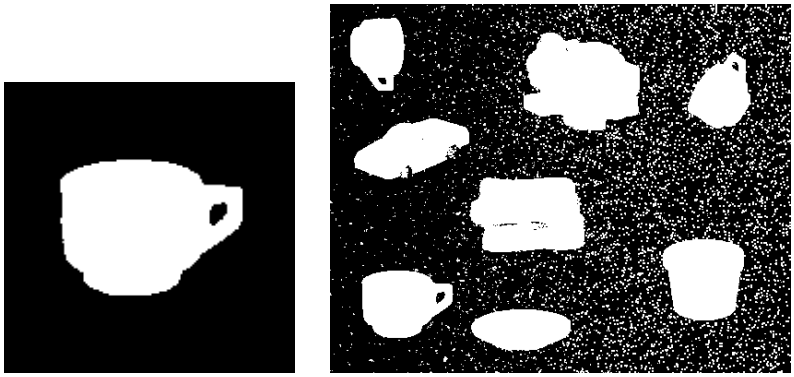


Table 3: Images of cup and scene after morphological operators

0.2.3 Labeling

If a image is labeled then it is easy to track the border of its objects. Matlab has a inbuilt function called bwlabel which gives automatic mumbering for the different objects in a image.

0.2.4 border tracing

A labeled image is given as an input to the algorithm, its very simple to obtain the boundaries of the image. The algorithm given in the text book is given below, which is implemented to find the inner boundaries of Given a labeled image. The connectivity used is 8.

- Search the image from top left until a pixel of a new region is found; this pixel Po then has the minimum column value of all pixels of that region having the minimum row value. Pixel P0 is a starting pixel of the region border. Define a variable dir which stores the direction of the previous move along the border from the previous border element to the current border element. Assign dir = 7

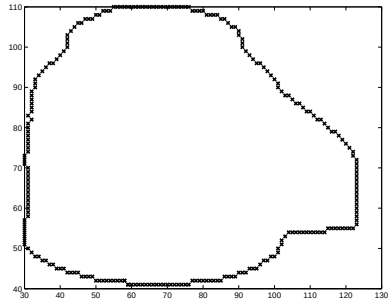
- Search the 3 x 3 neighborhood of the current pixel in an anti-clockwise direction, beginning the neighborhood search in the pixel positioned in the direction

  (dir + 7)mod8 if dir is even. (dir + 6)mod8 if dir is odd.

- The first pixel found with the same value as the current pixel is a new boundary element Pn . Update the dir value.
- If the current boundary element Pn is equal to the second border element P1 , and if the previous border element Pn−1 is equal to P0 , stop. Otherwise repeat step 2.
- The detected inner border is represented by pixels P0 ...Pn−2 .

The borders obtained for the cup is shown in table 4 and the scene are as shown in table 5

Table 4: Inner boundaries of the cup



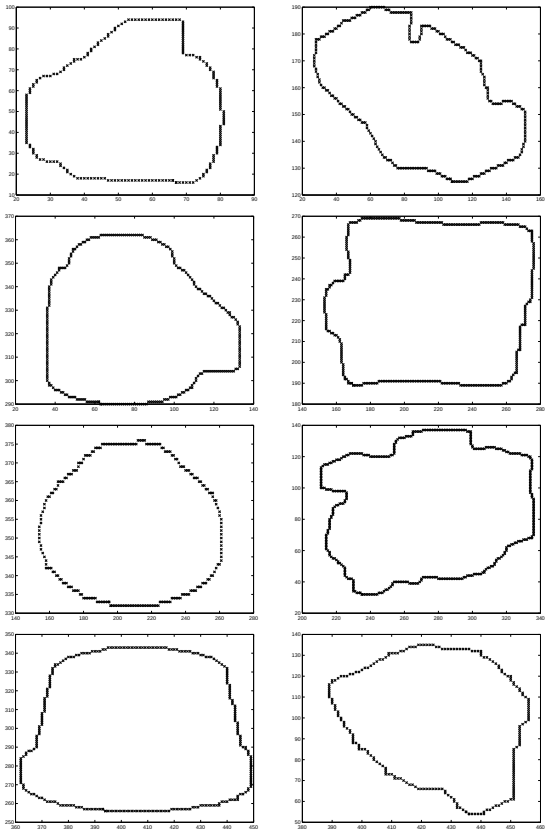
0.2.5 calculating Fourier descriptors

Its a method used in object recognition and image processing to represent the boundary shape of a segment in an image. The first few terms in a Fourier series provide the basis of a descriptor. This type of object descriptor is useful for recognition tasks because it can be designed to be independent of scaling, translation, or rotation. [source: wikianswers]. After calculating the border pixels, take X cordinates as real and Y cordinates as imaginary part and calculate the fourier descriptors using matlab in built function fft and its absolute values.

0.2.6 Detecting the Object

After we calculate the fourier descriptors of the inner boundary of both cup and scene, we take 2 to 10 coefficients of the cup and scene and calculate the euclidean distances, or L2 norm. The objects with the less distant between the cup and scene are the objects which are cups in the scene. We ignore the first fourier descriptor because it is position independent. I found that only 10 coefficients can be required to efficiently identify the objects.

Table 5: Inner boundaries of the objects in image scene



0.3 results

The stem plot of the distances show that fourier descriptors can be used to identify object in a very simple manner. It is clear from the stem graph in fig 3 that simple thresholding and using of morphological operators can be used to detect all the cups in the scene image. objects 1,3 and 8 are the cups in the scene.

0.4 conclusion

I conclude that fourier descriptors of the inner boundaries with atleast 10 coefficients can be used to succesfully for object detection. Fourier descriptors donot depend on the transformations of the object.

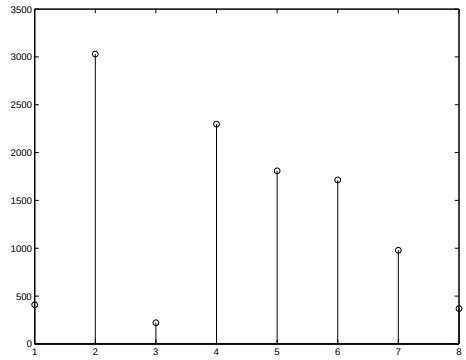


Figure 3: Stem graph of the distances of objects