CS270 - Digital Image Processing
ShanghaiTech University
Spring 2024

Project 3: Segmentation and Counting

1 Background

The technology of Image segmentation and edge detection plays a critical role in computer vision and many other fields where visual data needs to be analyzed and understood. Image segmentation refers to the process of partitioning an image into multiple segments or regions, each of which corresponds to a different object or area within the image. In this project, you will implement particle segmentation and counting with different difficulty levels.

2 Goal

2.1 Pearl counting

The image "Pearl.jpg" is a photo of six pearl particles, which are very simple and isolated. Please (make reasonable use of the knowledge learned both in and out of class to) implement image segmentation for the pearl objects.

Figure 1: Pearl.jpg

2.2 Nuts and bolts counting

The image "Nuts.jpg" contains nuts and bolts. (1) Try to implement image segmentation for the nuts and bolts. (2) Calculate the number of the nuts and bolts. The correct number is 3 for the nuts and 8 for the bolts, respectively. (3) Further calculate the number of long and short bolts. The correct number is 2 for the long bolts and 6 for the short bolts, respectively.

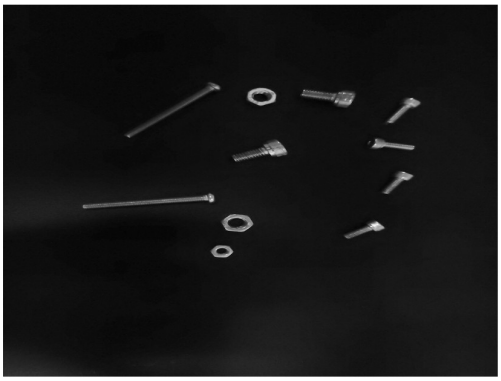

Figure 2: Nuts.jpg

2.3 Metal balls counting

The image "MetalBalls.jpg" contains metal balls. (1) Please extract the circular contours of the metal balls and count them in the image (a) (15 Pt). The correct number is 10. (2) The image (b) suffers from two different types of noise: grid noise and high-frequency noise. Try to extract the circular contours of the metal balls and count them again.

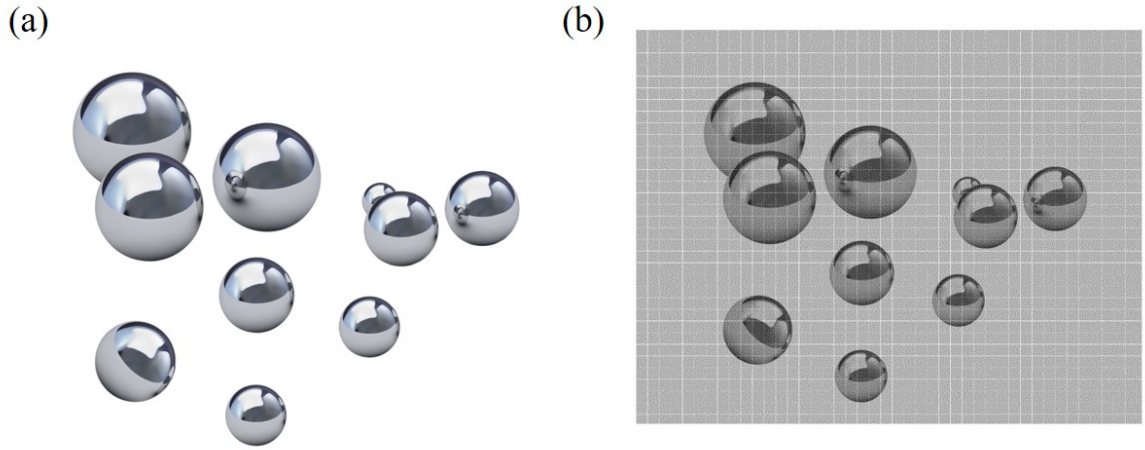

Figure 3: MetalBalls.jpg

2.4 Rice grain counting

Now it comes to rice grains. "Rice.jpg" is an image of rice grains, but the contrast of the image seems to be a bit low, and the edges of the rice grains are not very clear. Please try to segment and count the rice grains as perfectly as possible. The right image shows a possible result (but it may not be the perfect one, and your result can be that the entire region of the rice grain is white). In the left image, there are 2 grains which are tiny, so the number is actually 99+2. If your code recognizes some of these two grains, the corresponding number will be subtracted from your recognized number. The accuracy will be calculated as below:

$$acc = \frac{recognizednumber}{99} \tag{1}$$

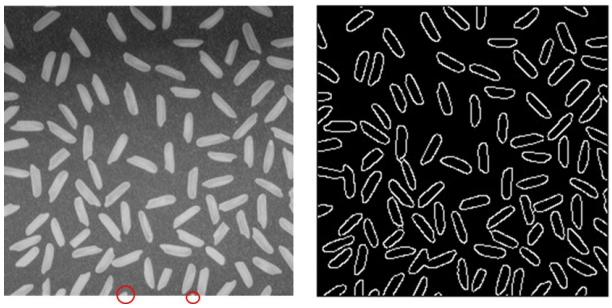

Figure 4: Rice.jpg

3 Notes

Please ensure that your code can be run without any modification by TAs. Your code should provide the same results as in your report. It is better to program the core function of the algorithm yourself (bonus), although calling built-in functions is also allowed. Deep learning algorithms are prohibited. You can call built-in functions used to implement basic operations, such as corrosion, dilation, filtering (The filtering operator needs to be designed by yourself), Fourier transform, binarization. For most cases, you can simply determine whether a built-in function can be called based on the implementation difficulty and the relevance of the algorithm.