Image Processing: Assessment 1

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Task 1

In order to enhance the image I first converted the image to unit 8 format, to allow subsequent functions to operate correctly. I also inverted the image, for the same reasons. I used a large structured element and the imopen function to isolate the background. This allows me to then remove the background from the foreground. In turn this enhances the results of imadjust, creating a greater difference between the foreground and background. The foreground objects are then sharpened, to further enhance the disparity between background and foreground. This then provides a great staging ground for binarization. However salt noise is then first removed by using a function that will remove any objects bellow a certain size. A structured element is then used to close any holes in object borders.

Task 2

For an edge detection algorithm I have used the Moore-Neighbour tracing algorithm. This choice is beneficial for me due to its relative simplicity, and that its main weakness is not present due to the handling of Task 1. The algorithm will end upon reaching the starting point of a boundary. However in certain cases, such as a boundary being a single pixel wide, and connected by diagonals the end condition can be met whilst disregarding large portions of the boundary. Due to to how I have handled removing background noise, and close borders, there is no case scenarios of this happening.

Task 3

I used the final result obtained from task 1 as a basis from which to perform segmentation from. The technique used was to identify each unique blob in the foreground as its own object, and label them. In order to display these results a mask was placed over the binary image, giving each unique segment its own pseudo randomly generated colour, as seen in Figure 1.

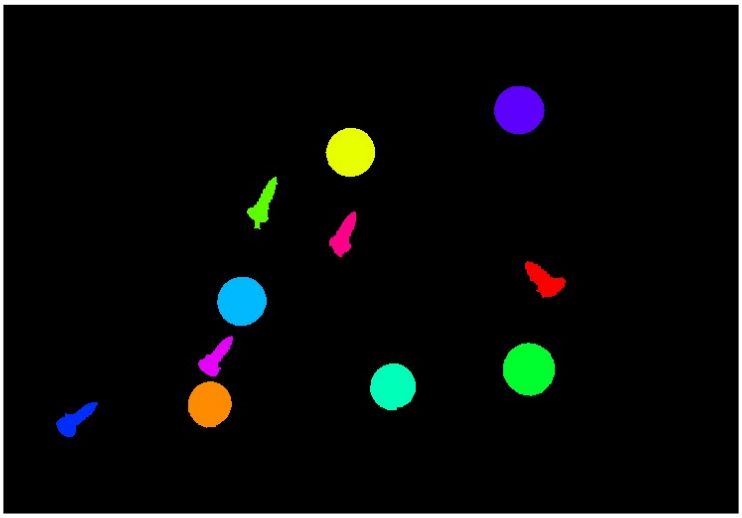

Figure 1: Segmented image resulted from task 3

Task 4

In order to differentiate washer from screws I first obtained information about each object within the image. Using the major and minor axis lengths of each object, I was able to calculate a set of ratios. It stands within reason that a circular washer should have a ratio close to one, even accounting for distortion after enhancement. Therefore, when rounding the ratios to the nearest whole number, all washers tended to 1 and the screws 0. Hence allowing me to differentiate between the two, and asign them colours.

Task 5

The images are first scaled to appropriate size using bi-linear interpolation in order to be the proper scale to compare with the ground truth images later. A similar process to what was described in task 1 then occurs. The background is removed from the foreground and then the image is adjusted to make the foreground more visible. Binarization then takes place, and any background noise is then removed, as well as joining any potential gaps in object boundaries. Object properties are then identified and the ratio of major and minor axis length compared to decide on what category the object is. Unlike in task 4, the ratios are not rounded to allow for better comparison and to differentiate between more than two object types. Each of these four stages has been illustrated in

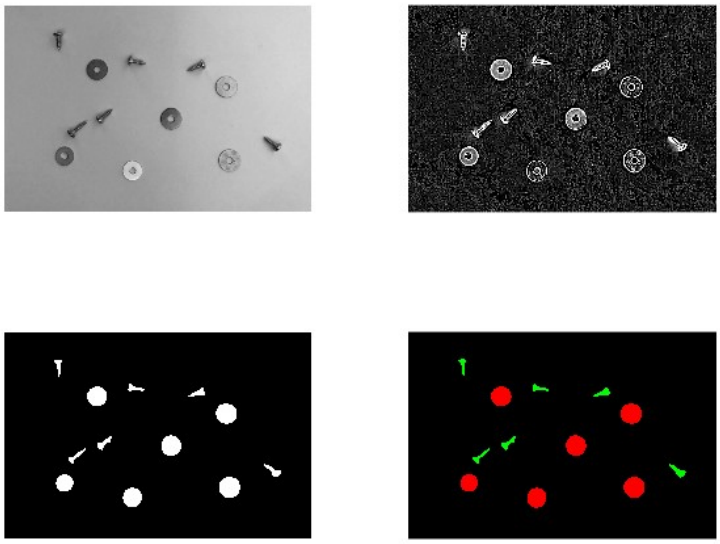

Figure 2: Outcome of each processing stage for IMG_08

Figure 2.

Task 6

Formula for Dice Similarity Coefficient:

$$DSC(I, GT) = 2(I \cap GT)/(I + GT) \tag{1}$$

Where $\cap$ represents the intersection of I and GT.

Formula for Precision:

$$Precision = TP/(TP + FP) \tag{2}$$

Where TP is true positive and FP is false positive.

Formula for Recall:

$$Recal = TP/(TP + FN) \tag{3}$$

Where TP is true positive and FN is false negative.

Image	Dice Score	Precision	Recall
IMG_01	0.8361	0.9965	0.7415
IMG_02	0.8372	0.9994	0.7667
IMG_03	0.8437	0.9990	0.7926
IMG_04	0.7824	0.9945	0.6862
IMG_05	0.7383	0.9985	0.6090
IMG_06	0.7547	0.9987	0.6351
IMG_07	0.7856	1.0000	0.6680
IMG_08	0.8423	0.9999	0.7815
IMG_09	0.8159	0.9999	0.7569
IMG_10	0.8332	0.9901	0.7543

Table 1: Performance measurements for images based on the ground truth images

	Dice Score	Precision	Recall
Mean	0.8069	0.9977	0.7192
Standard Deviation	0.0369	0.0030	0.0613

Table 2: Mean and Standard deviation for dice score, precision and recall