Count the number of coins in the image and calculate size of each coin

Image Processing

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Approach:

Input
- Read input image
- Convert image to grayscale

Binarization
- Determine a global threshold using Otsu's thresholding method
- Using this threshold, binarize the grayscale image

Dilation and Erosion
- First, dilate the binary image to fill the undesirable holes
- Then apply erosion to get rid of unnecessary conections

Identify Regions
- The different coins are now separated
- Using a region segmentation technique, demarkate different regions with non-zero values in the image obtained from previous step

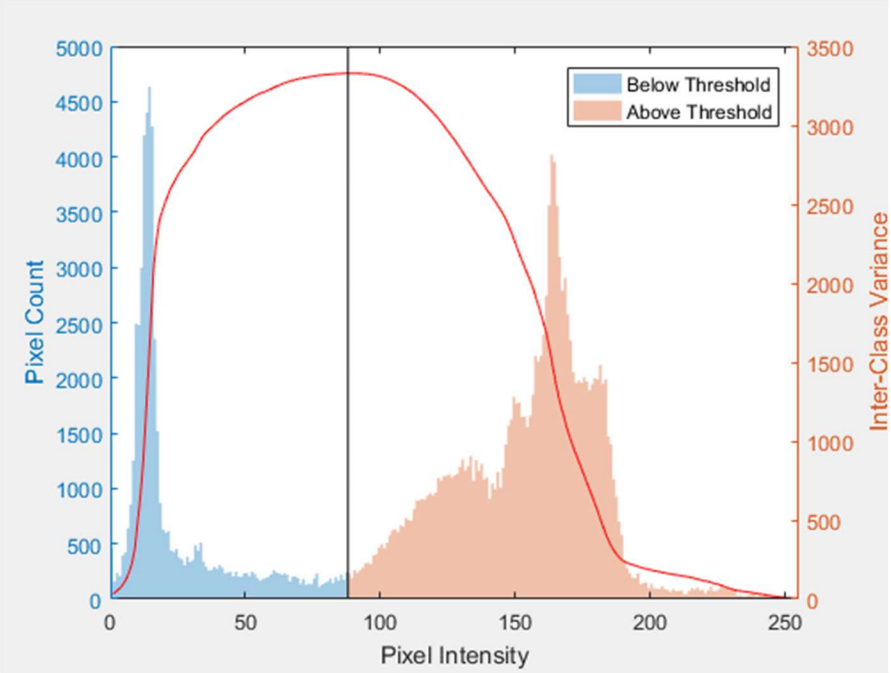
Output
- Indicate the total number of coins with the help of labels obtained in previous step
- Calculate the number of pixels in each region by teaversing the label array

Assumptions:

- The coins are placed on a white background
- The coins are well separated and not touching one another’s boundary or overlapping
- Each coin is at least 10 pixels large

1. Otsu's Global Thresholding:

In image processing, Otsu's method is used to perform automatic image thresholding. The algorithm returns a single intensity threshold that separate pixels into two classes, foreground and background. This threshold is determined by maximizing inter-class variance. The histogram of the grayscale image is divided into 2 classes: 0 and 1. The mean and variance of each class is calculated and then the inter-class variance is maximized. The gray level value at which the inter-class variance is maximum, is the threshold to be selected for image binarization.



Subscripts 1 and 0 indicate class 1 and class 0

$\omega_0(t) = \sum_{i=0}^{t-1} p(i)$ $\omega_1(t) = \sum_{i=t}^{255} p(i)$ These are class probabilities

$\mu_0(t) = \frac{\sum_{i=0}^{t-1} ip(i)}{\omega_0(t)}$ $\mu_1(t) = \frac{\sum_{i=0}^{255} ip(i)}{\omega_1(t)}$ These are class means

This term is maximized:

$\sigma_b^2 = \omega_0\omega_1(\mu_1 - \mu_0)^2$ Inter class variance

The grayscale at which inter-class variance is maximum is selected as threshold.

2. Region Labelling:

$$X_k = (X_{k-1} \oplus B) \cap A$$ where k=1,2,3,…

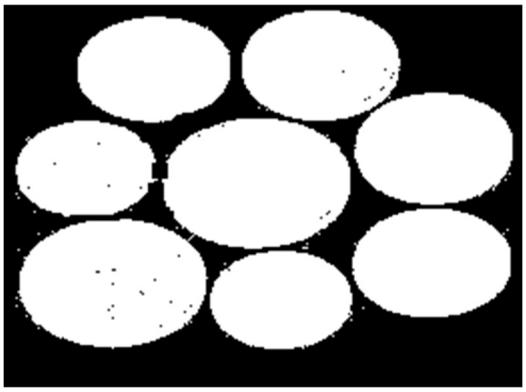
Steps:

- Read an image (A) that is a binary image.
- Define a structuring element (B).
- Initialize the Label matrix with zeros.
- Find the non-zero element positions in the input matrix A.
- Initialize a matrix X with zeros and place 1 in the non-zero element position found in the previous step.
- Perform dilation using the structuring element B on matrix X. i.e. imdilate(X,B);
- Perform intersection with the matrix A. Y= A&imdilate(X, B).
- Check whether Y==X. If no, then X=Y and perform steps 6 and 7 again else stop the iteration.
- Find the non-zero elements position in the Y. In matrix Label place a number N in those positions. N is for labeling the connected components.
- Similarly, place zero in those positions in the input matrix A.
- Again, find a non-zero element position in the matrix A. If found, goto step 5 else stop the iteration.

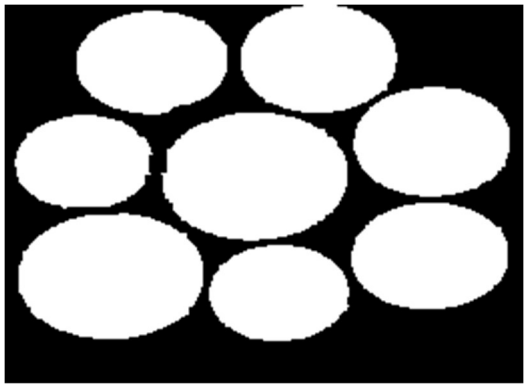
Results:

original image

grayscale image



binarized image(using Otsu threshold)

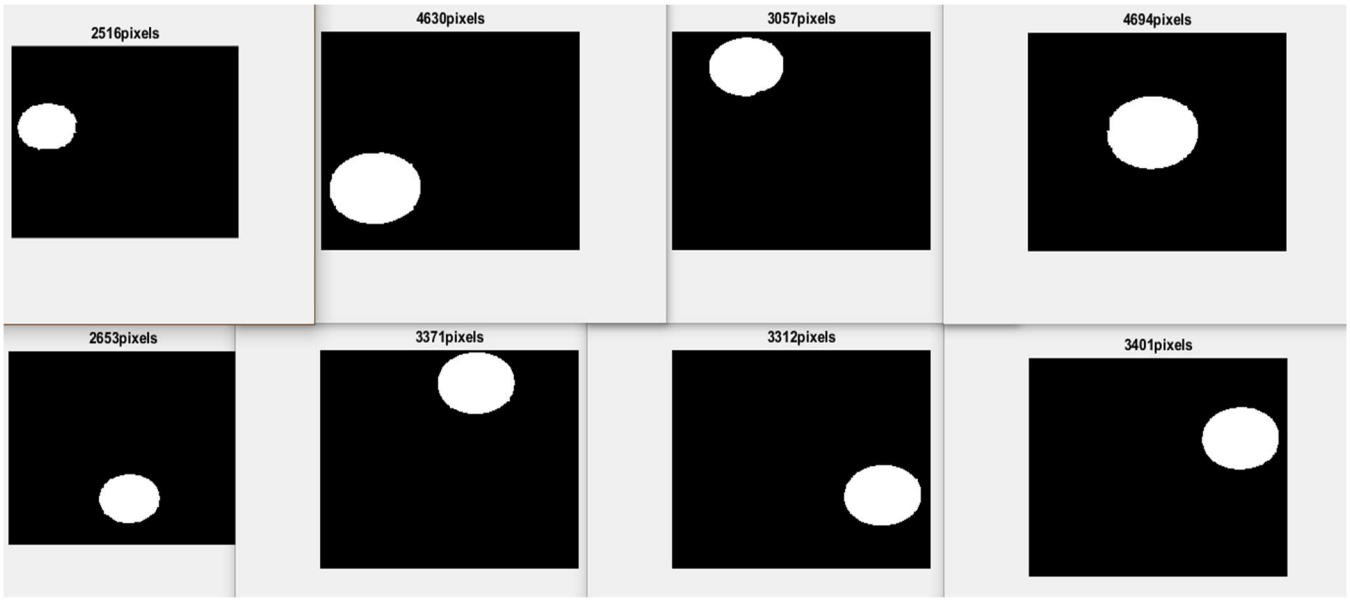


dilation and erosion performed

number of coins is: 8

size of each coin is given in pixels below:

2516 4630 3057 4694 2653 3371 3312 3401



all coins and their corresponding sizes