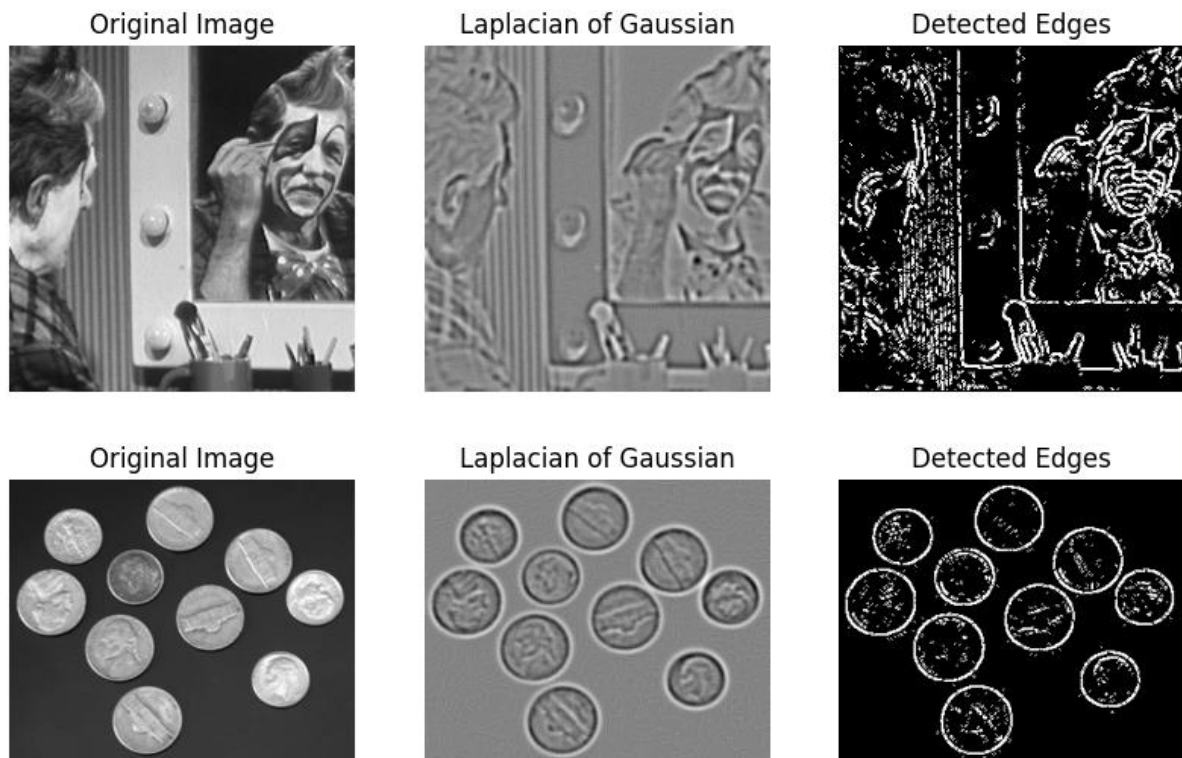


Part 2

Q3. Part A

Steps to perform Marr-Hildreth edge detection:

1. Apply Gaussian filter to smooth the image
2. Apply Laplacian to detect edges
3. Detect zero-crossings by checking sign changes
4. keep only strong edges: $|g(x + 1, y) - g(x - 1, y)| > \text{threshold}$
5. Those positions follows step 3 & 4, make their intensity 255 else 0.



Parameters used:

$$\sigma = 2$$

Laplacian kernel size = 3

Threshold = 15 (only strong edges detected)

Q3. Part B

Original Image



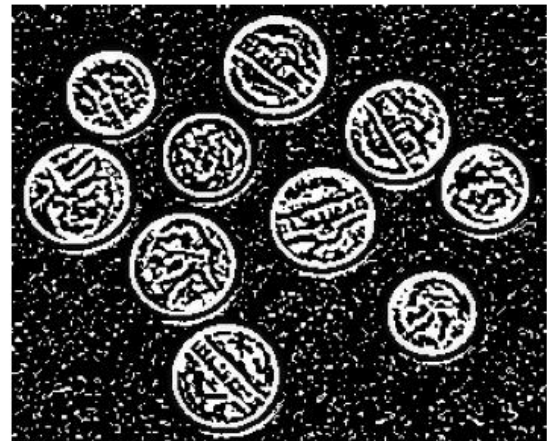
DOG



Original Image



DOG



$$\sigma^2 = \frac{\sigma_1^2 \sigma_2^2}{\sigma_1^2 - \sigma_2^2} \ln \left[\frac{\sigma_1^2}{\sigma_2^2} \right]$$

$\sigma = \sigma$ for LOG

σ_1 & σ_2 for DOG ($\sigma_1 = 1.6\sigma_2$)

Q3. Part C

Original Image



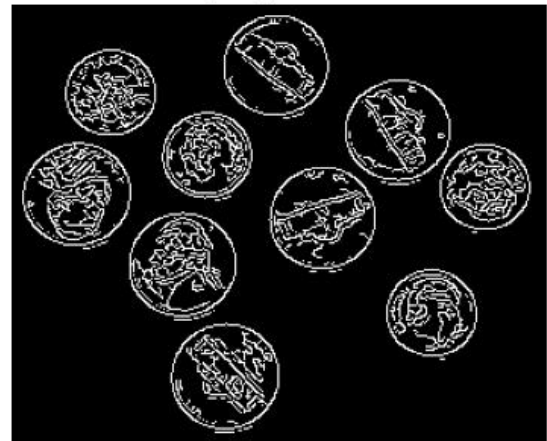
Canny Edge Detection



Original Image



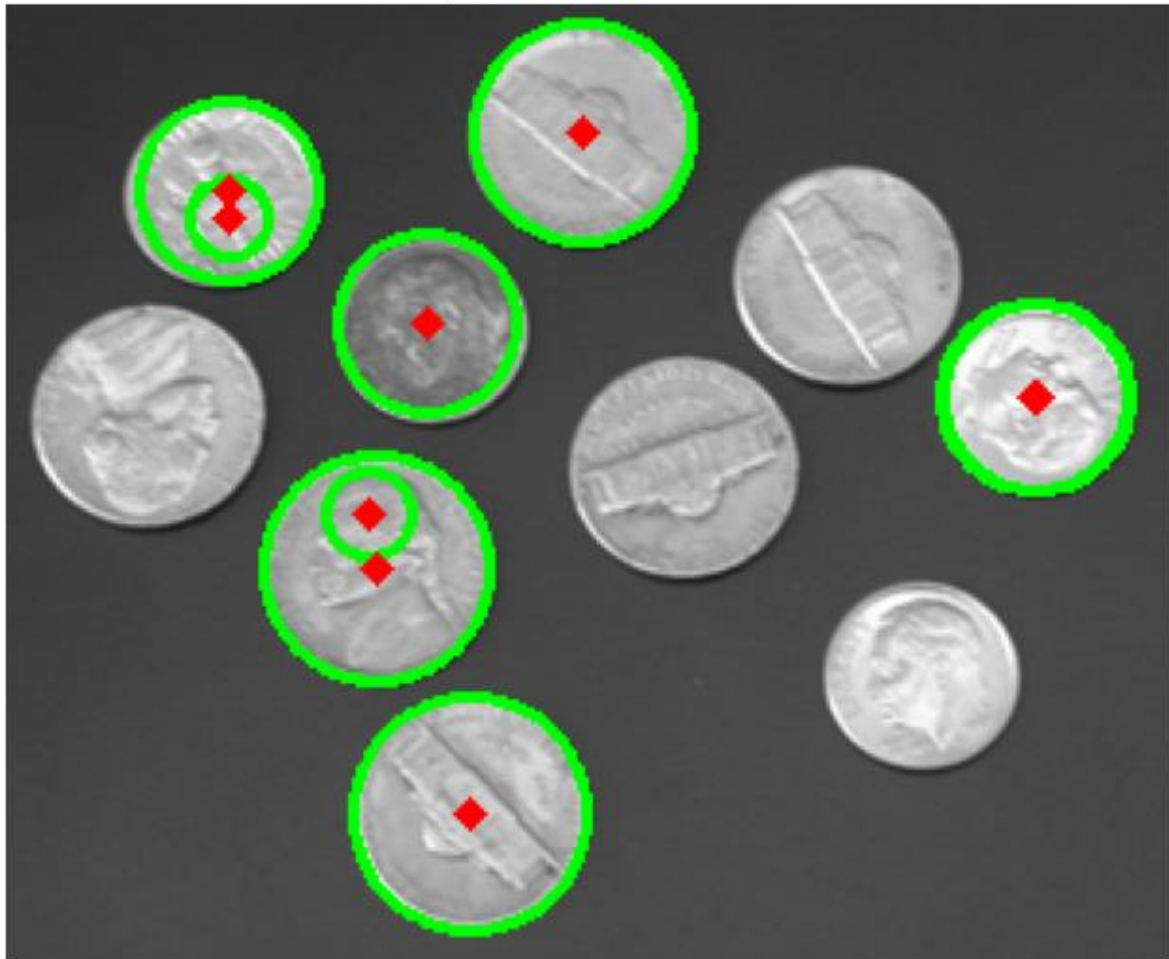
Canny Edge Detection



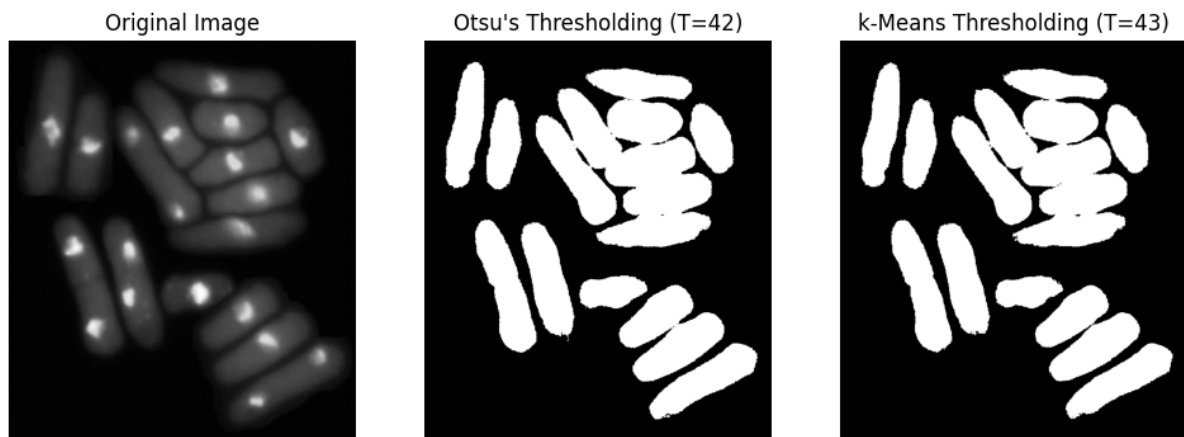
Low threshold = 50 and High threshold = 150

Q3. Part D

Top 8 Detected Circles



Q4. Part A



Otsu's Method:

Threshold = 42,

Within-Class Variance = 397.10443971363355,

Between-Class Variance = 693.8300285196959

k-Means Method:

Threshold = 43,

Mean1 = 15.044552826597554,

Mean2 = 71.5253290678386,

Within-Class Variance = 397.1170367677733,

Between-Class Variance = 693.8174314655562

Q4 Part B
Here, $K = 3$

Run 1
BCV: 14627.48



Run 2
BCV: 14625.94



Run 3
BCV: 14628.80



Run 4
BCV: 14624.26



Run 5
BCV: 14627.41



Run 6
BCV: 14627.16



There is very less variability in between-class-variance and visual outputs. This indicating less sensitivity to initialization.

Q4. Part C

Segmented Image with Cluster Means



Superpixel Edges



$S = 15$