EC7212 – Computer Vision and Image Processing
Take Home Assignment 2

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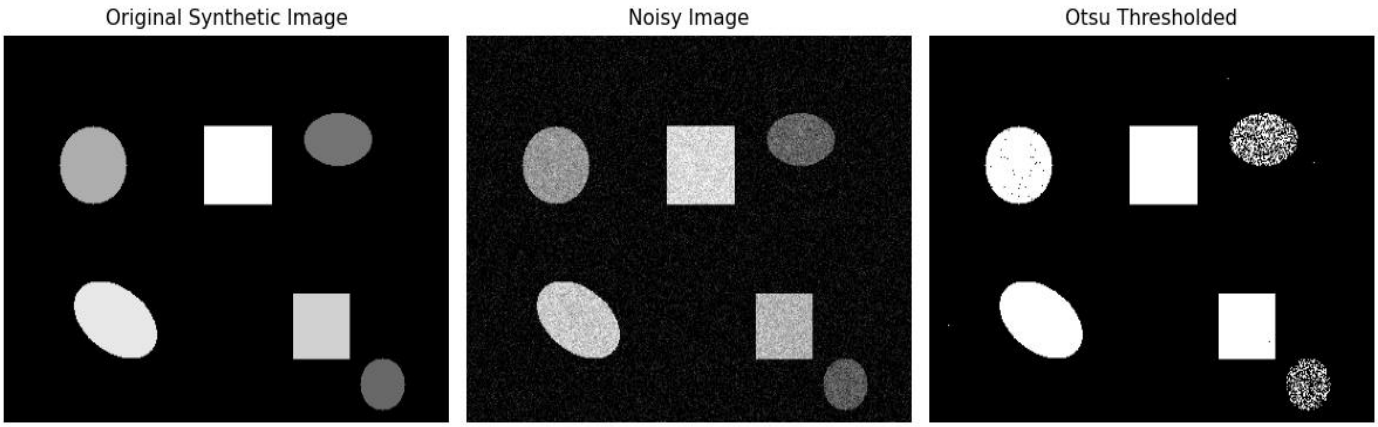
Github Repo: https://github.com/NisalDeZoysa/EC7212-CVIP-Assignment-02.git

1. Consider an image with 2 objects and a total of 3-pixel values (1 for each object and one for the background). Add Gaussian noise to the image. Implement and test Otsu's algorithm with this image

```
import numpy as np
import cv2
import matplotlib.pyplot as plt


image = cv2.imread("test_shapes_complex.png", 0)

if image is None:
    print("Image not found. Check filename.")
    exit()


def add_gaussian_noise(img, mean=0, sigma=25):
    noise = np.random.normal(mean, sigma, img.shape)
    noisy_img = img + noise
    noisy_img = np.clip(noisy_img, 0, 255)  # Keep in [0, 255]
    return noisy_img.astype(np.uint8)

noisy_image = add_gaussian_noise(image)


def otsu_threshold(img):
    if img.dtype != np.uint8:
        img = img.astype(np.uint8)
```

```
    _, otsu_img = cv2.threshold(img, 0, 255, cv2.THRESH_BINARY
+ cv2.THRESH_OTSU)
    return otsu_img

otsu_result = otsu_threshold(noisy_image)


plt.figure(figsize=(12, 4))

plt.subplot(1, 3, 1)
plt.title("Original Synthetic Image")
plt.imshow(image, cmap='gray')
plt.axis('off')

plt.subplot(1, 3, 2)
plt.title("Noisy Image")
plt.imshow(noisy_image, cmap='gray')
plt.axis('off')

plt.subplot(1, 3, 3)
plt.title("Otsu Thresholded")
plt.imshow(otsu_result, cmap='gray')
plt.axis('off')

plt.tight_layout()
plt.show()


cv2.imwrite("otsu_noisy_input.png", noisy_image)
cv2.imwrite("otsu_result_output.png", otsu_result)
print("Images saved: 'otsu_noisy_input.png' and
'otsu_result_output.png'")
```

Answer :



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2. Implement a region-growing technique for image segmentation. The basic idea is to start from a set of points inside the object of interest (foreground), denoted as seeds, and recursively add neighboring pixels as long as they are in a pre-defined range of the pixel values of the seeds.

```python
import cv2
import numpy as np
import matplotlib.pyplot as plt

# ---------------------------
# Function: Region Growing
# ---------------------------
def region_growing(image, seed_points, threshold=15):
    rows, cols = image.shape
    visited = np.zeros_like(image, dtype=bool)
    result = np.zeros_like(image, dtype=np.uint8)

    for seed in seed_points:
        x, y = seed
        region_value = image[x, y]
        print(f"Seed at ({x},{y}) - Intensity: {region_value}")
```

```
        stack = [(x, y)]
        visited[x, y] = True

        while stack:
            i, j = stack.pop()
            result[i, j] = 255

            for dx, dy in [(-1, 0), (1, 0), (0, -1), (0, 1)]:
                ni, nj = i + dx, j + dy
                if 0 <= ni < rows and 0 <= nj < cols and not
visited[ni, nj]:
                    if abs(int(image[ni, nj]) -
int(region_value)) <= threshold:
                        visited[ni, nj] = True
                        stack.append((ni, nj))
    return result

# ---------------------------
# Load Image (Grayscale)
# ---------------------------
image = cv2.imread('test_shapes_complex.png', 0)  # <-- Replace
with your filename if different

if image is None:
    print("Image not found. Check the path!")
    exit()

# ---------------------------
# Seed point & Threshold
# ---------------------------
seed_points = [(120, 130)]  # You can change this manually
threshold = 25  # Try 20-40 depending on contrast

# ---------------------------
# Run Region Growing
# ---------------------------
```

```
segmented = region_growing(image, seed_points,
threshold=threshold)

# ---------------------------
# Display Original + Result
# ---------------------------
plt.figure(figsize=(10, 5))

plt.subplot(1, 2, 1)
plt.title("Original Image")
plt.imshow(image, cmap='gray')
plt.axis('off')

plt.subplot(1, 2, 2)
plt.title("Region-Growing Output")
plt.imshow(segmented, cmap='gray')
plt.axis('off')

plt.tight_layout()
plt.show()

# ---------------------------
# Save the output
# ---------------------------
cv2.imwrite("region_growing_result.png", segmented)
print("Result saved as 'region_growing_result.png'")
```

Answer :