

Experiment-11-OPEN- HANDED

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AIM: Simulate dilation, erosion, opening and closing operation on images.[OPEN HANDED]

Theory:

Dilation, erosion, opening, and closing are morphological operations used in image processing to manipulate the shape and size of objects in an image.

Dilation:

Dilation expands the boundaries of objects in an image by adding pixels to the object's boundaries. It is achieved by sliding a structuring element over the image and assigning the maximum pixel value within the neighborhood of each pixel.

Erosion:

Erosion shrinks the boundaries of objects in an image by removing pixels from the object's boundaries. It is achieved by sliding a structuring element over the image and assigning the minimum pixel value within the neighborhood of each pixel.

Opening:

Opening is an erosion operation followed by a dilation operation. It is used to remove noise and small objects from the image while preserving the larger objects' shapes.

Closing:

Closing is a dilation operation followed by an erosion operation. It is used to close small gaps and holes within objects while preserving the overall object shapes.

Program

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

# Load the binary fingerprint (grayscale)
image = cv2.imread('Manual/exp_11_OH.png', 0)

# --- Step 1: Remove small bright specks ---
kernel_open = cv2.getStructuringElement(cv2.MORPH_ELLIPSE, (4, 4))
opened = cv2.morphologyEx(image, cv2.MORPH_OPEN, kernel_open)

# --- Step 2: Fill thin dark cracks ---
kernel_close = cv2.getStructuringElement(cv2.MORPH_ELLIPSE, (5,5))
closed = cv2.morphologyEx(opened, cv2.MORPH_CLOSE, kernel_close)

# Optional smoothing
final = cv2.morphologyEx(closed, cv2.MORPH_OPEN, kernel_open)

# --- Display results ---
plt.figure(figsize=(12, 8))
```

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

plt.subplot(2, 2, 2)
plt.imshow(opened, cmap='gray')
plt.title("After Opening (remove bright specks)")
plt.axis("off")

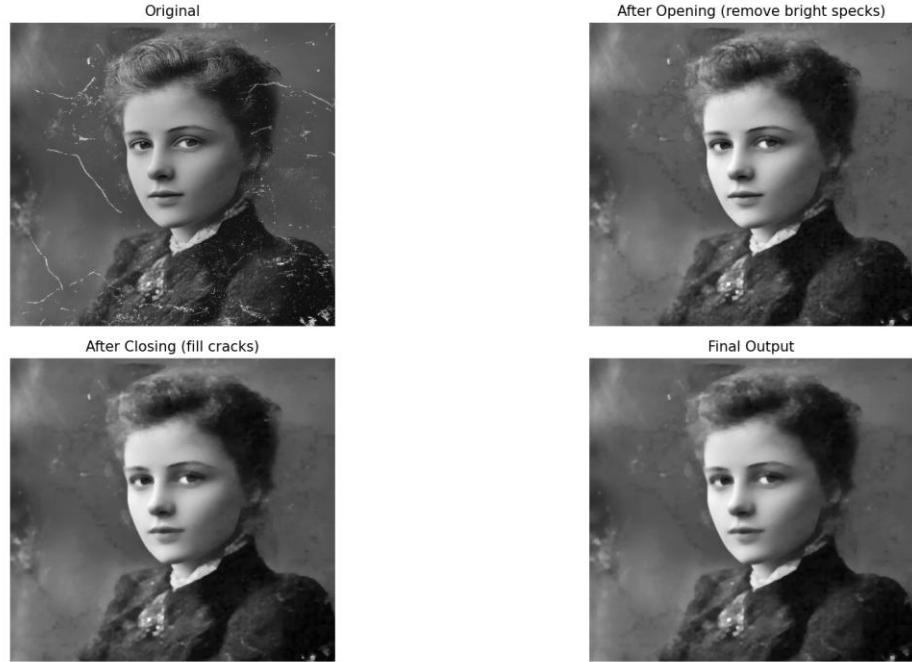
plt.subplot(2, 2, 3)
plt.imshow(closed, cmap='gray')
plt.title("After Closing (fill cracks)")
plt.axis("off")

plt.subplot(2, 2, 4)
plt.imshow(final, cmap='gray')
plt.title("Final Output")
plt.axis("off")

plt.tight_layout()
plt.show()
```

Output





Conclusion

- Morphological opening with a 4×4 elliptical kernel effectively removes small bright specks from the binary fingerprint image.
- Morphological closing with a 5×5 elliptical kernel successfully fills thin dark cracks between fingerprint ridges.
- Applying a final light opening smooths ridge boundaries and reduces leftover micro-noise.
- Overall, the sequence preserves the fingerprint's structural pattern while enhancing clarity and continuity of ridges.



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