Marwadi University
Faculty of Engineering and Technology
Department of Information and Communication Technology

Experiment-12

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AIM: Simulate dilation, erosion, opening and closing operation on images.
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
from google.colab.patches import cv2_imshow
# Load the image
image = cv2.imread('/content/Certificate 1698299913.jpg', 0)  # Load as grayscale

# Define the kernel (structuring element)
kernel = np.ones((5, 5), np.uint8)

# Perform Erosion
erosion = cv2.erode(image, kernel, iterations=1)

# Perform Dilation
dilation = cv2.dilate(image, kernel, iterations=1)

# Perform Opening (Erosion followed by Dilation)
opening = cv2.morphologyEx(image, cv2.MORPH_OPEN, kernel)

# Perform Closing (Dilation followed by Erosion)
closing = cv2.morphologyEx(image, cv2.MORPH_CLOSE, kernel)
```
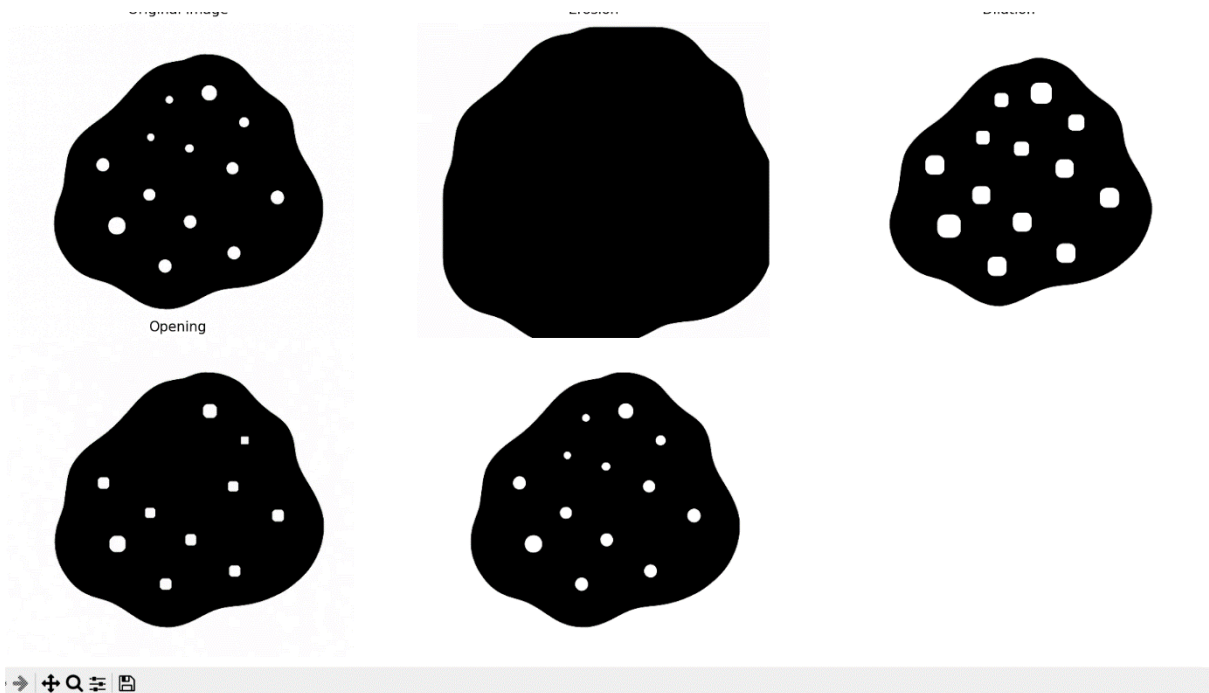
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# Display the original image and the results
cv2_imshow(image)
cv2_imshow(erosion)
cv2_imshow(dilation)
cv2_imshow(opening)
cv2_imshow(closing)

# Wait for a key press and then close the windows
cv2.waitKey(0)
cv2.destroyAllWindows()

Output

Conclusion

- The morphological operations have demonstrated their effectiveness in processing the image.
- Erosion has removed small noise points, while dilation has helped in connecting disjoint structures.
- Opening has effectively removed small objects from the foreground, and closing has filled small holes in the foreground.
- These operations are crucial in various image processing tasks, including object detection and image segmentation.