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Aim: To study object segmentation.

Objective: Object segmentation using the Watershed and GrabCut algorithms, Example of foreground detection with GrabCut, Image segmentation with the Watershed algorithm

Theory:

- 1. Image segmentation is the process of dividing an image into several disjoint small local areas or cluster sets according to certain rules and principles. The watershed algorithm is a computer vision technique used for image region segmentation. It is an algorithm that correctly determines the "outline of an object".
- 2. The algorithm used for foreground extraction is GrabCut Algorithm. In this algorithm, the region is drawn in accordance with the foreground, and a rectangle is drawn over it. This is the rectangle that encases our main object. The region coordinates are decided over understanding the foreground mask. But this segmentation is not perfect, as it may have marked some foreground region as background and vice versa. This problem can be avoided manually. This foreground extraction technique functions just like a green screen in cinematics.
- 3. The watershed algorithm uses topographic information to divide an image into multiple segments or regions. The algorithm views an image as a topographic surface, each pixel representing a different height. The watershed algorithm uses this information to identify catchment basins, similar to how water would collect in valleys in a real topographic map.

The whole process of the watershed algorithm can be summarized in the following steps:

- Marker placement: The first step is to place markers on the local minima, or the lowest points, in the image. These markers serve as the starting points for the flooding process.
- Flooding: The algorithm then floods the image with different colors, starting from the markers. As the color spreads, it fills up the catchment basins until it reaches the boundaries of the objects or regions in the image.



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- Catchment basin formation: As the color spreads, the catchment basins are gradually
 filled, creating a segmentation of the image. The resulting segments or regions are
 assigned unique colors, which can then be used to identify different objects or features in
 the image.
- Boundary identification: The watershed algorithm uses the boundaries between the
 different colored regions to identify the objects or regions in the image. The resulting
 segmentation can be used for object recognition, image analysis, and feature extraction
 tasks.

Code:

```
import cv2
import numpy as np
from IPython.display import Image, display
from matplotlib import pyplot as plt
# Plot the image
def imshow(img, ax=None):
 if ax is None:
  ret, encoded = cv2.imencode(".jpg", img)
  display(Image(encoded))
  ax.imshow(cv2.cvtColor(img, cv2.COLOR_BGR2RGB))
  ax.axis('off')
img = cv2.imread("/content/image.png")
gray = cv2.cvtColor(img, cv2.COLOR BGR2GRAY)
imshow(img)
#Threshold Processing
ret, bin img = cv2.threshold(gray,
        0, 255,
        cv2.THRESH BINARY INV + cv2.THRESH OTSU)
imshow(bin img)
```



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```
# noise removal
kernel = cv2.getStructuringElement(cv2.MORPH_RECT, (3, 3))
bin img = cv2.morphologyEx(bin img,cv2.MORPH OPEN,
       kernel, iterao
       ns=2)
imshow(bin img)
# Create subplots with 1 row and 2 columns
fig, axes = plt.subplots(nrows=2, ncols=2, figsize=(8, 8))
# sure background area
sure bg = cv2.dilate(bin img, kernel, iterations=3)
imshow(sure bg, axes[0,0])
axes[0, 0].set title('Sure Background')
# Distance transform
dist = cv2.distanceTransform(bin img, cv2.DIST L2, 5)
imshow(dist, axes[0,1])
axes[0, 1].set title('Distance Transform')
#foreground area
ret, sure fg = cv2.threshold(dist, 0.5 * dist.max(), 255, cv2.THRESH_BINARY)
sure fg = sure fg.astype(np.uint8)
imshow(sure fg, axes[1,0])
axes[1, 0].set title('Sure Foreground')
# unknown area
unknown = cv2.subtract(sure_bg, sure_fg)
imshow(unknown, axes[1,1])
axes[1, 1].set title('Unknown')
plt.show()
# Marker labelling
# sure foreground
ret, markers = cv2.connectedComponents(sure fg)
# Add one to all labels so that background is not 0, but 1
markers += 1
# mark the region of unknown with zero
markers[unknown == 255] = 0
```



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```
fig, ax = plt.subplots(figsize=(6, 6))
ax.imshow(markers, cmap="tab20b")
ax.axis('off')
plt.show()
# watershed Algorithm
markers = cv2.watershed(img, markers)
fig, ax = plt.subplots(figsize=(5, 5))
ax.imshow(markers, cmap="tab20b")
ax.axis('off')
plt.show()
labels = np.unique(markers)
coins = []
for label in labels[2:]:
# Create a binary image in which only the area of the label is in the foreground
#and the rest of the image is in the background
 target = np.where(markers == label, 255, 0).astype(np.uint8)
# Perform contour extraction on the created binary image
contours, hierarchy = cv2.findContours(
  target, cv2.RETR EXTERNAL, cv2.CHAIN APPROX SIMPLE
 )
 coins.append(contours[0])
# Draw the outline
img = cv2.drawContours(img, coins, -1, color=(0, 23, 223), thickness=2)
imshow(img)
```

Output:







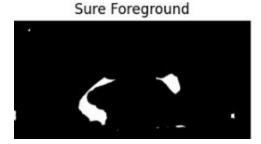
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Output Image











Conclusion:

The GrabCut algorithm is a versatile and accurate technique for image segmentation, allowing users to provide input for segmenting objects from their backgrounds. It's commonly used in applications such as image editing, object recognition, and interactive image segmentation tools. The Watershed algorithm is a powerful tool for segmenting objects in an image, especially when there are clear intensity differences between objects and the background. The code first loads the image and converts it to grayscale, performs some preprocessing steps, places markers on the local minima, floods the image with different colors, and finally identifies the boundaries between the regions. The resulting segmented image is then displayed.