Aim: To study the object segmentation

Objective: To study the object segmentation using watershed algorithm. Example image segmentation with watershed algorithm.

Theory:

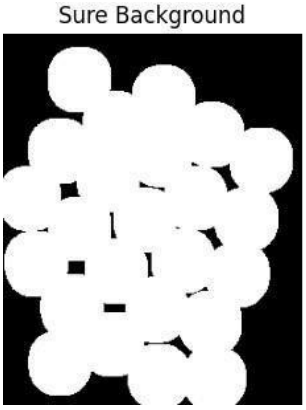
Image segmentation is the process of dividing an image into several disjoint small local areas or cluster sets according to certain rules and principles. The watershed algorithm is a computer vision technique used for image region segmentation **"**outline of an object**".**

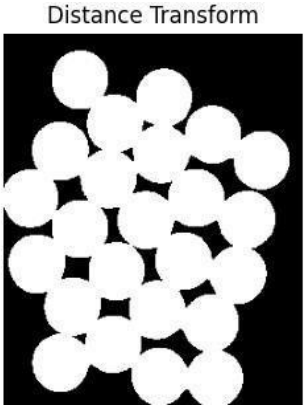
Watershed algorithm:

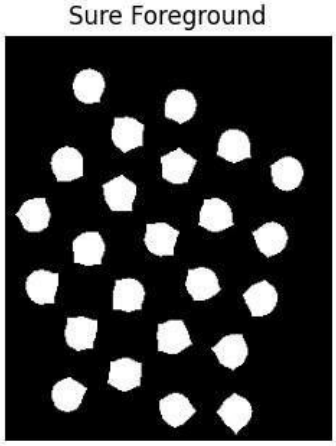
The watershed algorithm uses topographic information to divide an image into multiple segments or regions. The algorithm views an image as a topographic surface, each pixel representing a different height. The watershed algorithm uses this information to identify catchment basins, similar to how water would collect in valleys in a real topographic map. The watershed algorithm identifies the local minima, or the lowest points, in the image. These points are then marked as markers. The algorithm then floods the image with different colors, starting from these marked markers. As the color spreads, it fills up the catchment basins until it reaches the boundaries of the objects or regions in the image.The catchment basin in the watershed algorithm refers to a region in the image that is filled by the spreading color starting from a marker. The catchment basin is defined by the boundaries of the object or region in the image and the local minima in the intensity values of the pixels.The algorithm uses the catchment basins to divide the image into separate regions and then identifies the boundaries between the basins to create a segmentation of the image for object recognition, image analysis, and feature extraction tasks.

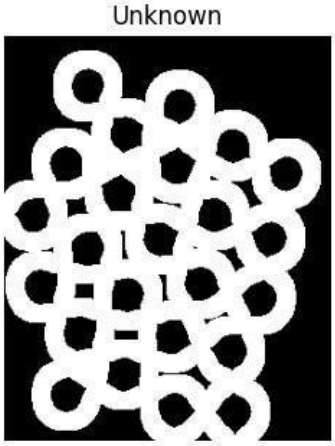
The whole process of the watershed algorithm can be summarized in the following steps:

- **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.
- **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("/content/download.png", img)
    display(Image(encoded))
  else:
    ax.imshow(cv2.cvtColor(img, cv2.COLOR_BGR2RGB))
    ax.axis('off')
#Image loading
img = cv2.imread("/content/download.png")
#image grayscale conversion
gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
# Show image
imshow(img)
```

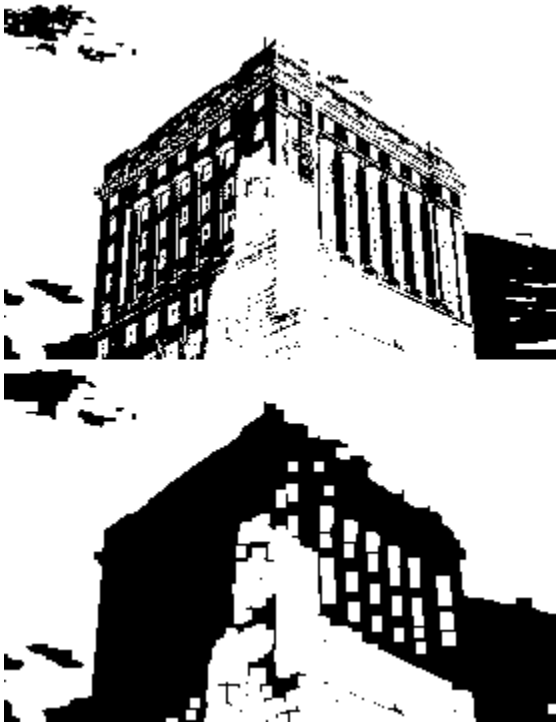
```
ret, bin_img = cv2.threshold(gray, 0,
255, cv2.THRESH_BINARY_INV +
cv2.THRESH_OTSU)

imshow(bin_img)
# noise removal
kernel =
cv2.getStructuringElement(cv2.MORPH_REC
T, (3, 3))
bin_img = cv2.morphologyEx(bin_img,
cv2.MORPH_OPEN,
kernel,
iterations=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')


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])
```

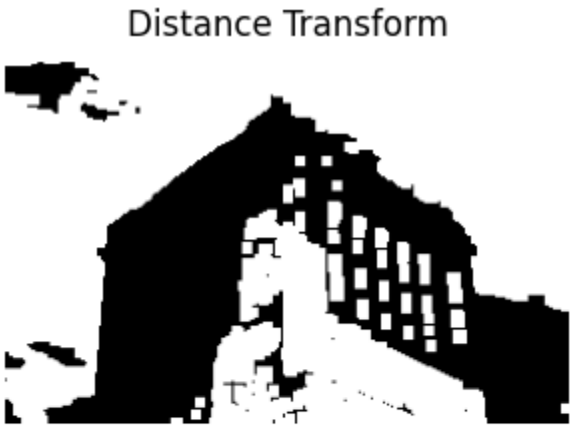
```
axes[1, 1].set_title('Unknown')
plt.show()
```

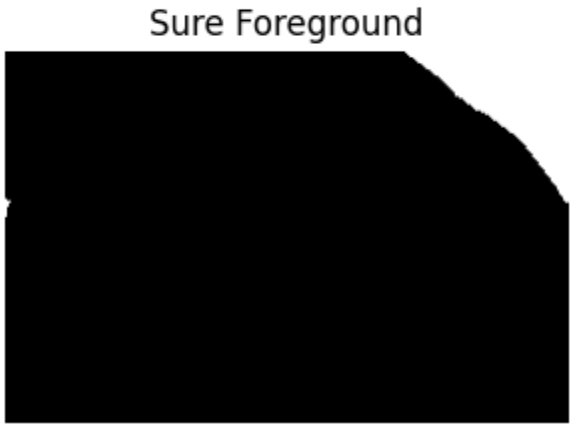
Output:

Input Image:

Output Image:







Conclusion:

- Object segmentation is a fundamental task in computer vision with far-reaching implications. It plays a pivotal role in image analysis, enabling the accurate delineation and isolation of objects within images or video streams. This capability has wide-ranging applications, from improving object recognition and tracking in autonomous vehicles to enhancing medical image analysis and enabling immersive augmented reality experiences.
- As technology evolves, object segmentation techniques continue to advance, leveraging deep learning, neural networks, and sophisticated algorithms to achieve remarkable accuracy and efficiency. These advancements hold promise for revolutionizing industries such as healthcare, robotics, and entertainment, making object segmentation a critical area of research and

development in the field of computer vision.