

I. Định nghĩa

Image segmentation is a computer vision technique that partitions a digital image into discrete groups of pixels (image segments) to inform object detection and related tasks. By parsing an image's complex visual data into specifically shaped segments, image segmentation enables faster, more advanced image processing.



Segmentation is an important stage of the image recognition system, because it extracts the objects of our interest, for further processing such as description or recognition. Segmentation of an image is in practice for the classification of image pixel

II. Kỹ thuật Segmentation

- So sánh Image segmentation với object detection và sự liên kết giữa hai cái này
Image segmentation: The process of partitioning an image into different meaningful segments, such as regions, edges, or individual objects.

Object detection: The process of detecting and locating specific objects within an image.

Output:

Image segmentation: Produces a mask for each part of the image, indicating which region belongs to which object.

Object detection: Determines the position and class of all objects in the image, typically represented by bounding boxes.

Complexity:

Image segmentation: Often more complex as it requires distinguishing between different regions of the image.

Object detection: Generally simpler, as it only needs to determine the position and class of objects in the image.

Applications:

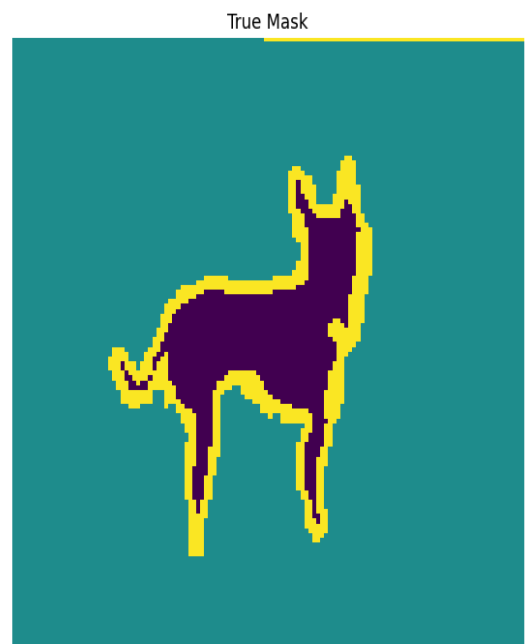
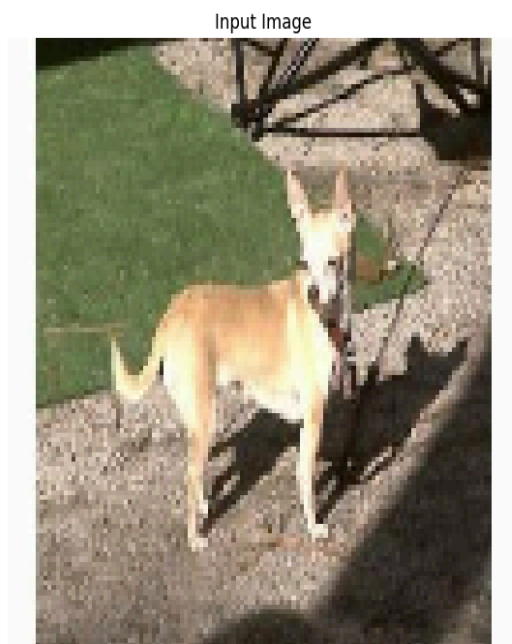
Image segmentation: Commonly used in applications that require detailed understanding of the image structure, such as object recognition, medical imaging, and autonomous driving.

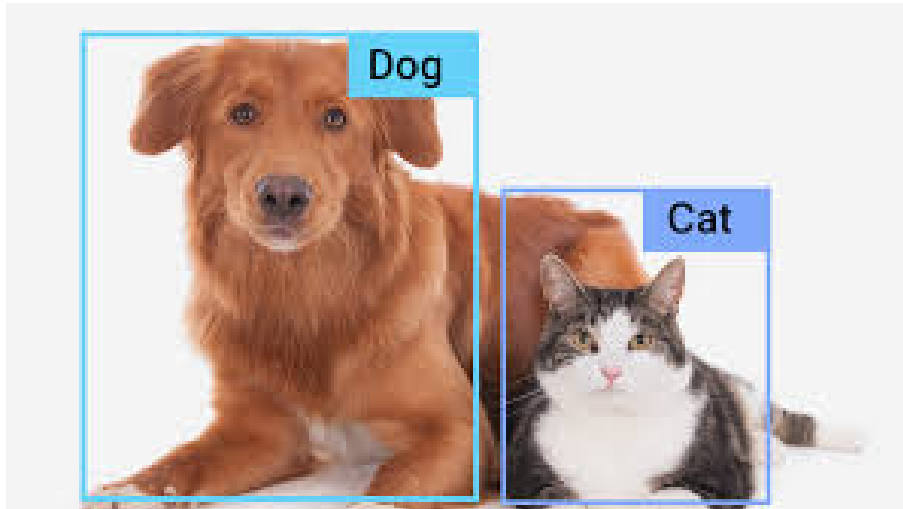
Object detection: Popular in applications like object tracking, face detection, object recognition in images or videos.

Accuracy:

Image segmentation: Can provide more detailed results about specific regions in the image.

Object detection: Typically provides accurate information about the precise location of objects in the image but may not provide detailed information about the internal structure of objects.





Các kỹ thuật Image segmentation:

Threshold Segmentation: This technique involves selecting a threshold value and classifying each pixel in the image based on whether its intensity is above or below the threshold. It's particularly useful for simple cases where objects and background have distinct intensity levels

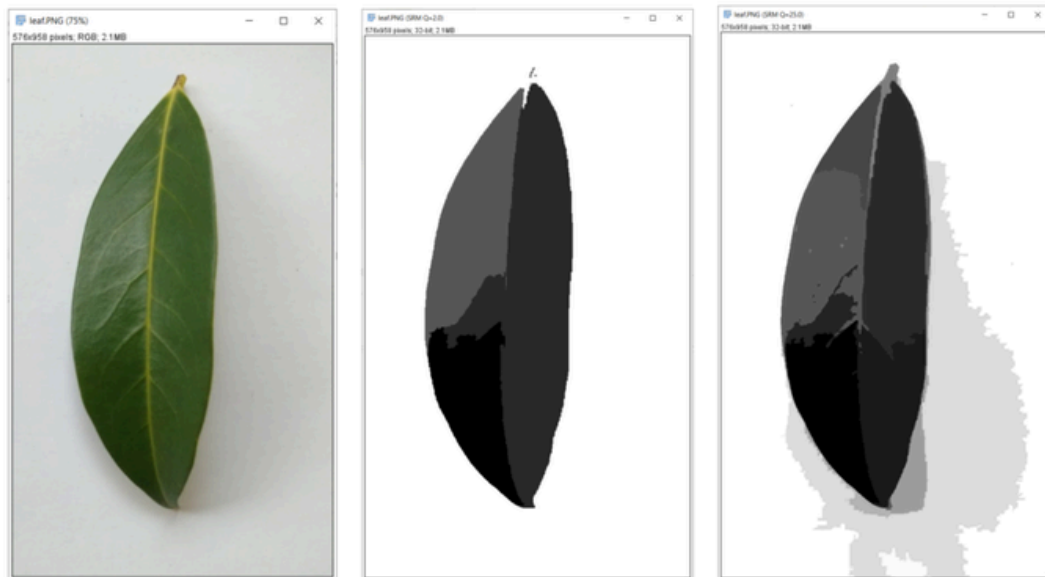


Original Image



Thresholded and segmented Image

Region-based segmentation: In this approach, the image is partitioned into regions based on certain criteria such as intensity similarity, texture, or color homogeneity. Examples include region growing and region splitting/merging algorithms.



Edge-based segmentation: Edge detection algorithms like Canny edge detector or Sobel operator are used to identify abrupt changes in intensity, which typically correspond to object boundaries. Once edges are detected, further processing may be done to connect them and form closed contours.



Clustering-based segmentation: Techniques such as K-means clustering or Gaussian mixture models can be used to group pixels into clusters

based on feature similarity. Each cluster represents a different segment in the image.

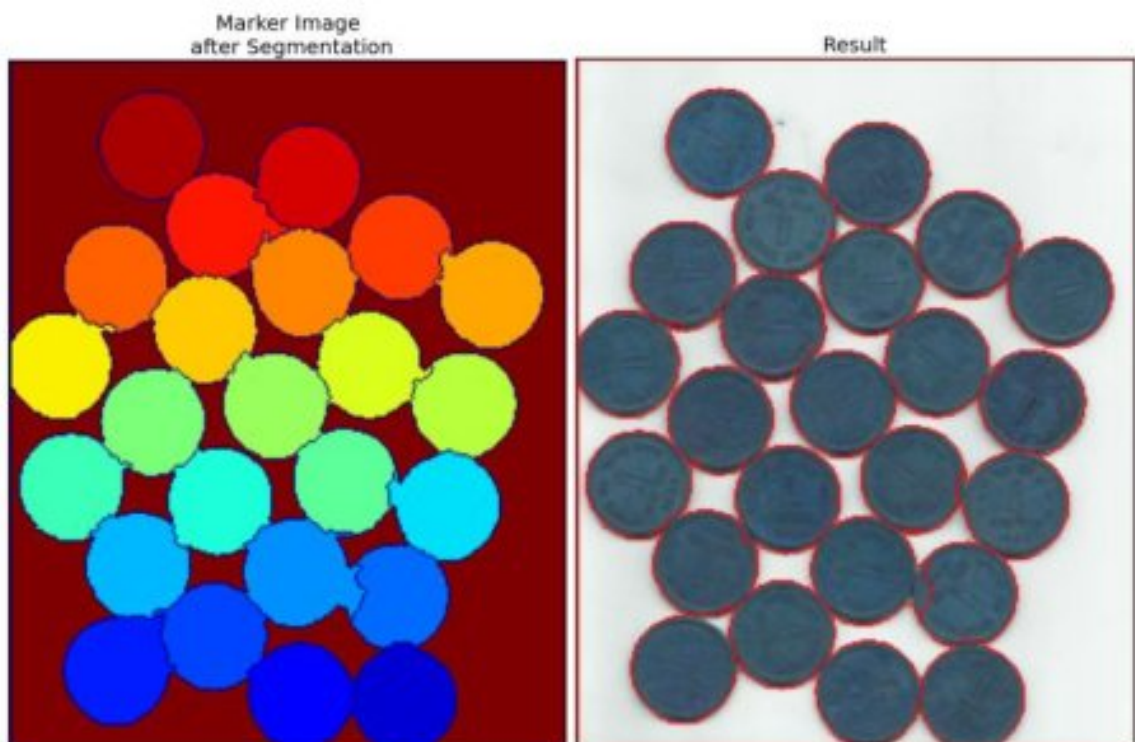


a



b

Watershed segmentation: Inspired by the physical concept of a watershed, this technique treats the pixel intensity values as a topographic surface. The image is flooded from the markers (seed points), and the regions where the flooding basins meet are segmented as object boundaries.



III. Lĩnh vực ứng dụng

1. Medical and Healthcare:

- Medical image analysis: Used to segment organs, tissues, and structures in medical images such as MRI, CT scans to assist in diagnosis and treatment.
- Detection of tumours and abnormalities: Image segmentation helps identify the location and size of tumours, polyps, or abnormal regions in medical images.

2.Automation and Robotics:

- Computer vision in robotics: Used to recognize and segment objects in the robot's surrounding environment, enabling it to understand and interact with the environment autonomously.
- Image and video processing in autonomous vehicles: Used to segment and identify objects such as pedestrians, cars, traffic signs to enable safe decision-making in autonomous driving systems.

3.Entertainment and Media:

- Image and video processing: Used to detect and classify objects, celebrities, or items in videos and images, supporting content search and management in media.
- Special effects and AR/VR: Image segmentation is used to create special effects such as background removal, scene changes, and creating virtual worlds in augmented reality or virtual reality.

4.Advertising and Marketing:

- Product classification and identification: Used to segment and identify products in advertising images and videos to create interactive shopping experiences and attract customers.
- Consumer behaviour analysis: Image segmentation can be used to analyse consumer behaviour based on images, such as identifying products used or customer satisfaction levels.

5.Resource Management and Environment:

- Object localization and segmentation of land: Used to monitor and manage land use, such as identifying agricultural areas, forests, or measuring land area.
- Environmental monitoring and disaster management: Used to detect and monitor environmental changes such as changes in land, sea dynamics, and natural disasters like floods, earthquakes.

6.Industry and Manufacturing:

- Product quality inspection: Image segmentation can be used to inspect product quality in the manufacturing process, such as checking size, shape, and defects of products.

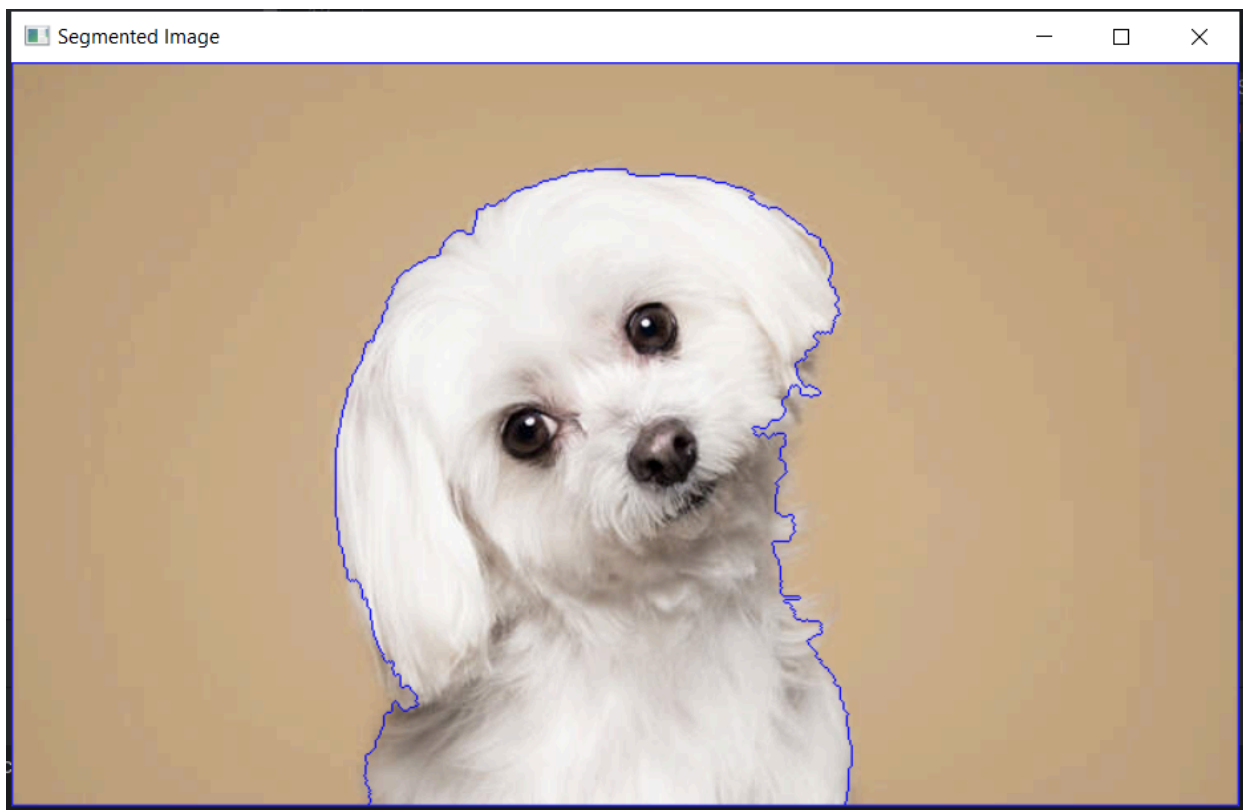
- Production line management: Segmenting images from production lines to monitor the manufacturing process, enhancing efficiency and quality.

7.Security and Surveillance:

- Surveillance image analysis: Used to detect and identify abnormal behaviors or objects in video surveillance systems, such as identifying intruders in a surveillance scene.
- Image processing from unmanned aerial vehicles (drones): Image segmentation is used to monitor borders, track animal movements, or detect unusual activities.

IV. Hình ảnh và code tham khảo

WaterShed



Nguồn tham khảo:

1. <https://www.tensorflow.org/tutorials/images/segmentation> (Có demo code)
2. <https://www.ibm.com/topics/image-segmentation>
3. <https://www.analyticsvidhya.com/blog/2021/09/image-segmentation-algorithms-with-implementation-in-python/> (Có demo code)
4. <https://data-flair.training/blogs/image-segmentation-machine-learning/>

