Guidebook: Image Segmentation

Contents

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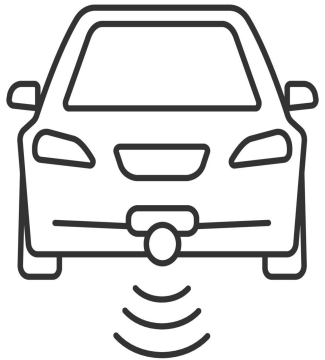
Did you know?

- Image segmentation has been crucial in medical imaging since the early days of computer vision.

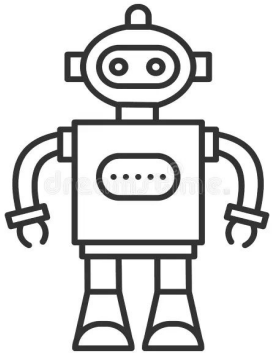
  They were used to detect tumors .

- Image segmentation is also essential for self-driving vehicles.

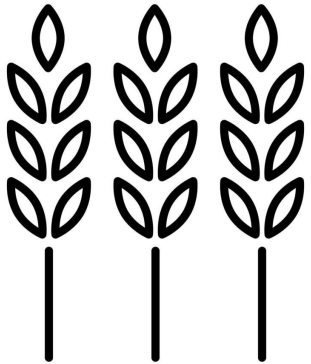


Did you know?

- In robotics, the process of their vision relies heavily on image segmentation, object recognition, and navigation.

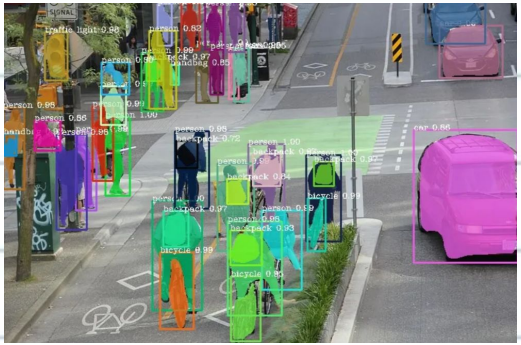


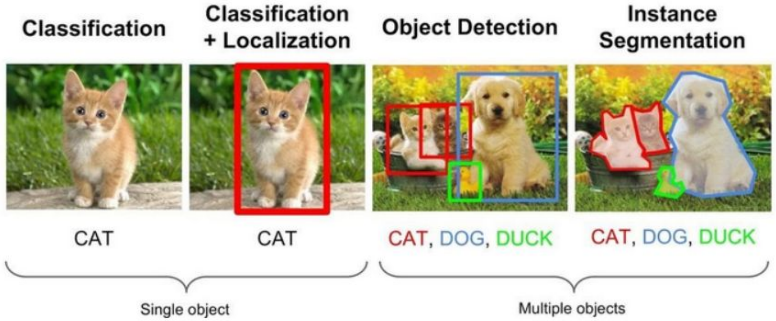
- Image segmentation is helping to improve crop management, reduce production cost, and increasing crop yield.



What is Image Segmentation?

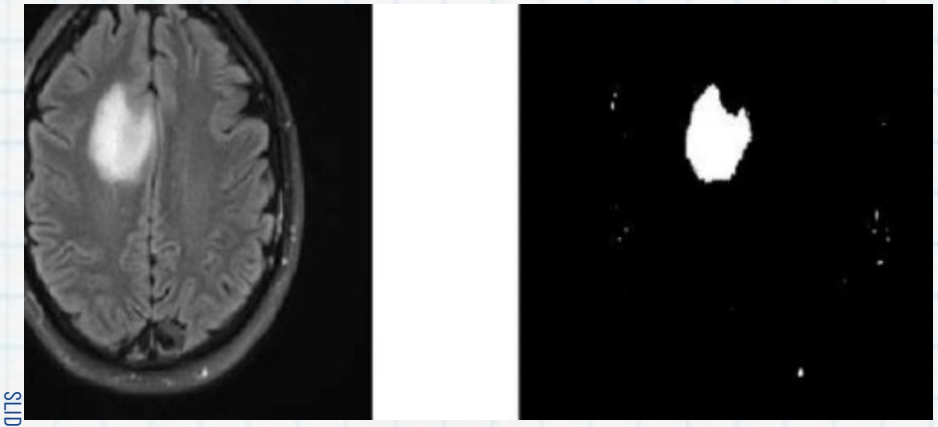
Image segmentation is a computer vision method that splits a digital image into groups of pixels, called segments, to help with tasks like object detection. By dividing the image into clear sections, it makes image processing faster and more efficient. Three common techniques for image segmentation are thresholding, edge detection, and clustering. The purpose of image segmentation is to simplify image processing and improve the accuracy of the tasks being done.

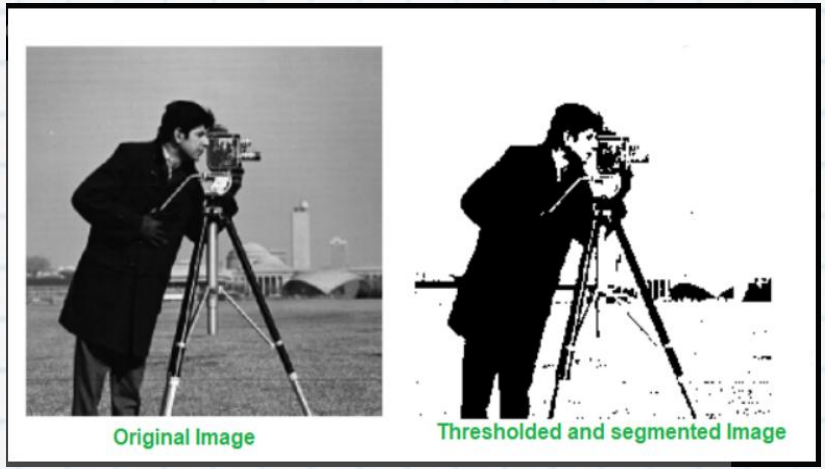




Thresholding Segmentation

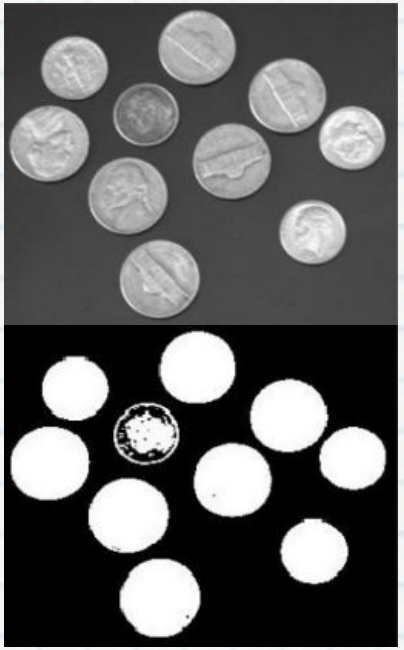
Thresholding is one of the techniques of Image Segmentation! It converts grayscale images to binary numbers by establishing a threshold. Pixels that exceeds or subceeds the value threshold will be grouped separately. The results is an image made up of binary numbers.





Thresholding Segmentation

The Thresholding technique can create works of art, choosing the right value to influence the shades of blacks and whites in between can make or break an art piece. And while it can be used for artistic pursuits. It absolutely has practical value and real uses in the world we live in. What we will find is the technique is utilized to separate the main focus of a photo from the background. The separation helps tremendously in image analysis! Some examples that rely on the technique for analysis are medical imaging, document examination, industrial inspection, remote sensing, and video surveillance.



Edge Detection

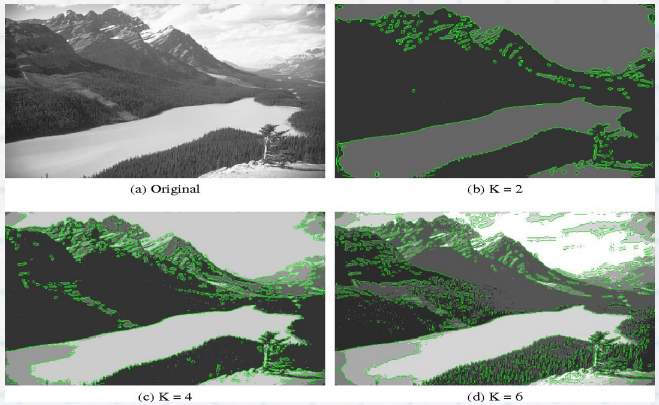
Edge detection is another technique in image segmentation that looks for the edge or boundaries of objects within an image. These edges help define the segments in the image, making it easier to identify different objects based on their features. Some algorithms used to find edges are Canny and Sobel, along with Prewitt and Roberts.

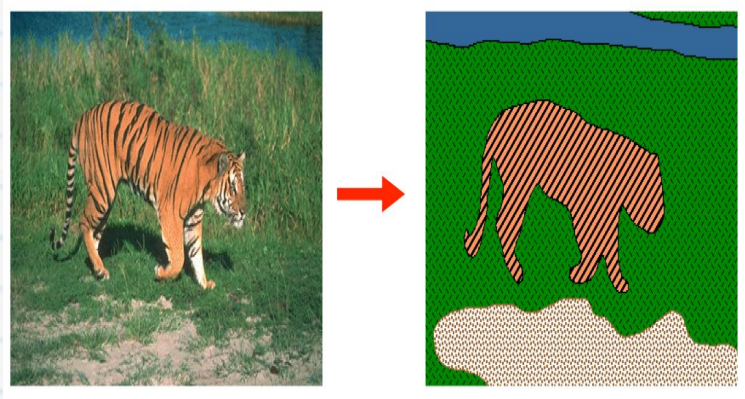
Edge Detection

It works by detecting discontinuities and disruptions in brightness. More specifically, it looks for variations in intensity, color, and texture to identify the boundaries of an object. Like the previous technique, the many applications edge detection algorithms are used is in machine learning, computer vision, medical imaging, remote sensing, and art!

Clustering

Clustering is a method used to divide an image into different regions by grouping similar pixels together. The goal is making an image easier to analyze by breaking it into meaningful parts, like separating objects from the background.





CONCLUSION

Image segmentation is a crucial method that gives robots the ability to comprehend and analyze visual information at the pixel-by-pixel level. Its uses are numerous, ranging from enhancing medical imaging diagnostic precision to guaranteeing driver safety in self-driving cars.

References

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Reflections - Mayela

While writing my contribution on image segmentation, I became aware of the numerous impactful technologies that rely on computer vision. It feels unreal the fact that I'm living in a time where self-driving cars are nonfictional anymore. We are still far away from flying cars, but with the AI, it could be within range.

Like it infers in the name, I believed image segmentation to be a non-complicated process of simply separating colors and figures to be more easily analyzed. However, I learned that it takes more than that; techniques such as clustering, edge detection, and thresholding are used to group pixels that share similar objects, identify the ones that differ, and find boundaries on an image.

Reflections - Eduardo

This project on image segmentation taught me how essential the technique is in computer vision and its broad applications. We explored key methods like thresholding, edge detection, and clustering, each contributing to the way images are analyzed. Thresholding was more complex than I expected, as the chosen threshold greatly impacts image results. Edge detection helped us see how algorithms define object boundaries, with applications in technologies like self-driving cars. Clustering made it easier to isolate objects in images, used in fields like facial recognition and crop management. Our group worked well together, combining theory with practical examples, which helped deepen our understanding. Overall, I realized how complex yet impactful image segmentation is in shaping the future of technology.

Reflections - Alejandro Rebolloso

Before I approached the challenge our group decided to work on, I like going through the presentation and study materials in the module first so I can have a frame or an idea of what we are about to learn and see if I can relate to it anything I experienced before. In this week's lesson and project, I learned several techniques and ways in how computers see, along with how they can examine and figure out what they do see. It is a complex subject, so it took time to fully understand it. Computer vision is an overall process, they first need to have the physical components and sensors to take in optical input, then they will begin to process the image using various techniques to analyze the contents, and lastly have an output which is the result. This project made me think back to the time when I first saw self-checkouts in Walmart. I remember looking up and seeing these television screens broadcasting the security cameras that are above each self-checkout station. There was a key detail in there that always made me think how in the world cameras can detect things and objects. On the television screen I remember seeing my mom highlighted in a red box with the products we were buying in yellow. The boxes will move when we move, it was surreal, and it blew my mind at the time. I now understand that what I was seeing happening was image segmentation! Computer Vision! Machine Learning! The computers used the security cameras as vessel to receive optical input, then the live video is being processed and using clustering, edge detection, and thresholding to identify objects within the footage, and finally the results show people and products successfully found and highlighted in boxes! It truly is fascinating to understand how computer vision works and how it can be broken down into techniques.

Reflections - Ibrahim

Working on this image segmentation project showed me the importance of this technique in computer vision and its wide range of applications. We delved into key methods such as thresholding, edge detection, and clustering, each playing a vital role in image analysis. I found thresholding to be more detailed than I thought, as the chosen threshold significantly affects the results. Edge detection revealed how algorithms identify object boundaries, which is crucial for technologies like self-driving cars. Clustering facilitated object isolation, with uses in areas such as facial recognition and crop management. Our group collaborated effectively, blending theoretical concepts with practical applications, which enriched our learning experience. Ultimately, I gained a deeper appreciation for the complexity and impact of image segmentation in advancing technology.

Reflection - Jesus

This project on image segmentation helped me understand how crucial this method is for computer vision and its diverse applications. We explored techniques like region-based segmentation, color-based segmentation, and thresholding, each offering different ways to break down images. I found color-based segmentation especially interesting because it helps identify objects based on their hues, which is key in medical imaging. Thresholding showed me how sensitive the process is to the choice of values. Our group also experimented with different algorithms, testing how they perform under various conditions. Working together allowed us to connect theory with real-world examples, making the learning process smoother. I now see how image segmentation plays a big role in advancements like facial recognition and even satellite imagery.