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Binary Morphologhical OperationsURL

Image morphology operation is a process that aims to change the shape of objects in the original image. This process can be carried out on grayscale images or binary images. The types of morphological operations include dilation, erosion, closing, and opening.

The stages of morphological operations are carried out by isolating a Structuring Element to an image. The structural element has a function like a mask in the filtering process. With morphological operations, some of the applications that can be done are as follows:

- Forms a spatial filter
- Obtaining the object's skeleton.
- Determine the location of objects in the image.
- Obtaining the shape of the object structure.

1. Dilation

Dilation is a morphological operation that will add pixels to the boundary between objects in a digital image. Or in detail Dilation is a process of adding pixels to the boundaries of objects in an image so that later when this operation is performed, the resulting image is larger in size than the original image.

2. Erosion

Erosion is the opposite of dilation. This process will make the size of an image smaller. In contrast to dilation, when erosion is carried out, what is done is to move pixels on the boundaries of the object to be eroded. The number of pixels added or removed depends on the size and shape of the structuring element used to process the image.

3. Closing

Closing is a combination where an image is subjected to a dilation operation followed by erosion. The closing operation also tends to refine objects in the image, but by connecting the fuses, narrow breaks and thin gulf and eliminating small holes in the object.

4. Opening

Opening is a combination process where a digital image is subjected to erosion operations followed by dilation. The opening operation on the image has the effect of smoothing object boundaries, separating previously coupled objects, and removing objects that are smaller than the structuring size.

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Image ThresholdingURL

Thresholding is an image segmentation method that separates objects from the background in an image based on differences in brightness or darkness.

1. Otsu Threshold

Otsu Threshold is used to perform automatic image thresholding. In the simplest form, the algorithm returns a single intensity threshold that separate pixels into two classes, foreground and background. This threshold is determined by minimizing intra-class intensity variance, or equivalently, by maximizing inter-class variance.

2. K-Means for Image Segmentation

K-Means is running By determining the number of segments as needed, the segmentation process can be carried out properly

3. Global Threshold

Global thresholding is a method where all pixels in the image are converted to black and white with one thresholding value

4. Adaptive Threshold

In different lighting cases sometimes the Global Threshold is not good enough under these conditions. Adaptive hreshold is a solution that will give better results. This algorithm will calculate the threshold value imposed for a certain area of the whole image. So that different threshold values will be obtained for different areas in the same image.

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Object DetectionURL

Object Detection is how to make the machine can recognize some objects and determine the position of these objects in an image. The concept of Object Detection is simple, namely by scanning all parts of the image and determining which objects are objects and which are not objects (background).

1. Edge Detection

Edge detection is an operation that is performed to detect the edges that separate two homogeneous image regions that have different brightness levels. Edge detection of a digital image is a process to find the difference in intensity which states the boundaries of an object (sub-image) in the overall digital image in question. The purpose of edge detection is to improve the appearance of the boundaries of an area or object in the image

2. Sobel Edge Detection

Is used in image processing and computer vision, particularly within edge detection algorithms where it creates an image emphasising edges. Sobel Edge is based on convolving the image with a small, separable, and integer-valued filter in the horizontal and vertical directions and is therefore relatively inexpensive in terms of computations.

3. Corner Detection

Corner detection is an approach used in computer vision to extract several types of features, determine the characteristics of an image, then conclude the contents of an image. Corner can be defined as the intersection of two edges or points that produce two different dominant edge directions in a local neighbor. Corner Detection Basic Idea Corner detection is widely used in motion detection, motion detection, image registration, image registration, video tracking, image mosaicing, panoramic stitching, 3D modeling and object recognition.

4. Grid Detection

Grid detection is a detection in image processing whose detection is based on a line on that line the image will be detected

5. Contour Detection

Contour detection is detecting the outermost contours of objects that have the same color or intensity

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Feature Matching, Face DetectionURL

Is a computer technology being used in a variety of applications that identifies human faces in digital images. Face detection also refers to the psychological process by which humans locate and attend to faces in a visual scene.

1. ORB (Orient Fast and Rotated BRIEF)

Is a feature-based recognition method based on keypoint, this method is scale invariant and rotation invariant and also more resistant to noise. The ORB method in several studies is a method that is widely used due to its ability in the recognition and matching process. The ORB is basically a mix of a FAST keypoint detector and a BRIEF descriptor with many modifications to improve its performance. As a first step, FAST is used to find the keypoint, then Harris Corner detection is used to find the highest N-point. However, FAST does not calculate the orientation. Modifications are made so that this algorithm is invariant to orientation.

2. SIFT (Scale-Invariant Feature Transform)

Scale Invariant Feature Transform (SIFT) is an algorithm in computer vision that is used to detect and describe local features in an image. The working principle of SIFT is that an image will be converted into a local feature vector which is then used as an approach in detecting and recognizing the object in question. through points or keypoints. The SIFT algorithm consists of several parts including:

- **Gaussian and Difference of Gaussian Scale Space**
  Gaussian function is used to create scale space so it is called Gaussian Scale Space

- **Detection Ekstremum**
- **Penentuan Orientasi Keypoint**
- **Penentuan Deskriptor Lokal**

Algoritma Face Detection is also executed quickly using the cascade classifier . Cascade classifier is to calculate the value of the image feature series based on the simple features that have been shown previously.

- **The first step this alghoritm** is change the input image into Grayscale. The initial feature used as a search is an edge feature that shows the presence of eyes and cheeks. If the image does not show this feature, it is assumed that there is no face in the image. If it is indicated, then proceed to look for the next feature, such as the nose bridge (middle of the nose), lips (lips), eyebrows. Search continues using cascading, which means there will be thousands of features collected.

In theory, this approach can be used on a variety of objects and detection. For example, it can be used to detect eyes, lips, nose and so on. Or it can also be used to detect other objects such as cars, motorbikes, planes, and so on. The weakness of this algorithm is the need for a large dataset reference to get the desired features.