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Research Article

MORPHOLOGICAL SEGMENTATION IN IMAGE PROCESSING

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ABSTRACT

This paper presents some of the most common segmentation techniques like Thresholding, Region based & Edge detection. Few techniques are suitable for noisy images of these technique is the simplest technique for segmentation. Actually these are the applications of image segmentation. Morphological image segmentation is often essential step in image analysis, object representation, visualization, and many other image processing tasks.

INTRODUCTION

Morphological image segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as super-pixels) in computer vision. The goal of segmentation is to simplify and change the representation of an image into something that is more meaningful and easier to analyze [1]. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain characteristics.[2] An image is basically two dimensional signal defined by mathematical function, F(x,y) where x and y gives value of horizontal and vertical co-ordinates.[3]

The main purpose of the segmentation process is to get more information in the region of interest in an image which helps in annotation of the object scene [4]. Edge detection is a fundamental tool in image processing, machine vision and computer vision, particularly in the areas of feature detection and feature extraction [5].

Classification

Image Segmentation can be classified as follows:

- Region Based
- Edge Based
- Thresholding

The image segmentation methods are categorized as follows.

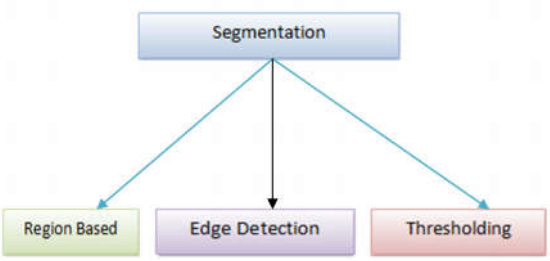

Fig 1

Region based segmentation

In this technique pixels that are related to an object are grouped for segmentation. Thresholding technique is bound with region based segmentation. The area that is detected for segmentation should be closed. Region based segmentation is also termed as Similarity Based Segmentation. In this an edge based technique may attempt to find the object boundaries and then locate the object itself by filling them in, a region based technique takes the opposite approach, starting in the middle of an object and then "growing" outward until it meets the object boundaries The boundaries are identified for segmentation. In each and every step at least one pixel is related to the region and is taken into consideration. After identifying the change in

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the color and texture, the edge flow is converted into a vector. From this the edges are detected for further segmentation.

Region Based segmentation methods divide an image into region having similar characteristic like color, texture etc. Region Growing performs a segmentation of an image which examine the neighboring pixels of a set of points, known as seed points, and determine whether the pixels could be classified to the cluster of seed point or not. In method of region Split-merge whole Image which is considered as a seed region splitting out into quadrant until the homogenous sub region is obtained, after the process of Splitting Merging process merge two adjacent regions according to similar characteristic.

Edge based segmentation.

In this technique, detected edges in an image are assumed to represent object boundaries, and used to identify these objects. Edges are significant local changes of intensity in an image. Edges typically occur on the boundary between two different regions in an image. The aim of edge detection is to Produce a line drawing of a scene from an image of that scene is shown in fig.

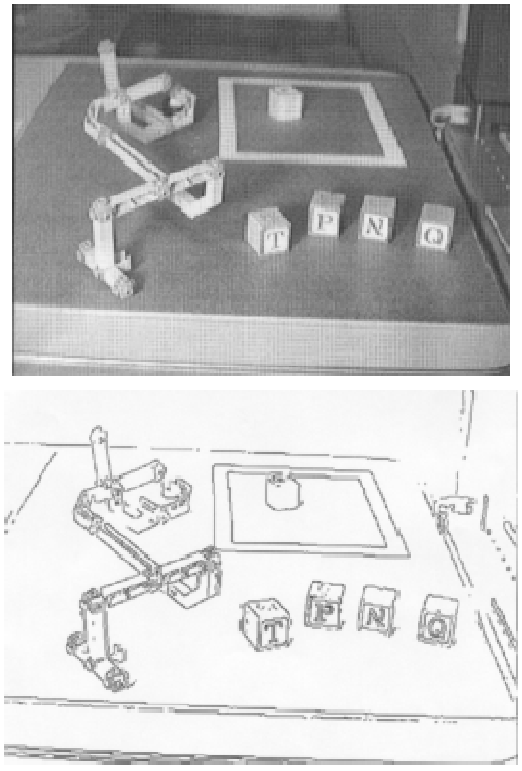


Fig 2

The Important features can be extracted from the edges of an image (e.g., corners, lines, curves). These features are used by higher-level computer vision algorithms (e.g., recognition)

Edge descriptors

Edge normal: unit vector in the direction of maximum intensity change.

Edge direction: unit vector perpendicular to the edge normal.
Edge position or center: the image position at which the edge is located.

Edge strength: related to the local image contrast along the normal.

Modeling intensity changes

Edges can be modeled according to their intensity profiles.

Step edge: The image intensity abruptly changes from one value to one side of the discontinuity to a different value on the opposite side.

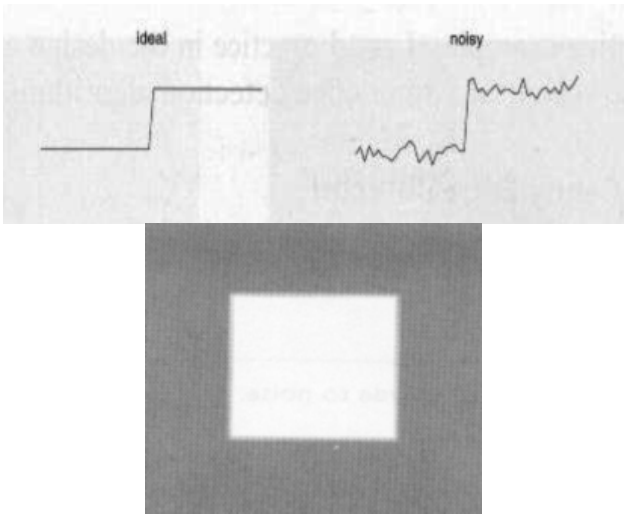


Fig 3

Ridge edge

The image intensity abruptly changes value but then returns to the starting value within some short distance (i.e., usually generated by lines).

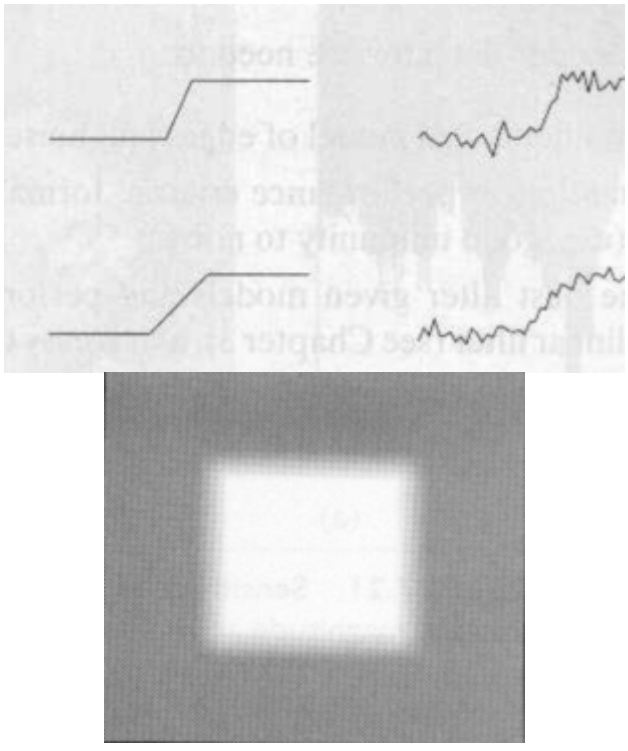


Fig 4

Roof edge

A ridge edge where the intensity change is not instantaneous but occur over a finite distance (i.e., usually generated by the intersection of two surfaces).

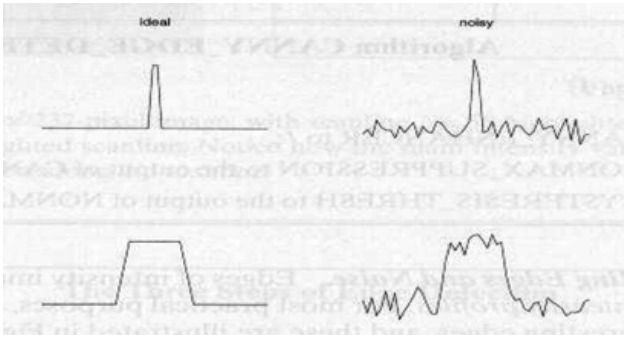


Fig 5

The main steps in edge detection

1. Smoothing: suppress as much noise as possible, without destroying the true edges.
2. Enhancement: apply a filter to enhance the quality of the edges in the image (sharpening).
3. Detection: determine which edge pixels should be discarded as noise and which should be retained (usually, Thresholding provides the criterion used for detection).
4. Localization: determine the exact location of an edge (*sub-pixel* resolution might be required for some applications, that is, estimate the location of an edge to better than the spacing between pixels). Edge thinning and linking are usually required in this step.

Thresholding

Thresholding is the simplest method of image segmentation. From a grayscale image, Thresholding can be used to create binary images .The purpose of Thresholding is to extract those pixels from some image which represent an object (either text or other line image data such as graphs, maps). Though the information is binary the pixels represent a range of intensities. Thus the objective of binarization is to mark pixels that belong to true foreground regions with a single intensity and background regions with different intensities.

During the thresholding process, individual pixels in an image are marked as "object" pixels if their value is greater than some threshold value (assuming an object to be brighter than the background) and as "background" pixels if their value is less than threshold value Typically, an object pixel is given a value of "1" while a background pixel is given a value of "0" .

In first step light objects in dark background

To extract the objects:

Select a T that separates the objects from the background i.e. any f (x,y) for which f(x,y) >T is an object point.

A threshold image is defined as

$$g(x,y) = \begin{cases} 1 & if\ f(x,y) > T \\ 0 & if\ f(x,y) \leq T \end{cases}$$

where $f(x,y)$ represents a grey value, and T is the threshold value.

Thresholding maps agrey-valued image to a binary image. After the Thresholding operation, the image has been segmented into two segments, identified by the pixel values 0 and 1 respectively.

If we have an image which contains bright objects on a dark background, Thresholding can be used to segment the image. Since in many types of images the grey values of objects are very different from the background value, Thresholding is often a well-suited method to segment an image into objects and background.

Example of Thresholding

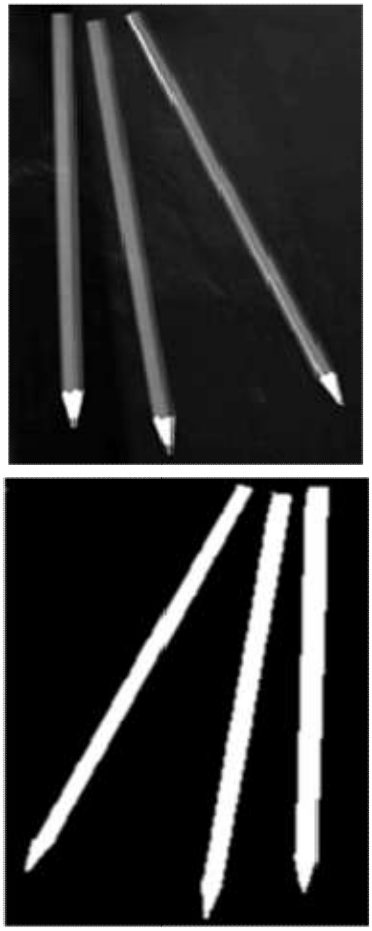


Fig 6 Example of segmentation by Thresholding. On the left, an original image with bright objects (the pencils) on a dark background. Thresholding using an appropriate threshold segments the image into objects (segment with value 1) and background (segment with value 0)

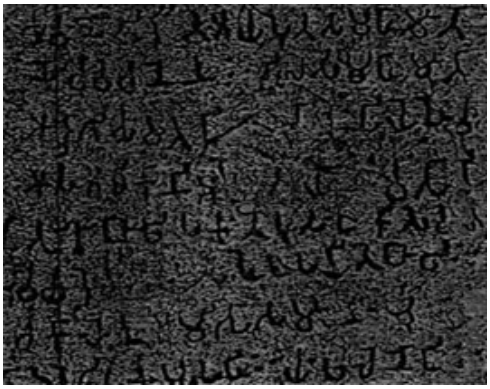
There are two types of Thresholding techniques

1. Global Thresholding
2. Local Thresholding

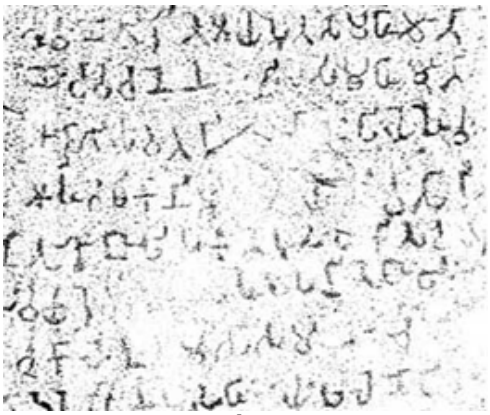
In this the image is scanned and labels are assigned. This technique is successful in highly controlled environments. This type of Thresholding is global Thresholding. It stores the intensities of the pixels in an array. The threshold is calculated by using total mean and variance. Based on this threshold value each pixel is set to either 0 or 1. i.e. background or foreground. Thus here the change of image takes place only once.

In local Thresholding the first stage is the image is divided into three sub images as foreground, background, and a sub image where it is hard to determine whether a pixel actually belongs to the foreground or the Background. Local Thresholding performed well as it generally was able to separate definite foreground (dark) pixels and definite (background pixels). The uncertain pixels were clearly defined and required further processing to determine appropriate assignment to background or foreground.

RESULTS



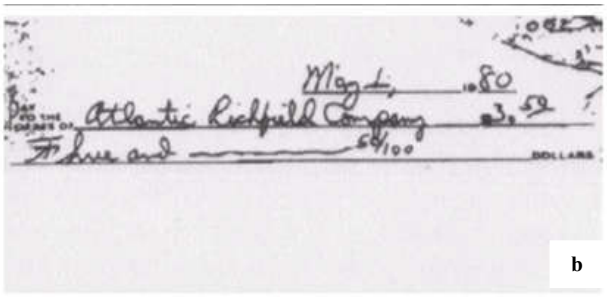
a



b

Fig a) Original Image b) image segmented by Global Thresholding

a



b

Fig a) Original Image b) image segmented by local Thresholding.

CONCLUSION

Image Segmentation plays an very important role in Computer Vision and morphological Image Processing. It is the process of separating the digital image into distinct region possessing homogeneous properties. The main objective of image segmentation is to extract various features of the image that are used for analyzing, interpretation and understanding of images. Image segmentation is applied in various applications like medical imaging, shape detection, content-based image retrieval, robot vision, etc. Several techniques have been developed for image segmentation such as pixel-based segmentation, edge based segmentation and region based segmentation. This gives better results.

We have seen several types of techniques i.e. Region based, edge deduction and Thresholding This paper summarizes various segmentation techniques. Thus segmentation is done to estimate the surfaces. Segmentation can be applied to any type of image. Comparing to other methods Thresholding is the simplest and computationally fast.

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