IMAGE SEGMENTATION TECHNIQUES

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ABSTRACT : Image segmentation plays vital role in digital image processing. The purpose of image segmentation is to divide an image into appropriate region of interest (ROI).The digital image is divided into multiple set of pixels by image segmentation. Various image segmentation algorithms have been developed. In this paper, we have compared two different images by fixed threshold/ global threshold method for different constant threshold values.

KEYWORDS- Segmentation, region of interest

Introduction

An image defined in the "real world" is considered to be a function of two real variables, for example a(x, y) with a as the amplitude (e.g. brightness) [1] of an image at real coordinate position (x, y).An image may be considered to contain sub images also called as regions-of-interest or regions. Image is a collection of objects. The amplitude of a given image will always be either real number or integer number. A quantization process converts a continuous range (say between 0 and 100%) into a discrete number of levels. A sampling process that converts an analog image a(x, y) in a 2D continuous space to a digital image a [m, n] in a 2D discrete space is called digitization. The 2D continuous image a(x, y) is divided into N rows and M columns. The intersection [1] of a row and a column is called a pixel.

Literacy Survey Image Segmentation :

Image segmentation is the process of partitioning a digital image into multiple segments (set of pixels also known as super pixels). Segmentation accuracy determines the eventual success or failure of computerized analysis procedure. It is useful for Improvement of pictorial information for human interpretation/ perception, Automatic analysis of remote sensing data from satellites to identify and measure regions of interest. Its applications include Medical imaging, Computer-guided surgery, Object detection, Pedestrian detection, Face detection, Brake light detection, objects in satellite imagery(roads, buildings, forests, etc), Agricultural imaging-crop disease detection, Recognition tasks, Fingerprint recognition, Iris recognition, Machine Vision Application etc. The images are segmented [3] on the basis of set of pixels or pixels in a region that are similar on the basis of some homogeneity criteria such as color, intensity or texture, which helps to locate and identify objects or boundaries in an image. Image segmentation divides a digital image f(x, y) into continuous, disconnect and nonempty

subsets f1,f2 ,f3 , ….,fn from these subsets higher level information can be easily extracted[3].Due to the significance of image segmentation multiple segmentation algorithms have been developed based on the image type and the nature of the problem.

Current Image Segmentation techniques

In recent years, there are various segmentation algorithms have been developed. No algorithm is suitable for all types of digital image. One algorithm that is very much practicable to one group of images that is not practicable for other group of images. The techniques that are used to find the objects of interest are usually referred to as segmentation techniques – segmenting the foreground from background [4].

Currently image segmentation approach, based on two properties of an image, is divided into two categories:

Discontinuities based

In this category, subdivision of images is carried out on the basis of abrupt changes in the intensity of grey levels of an image. Our focus is primarily based on identification of isolated points, lines and edges. This includes image segmentation algorithms like edge detection.

Similarities based

In this category, subdivision of images is carried out on the basis of similarities in intensity or grey levels of an image. Our focus here is on identification of similar points, lines and edges. This includes image segmentation algorithms like thresholding, region growing, region splitting and merging

The most commonly used techniques

1) Thresholding :

Image segmentation by using threshold method is quite simple but very powerful approach for segmenting images based on image-space region i.e. characteristics of the image [5]. This method is usually used for images having light object on darker background or vice versa.

A parameter è called the brightness threshold is chosen and applied to the image a[m,n] as follows:

If A[m,n]e"	a[m,n]=object=1
Else	a[m,n]=Background=0

In the above case light objects are on the dark background.

If A[m,n]d"	a[m,n]=object=0
Else	a[m,n]=Background=1

In the aforementioned case dark objects are on the lighter background.

Based on the selection of threshold value ,there are two types of thresholding method

i) Fixed Threshold/Global Threshold : Global (single) thresholding method is used when the intensity distribution between the objects of foreground and background are very distinct. When the difference between foreground and background objects are very distinct, a single value of threshold can simply be used to differentiate both objects apart. Thus, in this type of thresholding, the value of threshold T depends solely on the property of the pixel and the grey level value of the image. If it is known that one is dealing

with very high contrast images where the objects are very dark and the background is homogeneous and very light, then a constant threshold of 128 on a scale of 0 to 255 might be sufficiently accurate. Some most common used global thresholding methods are Otsu method, entropy based thresholding, etc[6].

ii) Histogram Derived Threshold/ Local Threshold : This method divides an image into several sub regions and then chooses various thresholds Ts for each sub region respectively. Thus, threshold depends on both f(x, y) and p(x, y). A variety of techniques have been devised to automatically choose a threshold starting from the gray-value histogram, $\{h[b] \mid b = 0, 1, \ldots, 2^B-1\}$. Some common used Local thresholding techniques are simple statistical thresholding, 2-D entropy-based thresholding histogram transformation thresholding etc[7]

2) Segmentation based on edge detection :

Edge detection is very important step in digital image processing and computer vision. In an image, edge represent object boundaries and thus help in detection and segmentation of objects in an image [5] [6]. Edge detection refers to algorithms which try to identify points in a digital image where there is an abrupt change in image brightness or there is a difference in intensities. These points are then linked together to form closed object boundaries [6]. The result of segmentation using edge detection is a binary image. There are many different ways to perform edge detection, however, two most prominent used algorithms are mentioned here:

1) Gray Histogram Technique: In this technique, segmentation depends upon separation of foreground from background by selecting a threshold value T. The difficulty arises in selecting the threshold values since gray threshold is uneven due to the presence of noise. Thus, we substitute the curves of object and the background with two conic Gaussian curves [7], whose intersection is chosen as the value of threshold T.

2) Gradient Based Method: Gradient is the first derivative for image f(x, y), when there is an abrupt change in the intensity near edge. Another noise, gradient based method [7] involves convolving gradient operators with the image. High value of gradient magnitude can be points with abrupt change between intensities of the two region. These points are called edge pixels and can be linked together to form closed boundaries. Normally sobel operator, canny operator, Laplace operator, Laplacian of Gaussian (LOG) operator etc is used as operator in gradient based method. Usually canny operator is used but it takes more time as compared to sobel operator. In practice edge detection algorithms require a balance between detecting edges accurately and reducing the level of noise. If the level of accuracy is too high, noise will create detection of numerous additional and fake edges. On the other hand, if we try to reduce the level of noise too greatly [7], we might reduce the accuracy of the edges and many of the useful edges might not be detected. Thus, edge detection algorithm is usually suitable for images that are simple and noise free [8].

Original Image

Segmented Image at Threshold value=16

Segmented image at threshold value=32

Segmented image at Threshold value=64

segmented image at threshold value=128

Image with bright foreground and dark background

OOriginal Image

Segmented Image at Threshold value=16

Segmented Image at Threshold value=32

Segmented Image at Threshold value=64

Segmented Image at Threshold value=128

Conclusion

We have seen after going through different recent years research paper no algorithm is suitable for all types of images. One Algorithm that is suitable for one set of images that is not suitable for another set of images. Howbeit, in paper we have compared two different images by Fixed threshold/ Global threshold method for different constant threshold values and shown the results for better computer vision.

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