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Image Segmentation using Morphological Operations for Automatic Region Growing

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***Abstract*: Image segmentation is a primary and crucial step in a sequence of processes intended at overall image understanding. In this paper we are focusing on noisy images. After filtering noise with guided filtering from image, we shall apply morphological function for seed placement. Following seed selection we use automatic region growing method for segmentation.**

***Keywords:* Image segmentation, Guided filtering, automatic region growing.**

I. INTRODUCTION

Image segmentation aspires to gather pixels into prominent image regions, i.e., regions equivalent to individual surfaces, items or accepted parts of objects. Segmentation is the course of action in which an image is partitioned into constituent objects or parts. It is often the primary and most imperative step in an image analysis task. The outcome of image segmentation is a set of segments that cooperatively cover the intact image, or a set of contours extract from the image. Digital images are prone to a multiplicity of types of noise. Noise is the consequence of errors in the image acquisition process that result in pixel values that do not imitate the accurate intensities of the authentic scene. There are numerous ways that noise can be introduced into an image, depending on how the image is produced. For instance, if the image is scanned from a photograph prepared on film, the film grain is a resource of noise. Noise can also be the result of damage to the film, or be introduced by the scanner itself or If the image is acquired directly in a digital layout, the method for gathering the data can establish noise. In this paper we shall remove noise with help of guided filter. We used morphological operations to create masks along with automatic region growing technique segment the filtered image. So in this method the users don't necessitate to opt for the seed point manually consequently there is no need of human intrusion [1].

II. IMAGE PRE-PROCESSING

In this first step, we take an image and add noise in that image. Noise is a factor that influences image quality, which is primarily formed in the process of image acquirement and transmission. Noise appears from diverse sources in an image. The digital image acquisition procedure converts an optical image into an incessant electrical signal that is then sampled, is prime process by means of which noise appears in digital image. We shall add Gaussian noise.

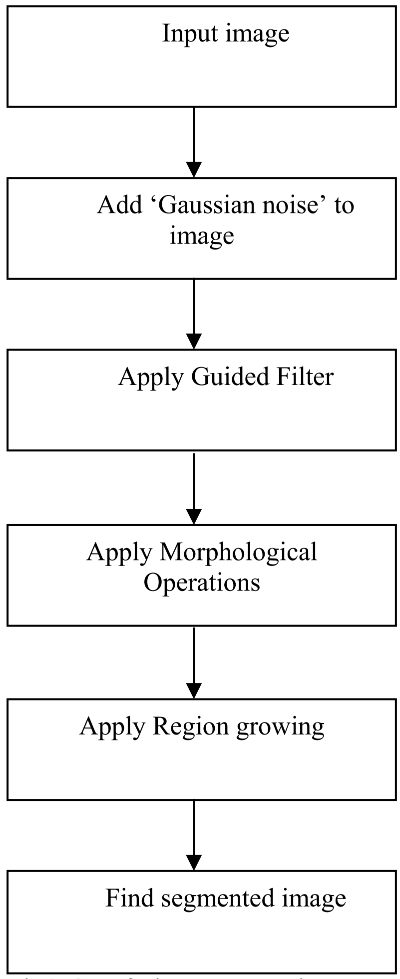

Fig 1: Steps for image segmentation

III. NOISE AND ITS TYPES

Image noise is random discrepancy of brightness or color information in images, and is frequently a phase of noise. It outcomes in errors in the image acquirement procedure that results in pixel values that do not imitate the accurate intensities of the real view.

Types of Noise

A. Gaussian noise

Gaussian noise is numerical noise that has a probability density function of the normal distribution. In supplementary, the values that the noise can acquire on are Gaussian-distributed. Gaussian noise is appropriately defined as the noise with a Gaussian amplitude distribution. Noise is modeled as preservative white Gaussian noise, wherever all the image pixels swerve from their original values subsequent the Gaussian curve. To facilitate is, for each image pixel with intensity value fij ($1 \leq i \leq m$, $1 \leq j \leq n$ for an m x n image), the equivalent pixel of the noisy image gij is given by,

$g_{i,j} = f_{i,j} + n_{i,j}$

Where, each noise value n is drawn from a zero -mean Gaussian distribution. [4]

B. Random variation impulsive noise (RVIN)

This form of noise is as well called the Gaussian noise or normal noise is erratically occurring as white intensity values.

Gaussian distribution noise can be uttered by:

$P(x) = 1/ (\sigma\sqrt{2\pi}) * e^{(x-\mu)^2} / 2\sigma^2 \quad -\infty < 0 < \infty$

P(x) is the Gaussian noise in image; μ and σ is the mean and standard deviation respectively.

C. Shot Noise

In Shot noise, there is deviation in the number of photons sensed at a certain disclosure level. It is prevailing noise in the lighter parts of an image from an image sensor is that caused by numerical quantum fluctuations.

D. Salt and Pepper Noise

Salt and Pepper noise can be caused by departed pixels, analog-to-digital converter errors, and bit errors in transmission, broken pixel elements in the camera sensors, faulty memory locations, or timing errors in the digitization process.

F. Speckle Noise

It is a rough noise that intrinsically exists in and degrades the superiority of the Active Radar and Synthetic Aperture Radar (SAR) images. It is caused by coherent giving out of backscattered signals from several scattered targets [5]. It increases the mean grey level.

G. Quantization Noise

In quantization noise there is quantizing of the pixels of a sensed image to a number of discrete levels. It has a just about uniform distributed although it can be signal independent if further noise source are abundance that grounds dithering, or if dithering is unambiguously applied.

IV. Noise Removal By Guided Filter

In second step, Gaussian noise shall be removed. This type of noise shall be removed by guided filtering. Guided filter is an unambiguous image filter, resultant from a local linear model; it generates the filtering output by taking into consideration the contented of a guidance image that can be the key in image itself or another deferent image [6]. It has a rapid and non-approximate linear-time algorithm, whose computational complexity is autonomous of the filtering kernel size. Its output is close by a linear transform of the guidance image. The filter has the edge-preserving smoothing feature like the bilateral filter, but does not undergo from the gradient setback artifacts. Besides, the guided filter has an O (N) time (number of pixels N) correct algorithm for both gray-scale and color images. The guided filter performs well in conditions of both superiority and efficiency in a range of applications, such as noise lessening, detail smoothing/enrichment, HDR detail smoothing/ enrichment, HDR compression, image mat/feathering and haze elimination.

V. Morphological Operations

Morphological Operations is a technique for the study and processing of geometrical structure, based on set hypothesis, lattice hypothesis, topology, and arbitrary functions. It is mainly frequently applied to digital images, but it can be engaged as well on graphs, surface meshes, solids, and many further spatial structures. It explores an image with a small form or template called a structuring element. The structuring element is situated at all potential locations in the image and it is compared with the subsequent region of pixels. Some operations test whether the element "fits" within the region, while others test whether it "hits" or intersect the region. [7]

Morphological Operations includes:-

A. Dilation

It is the set of all points in the image, wherever the structuring element “touches” the forefront. Consider each pixel in the input image, if the structuring element touches the forefront image; write a “1” at the starting point of the structuring element.

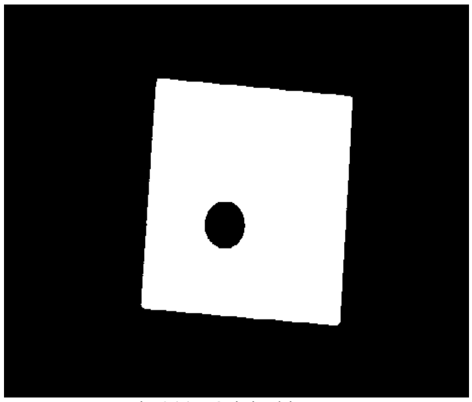

Fig 2(a): Original image

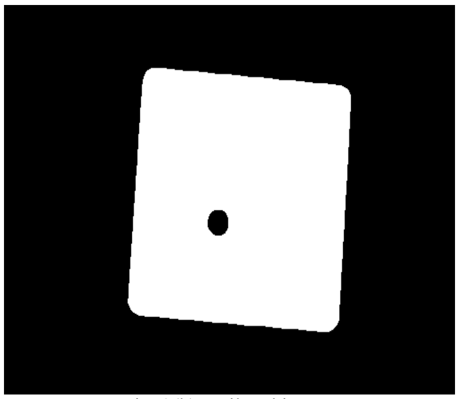

Fig. 2(b): Dilated image

B. Erosion

Erosion is the set of all points in the image, where the structuring element “fits into”. Consider each forefront pixel in the key in image, if the structuring element fits in; write a “1” at the starting point of the structuring element. Pattern matching is the simple application of erosion.

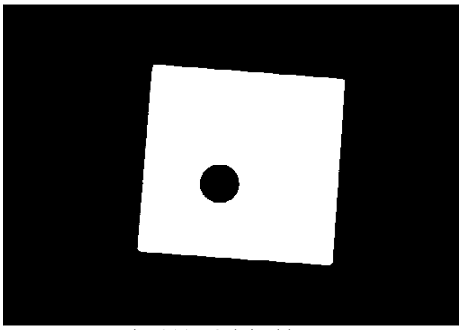

Fig. 3(a): Original image

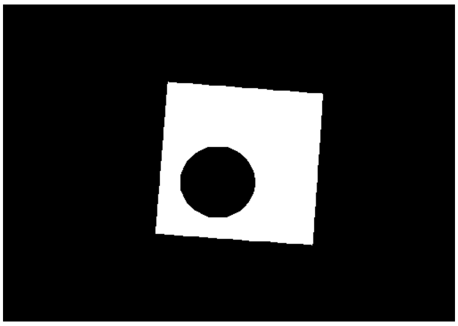

Fig. 3(b): Erosion image

C. Opening

Opening consists of an erosion followed by a dilation and is used to eradicate all pixels in regions that are too tiny to include the structuring element. Here the structuring element is often called a query, because it is inquiring the image looking for small objects to strain out of the image.

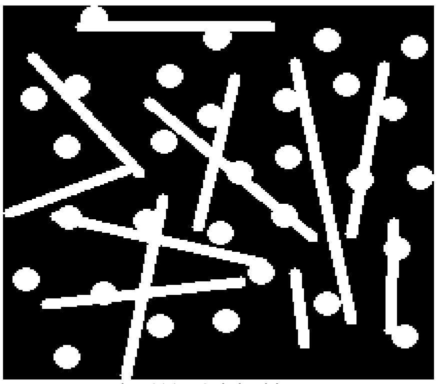

Fig. 4(a): Original image

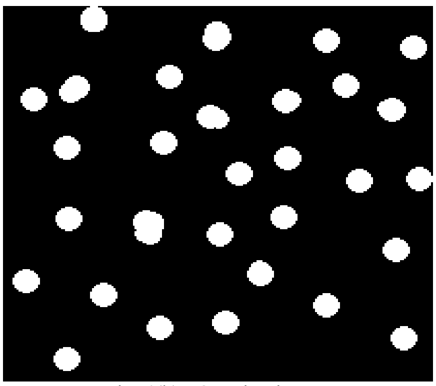

Fig. 4(b): Opening image

D. Closing

Closing comprises of a dilation followed by erosion and can be used to fill in holes and small gaps.

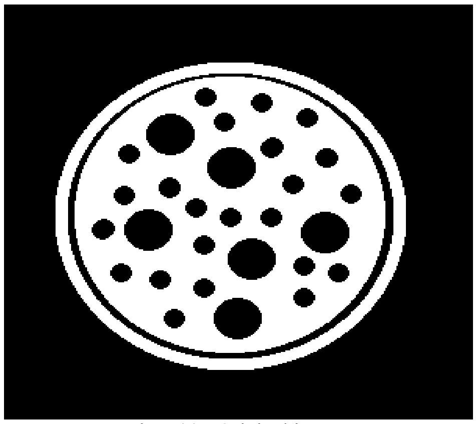

Fig. 5(a): Original image

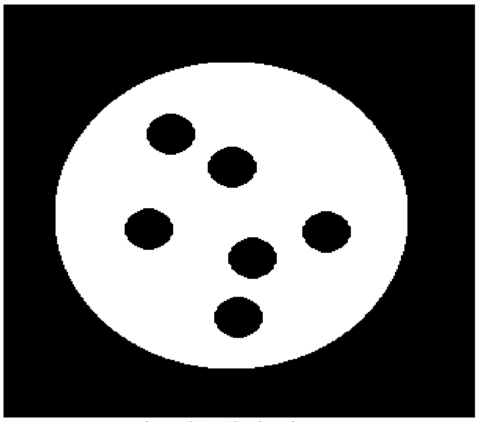

Fig. 5(b): Closing image

VI. AUTOMATIC REGION GROWING METHOD

The Automatic seeded region growing algorithm is one of the simplest region-based segmentation methods. It performs a segmentation on an image with examine the neighboring pixels of a set of points, acknowledged as seed points, and conclude whether the pixels could be classified to the cluster of seed point or not [8]. The algorithm procedure is as follows.

Step1. We start with a number of seed points which have been clustered into n clusters, called $C1$, $C2$… Cn. And the position of initial seed points is set as $p1$, $p2$… $p3$.

Step2. To compute the difference of pixel value of the initial seed point pi and its neighboring points, if the difference is smaller than the threshold (criterion) we define, the neighboring point could be classified into Ci, where $i = 1, 2, \ldots, n$.

Step3. Recomputed the boundary of Ci and set those boundary points as new seed points pi (s). In addition, the mean pixel values of Ci have to be recomputed correspondingly.

Step4. Repeat Step2 and 3 until all pixels in image have been allocated to a suitable cluster.

VII. CONCLUSION

In this paper, we propose an algorithm for noise removal and automatic segmentation. This algorithm improves the output segmented image as compare to other approaches. Our approach will help to denoising an image and by applying morphological operations we shall grow region automatically. It saves lots of human interference, and may be useful for many other approaches where seed selection is tough task. With this algorithm, we shall get better and improved results with different parameters.

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