Parameter Evaluation and Review of Region Based Image Segmentation Algorithms

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Abstract: - Image segmentation is an important image processing step, and it is used everywhere if we want to analyze what is inside the image. Image segmentation; basically provide the meaningful objects of the image. The main goal is to make image simpler and meaningful .There are various image segmentation techniques that could be used in the segmentation algorithm. Region based segmentation is one of them. Whenever we work with the image in any application, initial step is to segment the image in order to solve its complexity. The segmentation of images is the basic thing for understanding the images. It is used in the Image processing applications, Computer vision, etc. In this paper, two region based image segmentation algorithms watershed and k-nearest neighbors are used to perform image segmentation basis on regions of image and compare their performance with parameters PSNR, MSE. In Region based segmentation, we have to find homogeneous regions according to a specific criterion (intensity value, texture).

Keywords: - Image segmentation, Region Based technique, Watershed transformation, K-NN Algorithm, PSNR, MSE.

I. INTRODUCTION

Image segmentation is part of image processing and it deals with images. Image segmentation is the process of classification of an image into different groups. Image is a picture that has been created or copied and stored in electronic form. An image can be described in terms of vector and raster graphics. An image stored in raster form is sometimes called a bitmap. Images are mainly three types, binary image, and grayscale and color image.

The purpose of image segmentation is to partition an image into meaningful regions with respect to a particular application. Image segmentation, is often an essential step in image analysis, object representation, visualization, and many other image processing tasks. The segmentation is based on measurements taken from the image and might be grey level, color, texture, depth or motion. Segmentation divides an image into its constituent regions or objects. Segmentation of images is a difficult task in image processing. Segmentation allows in extracting the objects in images. Image segmentation Techniques are extensively used in similarity searches. Segmentation algorithms are based on one of two basic properties of color, gray values, or texture: discontinuity and similarity. [2] Image segmentation techniques is mainly three types i.e. region based, clustering based and edge based image segmentation. In this research paper we deal with region based segmentations in Order to perform comparisons of watershed algorithm and K-NN.

A] Discontinuities based: It means to partition an image based on abrupt changes in intensity, this includes image segmentation algorithm like edge detection.

B] Similarities based: It means to partition an image into regions that are similar to a set of predefined criterion this includes image segmentation algorithms like thresholding, region growing. [3]

II. REGION BASED IMAGE SEGMENTATION ALGORITHMS:

Here we deal with comparisons of two region based algorithms i.e. Watershed and K-NN.

A) Watershed Algorithm.
B) K-NN Algorithm.

A) WATERSHED ALGORITHM

Watershed algorithm is new segmentation approach with relatively less application in remote sensing image segmentation than other described models. However, it may be good for initial segmentation in a multi-scale resolution as it produces an over-segmentation. Over-segmentation elimination is also a problem associated with this method. Watershed algorithm produces over-segmentation because of noise or textured patterns watershed algorithm was applied with median filter to eliminate noise and preserve contours. [2]

Watershed segmentation applied to gradient of an image, rather than to the image itself. The aim of the watershed transform is to search for regions of high intensity gradients (watersheds) that divide neighbored local minima (basins) [4]. A drop of water falling on a topographic relief flows towards the "nearest" minimum. The "nearest" minimum is that minimum which lies at the end of the path of steepest descent. In terms of topography, this occurs if the point lies in the catchment basin of that minimum. An alternative approach is to imagine the landscape being immersed in a lake in which holes are pierced in the local minima is called the catchment basin. Water will be filled up at these starting local minima and at points where water coming from different basins would meet and dams will be built. When the water level reaches the highest peak in the landscape the process is stopped. As a result, the landscape is partitioned into regions or basins separated by dams, called watershed lines or simply watersheds. [5]

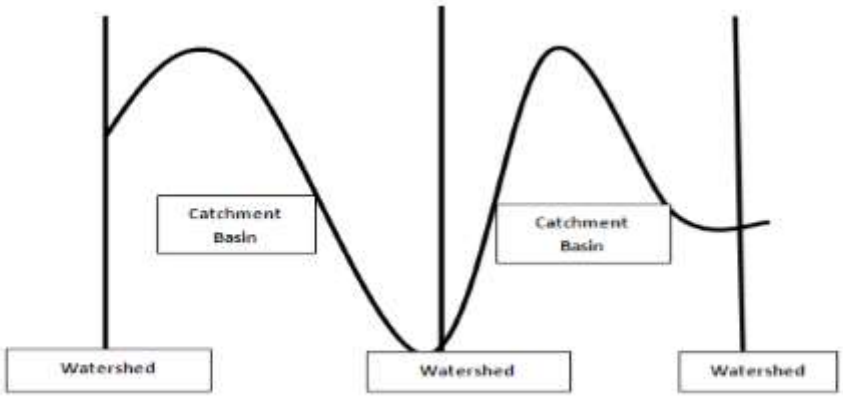


Figure 3.1 Watershed Segmentation - local minima yield catchment basins;
Local maxima define the watershed lines.

Let have minima , for some index set I. The catchment basin of a minimum mi is defined as the set of points which are topographically closer to than to any other regional minimum mi. [1]

CBmi (1)

The watershed of is the set of points which do not belong to any catchment basin:

Watershed (2)

Let be some label. The watershed transform is a mapping, such that , and.So, the watershed transform of assigns labels to the points of , such that (i) different catchment basins are uniquely labeled, and (ii) a special label W is assigned to all points of the watershed of .

B) K-NEAREST NEIGHBORS ALGORITHM

The k-nearest neighbor's algorithm (K-NN) is a non-parametric method used for classification and regression. In both cases, the input consists of the k closest training examples in the feature space. The output depends on whether K-NN is used for classification or regression: -

- In K-NN classification, the output is a class membership. An object is classified by a majority vote of its neighbors, with the object being assigned to the class most common among its k nearest neighbors (k is a positive integer, typically small). If k = 1, then the object is simply assigned to the class of that single nearest neighbor.
- In K-NN regression, the output is the property value for the object. This value is the average of the values of its k nearest neighbors.

K-NN is a type of instance-based learning, or lazy learning, where the function is only approximated locally and all computation is deferred until classification. The K-NN algorithm is among the simplest of all machine learning algorithms.

Both for classification and regression, it can be useful to assign weight to the contributions of the neighbors, so that the nearer neighbors contribute more to the average than the more distant ones. For example, a common weighting scheme consists in giving each neighbor a weight of 1/d, where d is the distance to the neighbor.

III) RESULTS AND ANALYSIS

We will discuss the experimental results of the two region based image segmentation algorithms. We will compare these algorithms on the basis of following parameters.

a) MSE (Mean Square Error): Lower is better.

b) PSNR (Peak Signal to Noise Ratio): Higher is better.

a) Mean Square Error

It is the error metrics used to compare image segmentation quality. The lower the value of MSE, the lower is the error and betters the quality of segmentation. MSE is calculated as: -

$$MSE = \sum_{M,N} \frac{[I_1(m,n) - I_2(m,n)]^2}{M*N}$$

In Eq. M, N is number of rows and columns in input images I1 and I2 respectively.

a) Peak Signal to Noise Ratio

Peak Signal to Noise Ratio measured (PSNR) is measured in decibels. It represents the measure of the peak error. The higher PSNR, the better is the quality of the reconstructed or compressed image. In order to calculate PSNR, MSE is calculated first.

PSNR= 10 log10 (R2)/ MSE

R is maximum fluctuation in input image data type. R is1 for double precision data type and 255 for 8 bit unsigned data type.

The table showing the different parameter values in case of various input images: -

S.NO.	IMAGE	ALGORITHM	PSNR	MSE
1	Tulips.jpg	Watershed	30.3280	55.9873
2	Tulips.jpg	K-NN	50.9262	0.5254
3	Jellyfish.jpg	Watershed	34.0573	25.5477
4	Jellyfish.jpg	K-NN	51.4878	0.4616

Table 1 Result and Analysis

So the bases on parameter I have seen that K-NN algorithm is best as compare to watershed. For every image 'PSNR' value is higher and 'MSE' value is smaller of' K-NN' algorithm as compared to watershed. These images are having same size that is applied to watershed and K-NN algorithms.

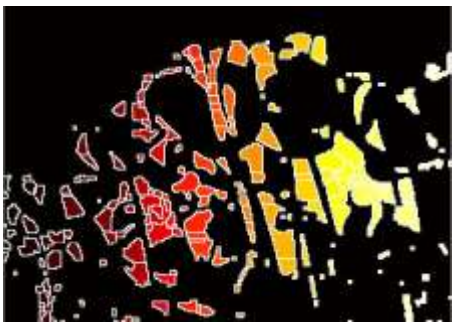
Hence K-NN algorithm is good as compare to Watershed.

SIMULATION SNAPSHOTS:

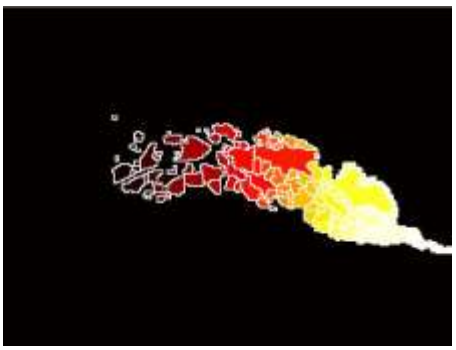
a) Watershed algorithms:-

Images **Input** **Output**

Tulips.jpg



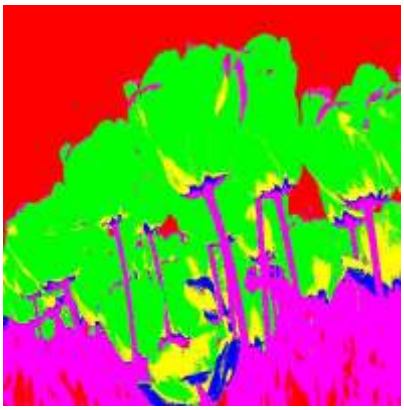
Jellyfish.jpg



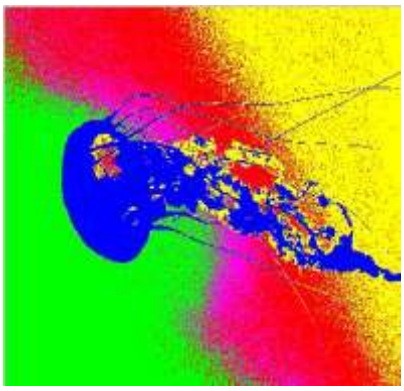
b) K-NN ALGORITHM:

Images **Input image** **Output image**

Tulips.jpg



Jellyfish.jpg



IV) CONCLUSION

Two region based algorithms for Image Segmentation are compared. The comparison is done on the basis of PSNR and MSE parameter's values. These parameters are used to examine the quality of segmented image. From the implementation of these two algorithms, it is observed that:-

1. Image quality is high when K-NN is implemented.
2. Value of PSNR is high in case of K-NN.
3. Value of MSE is low in case of K-NN.

Thus, K-NN algorithm provide good Segmentation of images as compared to Watershed Algorithm.

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