MARKER BASED WATERSHED TRANSFORMATION FOR IMAGE SEGMENTATION

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ABSTRACT

The image segmentation is one of the most challenging tasks in the field of image processing and pattern recognition. Watershed transform is a technique that always generates closed contours for every region of an image and one of the best techniques used for image segmentation but over segmentation is a major drawback of this method for which present study was undertaken to devise a new three step methodology for image segmentation using watershed transformation working firstly with pre-segmentation processing then detecting edges of image and then computing watershed transformation. As a result of applying these segmentation processes on image, better results were observed than traditional methodology. Improved marker based watershed transformation for image segmentation was done using MATLAB.


INTRODUCTION

Image segmentation is a basic step in image processing having specific role in analysis and identification of image processing. A process in which partitioning of an image into non-overlap regions is done called image segmentation [1]. In it an image is represented in symbolic form which is described as a homogenous area according to some specified properties or attributes of image. The process of segmentation is directly related to recognition of the object and its complete separation from background. So separation can only be performed if information is obtained from higher level recognition, inference and perceptual completion procedures. There are many algorithms that are used for image segmentation such as clustering, threshold, fuzzy logic, edge detection and watershed transformation. Among all of the above algorithms the most effective is Watershed segmentation which was firstly proposed by L. Vincent and P. Soilled [4]. It is one of the widely used algorithms and known as “immersion algorithm” and an efficient and effective way to carry out watershed transforms, after then Beucher also effectively used markers for watershed algorithm [5].

Over segmentation is one of the significant problems seen in watershed algorithms. This study proposes an improved marker based watershed algorithm that provides better results than the traditional algorithm and also helps to reduce the over segmentation problem.

PROPOSED MARKER BASED WATERSHED TRANSFORMATION

The scope of this study is marker based watershed transformation. In the field of topography the watershed concept is a famous tool and the main problem with the basic watershed transformation is over-segmentation which is reduced to some extent in marker controlled watershed transformation. Quantization error and noise are the main sources of this problem. “Noise” is perturbations of the pixel values and arises in the sensor or the imaging process. So, use efficient algorithm as a pre or past processing to reduce the error and noise effects [3]. Noise can be reduced using some
preprocessing techniques. The techniques are distance transformation, image reconstruction or filtering. For getting the reliable results, that is to achieve more accurate segmentation while solving the over segmentation problem on the basis of pre segmentation techniques [2].

The proposed method consist of mainly three steps: first is pre-segmentation processing that includes image enhancement and noise reducing techniques, second step is to detect edges of images and compute foreground and background markers and the last step is to compute watershed transformation of image and get the segmented image.

**Pre-Segmentation Process**

Pre-segmentation process includes some image enhancement and noise reducing steps. The quality of image is enhanced or improved so that the edges can be easily detected by edge detection operator [6]. Noise can also be eliminated to avoid the over segmentation problem and Adaptive histogram equalization is used to adjust the contrast of an image and to reduce noise apply the non local means filter.

**Adaptive Histogram Equalization**

Adaptive histogram equalization is an excellent contrast enhancement method for both natural images and medical images and other initially non visual images [7]. Mostly the images we acquired from different sources are having low contrast and one is unable to identify or read them effectively, such as industrial x-ray and medical images. So, to reduce this problem one has to improve the contrast of an image for which various algorithms have been proposed and from all of them the effective and simple algorithm is Histogram Equalization. This method has been divided into two types: Global Histogram Equalization and Local Histogram Equalization. Although Global histogram Equalization not counted for local image information hence in small regions of an image contrast losses occurs [8]. Local Histogram Equalization also known as Adaptive Histogram Equalization overcomes this shortcoming caused by Global Histogram Equalization. To obtain high contrast for all regions of an image each pixel of an image has to adapt to its neighboring region which is allowed in local histogram equalization. In it, firstly define a contextual region, a histogram of that region is calculated and then from its Cumulative Distribution Function its grey level transfer function is derived. After that the center pixel of the region is histogram equalized using this function [6].

**Non Local Means Filter**

The Non local Means has been proposed by Buades et al. [10] it is mainly used for the suppression of white Gaussian noise. Non Local Means filter estimates noise-free pixel intensity as a weighted average of all pixel intensities in the image and the weights are proportional to the similarity between the local neighborhood of the pixel being processed and local neighborhoods of surrounding pixels [9].

As compared to other image de-noising filters such as Weiner filter, Gaussian filter, anisotropic filtering, Total variation and neighborhood filter the Non Local means Filter gives the better results [10].

**Edge Detection and Marker Computation**

After pre-segmentation process, the next step is to detect edges and find out the foreground and background markers.

**Prewitt Operator**

Edge detection is an important step in image segmentation process. Edge detection finds counters of an object, boundaries between objects and the background of an image. Edge may be defined as a line that separates two homogenous
regions and edge detection helps to find out those sharp discontinuities in the image intensity. To calculate the orientation and magnitude of an edge the Prewitt operator is a suitable way. Prewitt operator is one of the best operators used to detect edges. The two components are being measured by Prewitt operator. The kernel Gx calculates vertical edge component and the kernel Gy calculates horizontal edge component. The intensity of the gradient in the current pixel is indicated by |Gx| + |Gy|[11].

Marker Computation

Marker controlled watershed transformation helps to reduce the over segmentation problem of basic watershed transformation. The images having objects with closed contours and where boundaries are represented as ridges, the marker-controlled watershed segmentation is found to be very robust and flexible method for segmentation. The markers are computed using morphological reconstruction [3]. Erosion based gray-scale reconstruction followed by dilation based gray-scale reconstruction is used to trace the foreground markers and regional maxima to clean the edges. Background markers are obtained by applying threshold operation followed by distance transform and then watershed transform on the image obtained after computing foreground markers.

![Flowchart of an Improved Marker Controlled Watershed Transformation](image)

**Figure 1: Flowchart of an Improved Marker Controlled Watershed Transformation**

Watershed Transformation Computation

Watershed transformation is a morphological tool used for image segmentation. It is based on the immersion process. It is one of the best tools used for image segmentation [4]. Application of watershed transformation on the image generates a segmented image.

**EXPERIMENTAL RESULTS**

The proposed algorithm is implemented on various test images.
CONCLUSIONS

The traditional watershed transformation approach has a problem of over segmentation. To solve this problem a new algorithm was proposed which gave good results when compared to traditional results.

REFERENCES


