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Image Segmentation using Improved Watershed Algorithm

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Abstract: In this paper Denoising and Segmentation of various images is performed using morphological filters and watershed Algotrithm.Watershed Algorithm gives complete division of the image.It has low computational complexity and it suffers from oversegmentation.Segmentation is a process which divides the image into various segments which can be used for further study.These images or the formed segments are very sensible towards noise.Now a days technology has been developed to reduce the affect of the noise but still during the process of image accusation noise comes in the image either due to environmental error or instrumental error.So whatever the results appear are not upto the mark and are not acceptable.That is why denoising is necessary to reduce the affect of noise on the image results.In this paper for denoising we have studied various morphological filters and have used median filters to improve the results of watershed Segmentation.The Proposed Algorithm is applied on various images of different fields.Then these results are compared and evaluated with the original algorithm's results on the basis of PSNR,MSE,RMSE and the time consumed to obtain the results.

KeyWords:Watershed ,Segmentation,Denoising,Filters.

INTRODUCTION:

Segmentation subdivides the image into its constituent regions or objects. The main objective of segmentation is to find certain objects of interest which may be depicted in the image.Segmentation of nontrivial image is one of the most difficult task in image processing.Segmentation accuracy determines the eventual successs or failure of the analysis process.For this reason considerable care should be taken care about the accuracy of the results.As these images are sensible towards the noise. That means it contain noisy signals, results of the whole operation are unpredictable.Noise is a random variation in color,brightness pixel value which is either due to environmental factor or technology limititation.It is a unwanted affect So before performing the segmentation on images,it is necessary to remove noise from it.Although various spatial and frequency domain filtering techniques exists, in this paper median filters are used. Filters along with the Watershed Segmentation yield good Results.

NOISE AND DENOISING OF IMAGES:

Noise is any undesirable signal. Noise is everywhere and thus we have to learn to live with it. Noise gets introduced into the data via any electrical system used for storage, transmission and processing. In addition, nature will always plays a "noisy" trick or two with the data under observation.When encountering an image corrupted with noise we want to improve its appearance for a specific application. The techniques applied are application-oriented. Also the different procedures are related to the types of noise introduced to the image. Some examples of noise are: Gaussian or White, Rayleigh, Shot or Impulse, Salt and pepper, periodic, sinusoidal or coherent, uncorrelated, and granular.So the removal of noise up to some extent is called denoising of images or data for particular application.There are various denoising models available but in our project we have used simple and most common denoising model called median filter. **Median filter** is a nonlinear spatial filter based on order-statistics theory. It replaces the value of a pixel by the median of the gray levels in the neighbourhood of that pixel. Let S_{xy} represent an m*n subimage of the input noisy image, g . It is centered at coordinates (x,y) . f(x,y) represents the filter response at those coordinates. Then the 2-dimensional median filter is given by the expression:

$f(x ,y) =\text{median}\{g(s,t)\}$ [where (s,t) belongs to $S_{xy]}$ [11,17]

Median filter is used to reduce noise in an image[9,11]. It is similar to the mean filter. In a median filter, a window slides along the image, and the median intensity value of the pixels within the window becomes the output intensity value of the pixel being processed. Median filter preserves edges in an image while reducing noise.

WATERSHED SEGMENTATION:

Watershed algorithm is a powerful mathematical morphological tool for the image segmentation.It is more popular in the fields like biomedical, medical image segmentation and computer vision. It is based on the geography. Image is taken as geological landscape; the watershed lines determine boundaries which separate image regions. The watershed transform computes catchment basins and ridgelines, where catchment basins are correspond to image regions and ridgelines relating region boundaries.

We can do the watershed segmentation on image by using the MATLAB functions that are inbuilt in it.In the proposed algorithm watershed algorithm plays an important role.As in this paper for better results we have used two kind of images one from the field of medical and other from the nature.In the proposed algorithm images are first denoised by using the median filters in MATLAB then they

are segmented and the results are compared by using certain parameters Those parameters are:

PSNR:

Peak Signal Noise Ratio: PSNR is the ratio between the maximum possible power of a signal and the power of corrupting noise that affects the fidelity of its representation. PSNR is usually expressed in terms of the logarithmic decibel scale. PSNR is an approximation to human perception of reconstruction quality. A higher PSNR generally indicates that the reconstruction is of higher quality. [4,5]. PSNR can be defined as:

$$PSNR = 10 * log_{10}\left(\frac{255^2 * M * N}{\sum\sum(x(i,j)-y(i,j))^2}\right)$$

Value of PSNR should be high for an efficient filter.

MSE,RMSE:

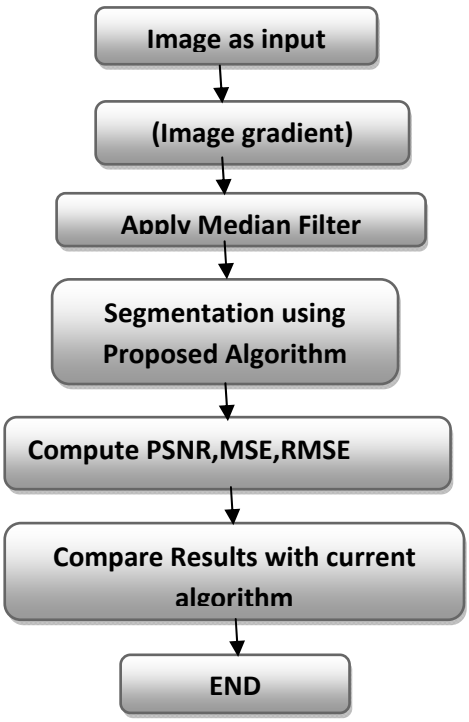
Mean Square Error, Root mean square error: It considers the quantity of the removed noise. The mean square error (MSE) [4,5]is defined as:

$$MSE = 1MN\Sigma\Sigma(f(m,n)-f'(m,n))^2$$

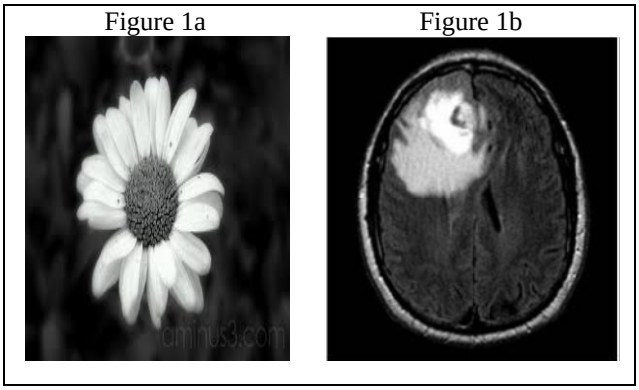
RMSE=Sqrt(MSE)

Value of RMSE should be low for an efficient filter.

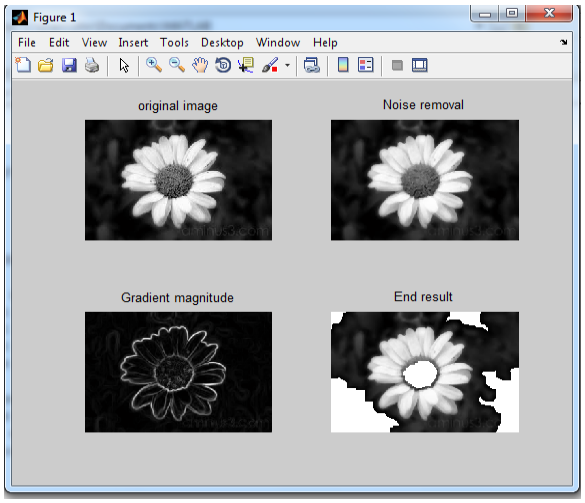
Thus we can show the difference between the results of current algorithm and proposed algorithm. Following shows the complete flowchart of proposed algorithm.



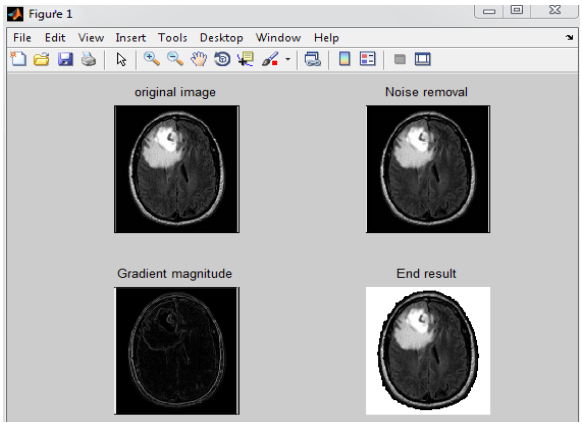
On the basis of above given flowchart we apply the whole process on the following images.



The experimental results of the above given proposed algorithm in the image form are shown below.



Result Image 1a



Result Image 1b

Here in above given results we have used MATLAB instructions and inbuilt tools.Above given four images are the results of four different steps of the proposed algorithm.But the actual difference in the results can only be known by the comparison parameters which is shown in the form of the table.

Images	PSNR	
	Current algo	Proposed algo
Image1a	17.18db	18.14 db
Image1b	22.39 db	28.46 db

Images	MSE	
	Current algo	Proposed algo
Image1a	1.2154e-004	0.0050
Image1b	0.0191	0.0181

Images	RMSE	
	Current algo	Proposed algo
Image1a	0.0717	0.0110
Image1b	0.1384	0.1347

CONCLUSIONS AND DISCUSSIONS:

The proposed algorithm is totally based on image and its features and intensity.As watershed transform is well known and most used one so work can be done on this.Uptill now I have done work by converting image to grey scale.In future we can try it on colored images.In segmentation some times the value of PSNR varies on same image on repeated operations so we can also work on that to make it stable.Sometimes it happens that due oversegmentation value of comparison parameters varies so we can also work on that to stabilize it.

As noise removal was the prominent part of this paper and I have used median filter for this which gives fabulous results but it can be made better.

Main objective of this dissertation is to enhance the performance of watershed algorithm on the basis of comparison parameters which can be seen in above given tables.More parameters can be added to make it better.

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