Improving Segmentation by Denoising Brain MRI Images through Interpolation Median Filter in ADTVFCM

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***Abstract*- In medical science image segmentation plays a very important role. Medical images need very careful analyses. Detection of minor problem in any body part is sometimes a very difficult task. So to make medical diagnosis to be easy task image segmentation is very helpful as it segment the image into number of parts and the required parts are taken for the study. Brain images are very difficult to analyse because of they are grey scale images i.e there is very small intensity change between pixels of these images. Proposed method is to improve the segmentation results by removing noise using interpolation median filter (IMF) which removes the noise by retaining image details and then performing segmentation using ADTVFCM which provides 0.8653 segmentation accuracy with 39% of noise level but by adding IMF to this segmentation method is expected to give more accuracy.**

***Keywords*- Image segmentation, Interpolation median filter, ADTVFCM**

I. INTRODUCTION

Image segmentation is the process which divides the image into different regions or parts. In this input is given as an image but the output comes out to be different parts of the image important for study. This process is stopped when the parts of the image are detected required for the study. Image segmentation is mainly used to locate objects in images. Each pixel of the one part or region of an image is similar with respect to some characteristics like color, brightness etc. but adjacent regions are different with respect to the same characteristics. Thus we can say different regions are differentiated on the basis of these characteristics thus segmentation is carried out. Brain Image Segmentation In medical science detecting disease in brain is a difficult task. Thus segmentation proves to be very beneficial in this case. Medical images are of various types like Magnetic resonance images (MRI), X-ray images, Ultrasound images etc. Brain is a very complex structure thus the diagnosis of problems in brain need an accurate segmentation of brain tissues.

Brain MRI images are gray scale images. These do not have any colored part. Pixels of these images represent the brightness of the image. It is having 0-255 brightness values where 0 represents the black pixel and 1 represent the white pixel and all other pixels from 1-254 are different gray forms. It is very difficult to find out the edges or boundaries between different regions of gray scale images because of very small intensity variation among pixels in these images. Thus for this purpose an efficient segmentation algorithm is required.

Also medical images include unknown noise which is very necessary to detect and remove for the segmentation accuracy. The method of removing noise from the images and obtaining original image back is Denoising. There are various methods to denoise the image. Thus for different kind of images and type of noise present in an image different Denoising method is used. Different type of noise includes Salt and Pepper Noise, Speckle noise, Gaussian noise etc. Different techniques are there to denoise the image. Various filters are available for denoising purpose which includes Standard filter, Weighted median, Minimum-Maximum exclusive mean filter, Mean filter, Median filter. The drawback of these filters was that they were unable to denoise the images having very high amount of noise or we can say very large variation in intensity values. This drawback is eliminated with one new approach i.e. Interpolation median filter which is the combination of mean and median filter. It is having features of both mean and median filter which helps in retaining image details by suppressing noise.

II. INTERPOLATE MEDIAN FILTER

The Interpolate Median filter replaces the pixel value with the interpolation of neighbouring pixel values rather than replacing the pixel value with the mean or median of those values. The interpolation value is calculated by sorting all pixel values in numerical order and stored in an array and then replacing the pixel under consideration with that value. To calculate the interpolation value first we calculate the mid value of that array and after that following formulas are used to calculate the interpolate value.

$$k=a[l]+a[h]/2$$

$$m=l+(h-l)*((k-a[l])/(a[h]-a[l]))$$

k- mid value of array
a[l]- lowest value of array
a[h]- highest value of array

m- mid-point of array and value at that mid-point gives the interpolated value.

The advantage of this filter is that it creates new pixel values for some pixels also retain the pixel for some other pixels as required.

III. ADTVFCM

Medical images always contain unknown noise which is necessary to remove from the image because it may result in some error in results of segmentation. Earlier FCM and other methods were proposed for segmentation of brain images but these are sensitive to noise. Thus cannot be applied. To overcome this problem ADTVFCM method was proposed. It reduces the noise from image without removing significant parts of the image thus the results obtained with better segmentation accuracy. It gives segmentation accuracy of 0.88 and 0.86 at noise level of 31% and 39 % [1].

IV. Proposed Algorithm

The Proposed method denoises the images with the IMF and the segmentation will be done using ADTVFCM to produce better segmentation accuracy when image is having high density of noise. It is supposed to give segmentation accuracy as shown in Table 1. There will be slight improvement in segmentation results when we use the given filter for denoising and then go for segmentation.

A. Image denoising

For image denoising here we use Interpolate median filter. Initially image is pre-processed i.e. its brightness is made correct. Then that image will be subjected to IMF for denoising. After denoising the resultant image produced will be free from noise.

B. Image segmentation

The denoised image produced in above step will be given to segmentation method i.e. ADTVFCM for the segmentation of the image. It follows the steps shown in Fig 1. First of all original image will be there which will be pre-processed and then Denoising will be done to remove the unknown noise from the image. After Denoising image will be noise free on which segmentation will be performed using anisotropic diffusion total variation FCM method (ADTVFCM) and the segments are obtained. Then the segmentation accuracy of these segments will be compared with the previous segmentation results of ADTVFCM algorithm to show a little improvement in segmentation.

TABLE I
SEGMENTATION ACCURACY

Algorithm	**Noise level**		
	27%	**31%**	**39%**
ADTVFCM	0.90	0.88	0.86
IMF+ADTVFCM(Proposed)	0.91	0.89	0.88

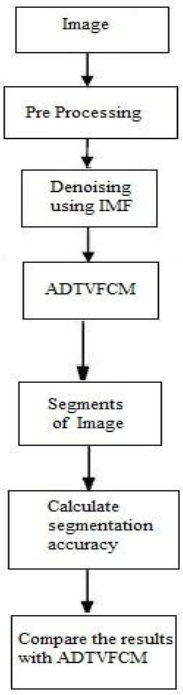

Fig 1. Steps to be followed for proposed method

V. Conclusion

In this paper we have proposed a method which combines interpolate median filter (IMF) with anisotropic diffusion total variation FCM (ADTVFCM) to improve the segmentation accuracy for brain MRI images as it is necessary for medical images to be noise free for correct detection of brain disorder or injury in brain so that right treatment can be planned. Thus this proposed method is supposed to yield better segmentation results as compare to previous one.

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