STUDY OF VARIOUS REGION OF INTEREST: WITH REFERENCE TO MEDICAL IMAGE

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Abstract: ***Classification, in general, refers to clustering or grouping data into similar sets. This information is helpful in the study for any signal or data processing system. Image classification is alike to general data classification, but in different fields of appliance it can vary in different way. A human analyst attempt to classify the various textures in an image uses the elements of visual understanding to categorize homogeneous groups of pixels that represent various features for the classes of significance. Image classification and segmentation refers to discover and grouping areas in an image that bear some resemblance to each other. This can be used to separate definite areas of interest from an image or segment them with similar colors to differentiate such areas within the image. Applications for such segmentation are establish, particularly in medical image such as blood and MRI image segmentation and its various techniques are implemented here.***

Index Terms – Clustering, Otsu, FCM, Blood image, MRI image, Segmentation.

I. INTRODUCTION

In Medical Image analysis, Image Segmentation becomes vital process for its proper detection and diagnosis of diseases. Accurate segmentation of medical image like White Blood Cell (WBC) detection from blood image and tumor detection from MRI (Magnetic Resonance Imaging) are the most extensively used methods in the field of image processing. MRI is a scanning device that uses magnetic fields and computers to capture images on film. Similarly, by counting the differential value of WBC, we can get the proper information regarding the disease diagnosis. Manual process of counting is a very time consuming task as well as having less precision, now-a-days it is not at all acceptable for proper and accurate diagnosis according to modern medical science. Hence, an automatic counting process is essential to get high precision results that lead to proper treatment. Segmentation of the blood cell image or tumor segmentation is also very useful for classifying purpose. Therefore, an automatic and efficient system is essential. Segmentation or separate the region of interest from particular image can be achieved using various image processing techniques like Thresholding Method, Edge Based Segmentation Method, and Region Based Segmentation Method etc. Here two existing classical as well as fuzzy based clustering techniques have been considered. The aim of the work is to compare the performance of the three classical techniques used for classification with reference of two different types of medical images.

II. BACKGROUND

Blood performs major functions as it circulates through the body. It transports oxygen from the lungs to other body tissues and carries away carbon dioxide. Blood cell primarily consists of three different cells namely RBC, WBC and PLATELET as shown in Fig.1 (a). If the RBC count is low than it is called anemia; means the body may not be getting the oxygen it needs. If the count is too high than that condition is called polycythemia, there is a chance that the red blood cells can clump together and tiny blood vessels are blocked.

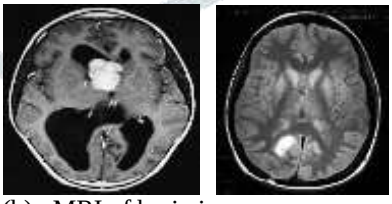

Fig. 1. (a) Blood cell and its composition (b) MRI of brain images.

This also makes it hard for RBC to carry oxygen. Compared to RBC, WBC means White blood cells (also called leukocytes) which are lesser in numbers, with a ratio of about one white blood cell to every six hundred to seven hundred red blood cells [2]. White blood cells clinically provide more information than red blood cells and helps in detection of many blood disorders. Thus, accurate segmentation of these cells is very much essential. White blood cell count is most useful to determine the presence of an infection in the human body. In this research work considered only the nucleus of WBC from the various blood images. And we have also considered the MRI brain image for segmentation purpose. It is useful to get high accuracy results on segmentation that would be helpful for proper diagnosis. Figure 1(b) shown MRI brain images. In this proposed work of the research, a solution for image segmentation like tumor segmentation is also considered for detection of the desired area from a particular image.

III. LITERATURE SURVEY AND IMAGE SEGMENTATION

In a specified image, it provides a label to each pixel, such that pixel with identical label contribute to common visual characteristics. It makes an image processing simpler to analysis. Image segmentation is used to trace the objects and boundaries in improved images. The segmentation step is very important because the correctness of the subsequent feature extraction or we can say that the classification depends on the proper segmentation of white blood cells. It is also a difficult task due to the complex nature of the cells and uncertainty in the microscopic image. Therefore, this is the most vital problem in many literatures and development of cell segmentation that has been the

frequent attempt in many research works. Many researchers have given number of diverse techniques for image segmentation such as threshold-based, region-based edge-based or clustering methods such as, fuzzy-C mean clustering and K-mean clustering etc.

Liao presents a perfect segmentation process for white blood cells. A simple thresholding approach is applied to provide an initial label to pixels in the blood cell images. This algorithm is based on proper information about blood images. Then the labels are adjusted with a shape detection method based on large regional context information that generates significant results. This algorithm is only suitable if the shape of each white blood cell boundary is close to a circle [3].

Cseke also used an automatic thresholding method (1979). This algorithm is also based on thresholding techniques but thresholding technique cannot always provide significant results because no spatial information is used through the selection of the segmentation threshold value . So they are often combined with mathematical morphological operations [4].

L. Putzu and C. D. Ruberto present a segmentation method for white blood cells identification and counting based on thresholding technique [5]. In this scheme, first the background of the image is identified, secondly identifies the Leukocytes then removed the background and select the Nucleus and Cytoplasm are finally produce the segmented White Blood Cells (WBC).

In this paper, three well established segmentation techniques have been considered and simulated using MATLAB. Implementations of three techniques are used for color blood image and two methods are considered for MRI gray level image. The results are compared and presented in section V.

The three methods are:

- Otsu's thresholding method
- YC_bC_r conversion method
- Fuzzy clustering method

3.1 Otsu's thresholding method:

The Otsu's thresholding method is used for image segmentation. This segmentation is done here with the help of image thresholding, or the reduction of a gray level image to a binary image. Thresholding can perform the task image segmentation when object and background pixels can be differentiated by their gray level values (from bi-model histogram). We have to find the threshold value and that can be calculated from total mean and variance of within-class and between-class respectively.

3.2 YC_bC_r conversion method:

The YC_bC_r method is widely used for digital video. Here component (C) stored all the chrominance information and similarly (Y) store luminance information. The chrominance is consists of two color-difference components (C_b and C_r). Here C_b refers to the difference between a reference value and the blue component. And C_r represents the difference between a reference value and the red component. YC_bC_r conversion is used to segment the RGB image into Y, C_b and Cr components with the help of standard conversion matrix.

3.3 Fuzzy clustering method:

Fuzzy C-Mean (FCM) comes under the unsupervised clustering algorithm. It has been applied to broad range of problems involving feature clustering, analysis and classifier design. According to Fuzzy C means algorithm the same data may be belong to more than one cluster. For this reason this method is widely used in pattern recognition [7].The clusters are formed according to the distance between data points and cluster centers are formed for each cluster. Initially the center of the cluster is most likely incorrect. Next, FCM assigns every data point a membership grade for each cluster. By iteratively updating the cluster centers and the membership grades for each data point, FCM iteratively moves towards the center of the right location within a data set.

IV. STEPS INVOLVE FOR THIS WORK

4.1 Details of different steps involve:

In step one; Image Pre-processing has been done for both Digital images like Blood and MRI image that may be collected in Bitmap or JPEG format from different sources. Image pre-processing makes a sample image more appropriate for a particular purpose.

It mainly involves improvement or enhancement of image, which includes noise removal using various filters, edge highlighting , sharpening, de-blurring , brightening , change in image contrast, masking, cropping or re-sizing etc. The pre-processing step removes the unwanted parts and then enhances the image, corrects the image skew and removes noise from the image. Here we have taken three types of blood images and five different kinds of MRI images as input for this experimental purpose.

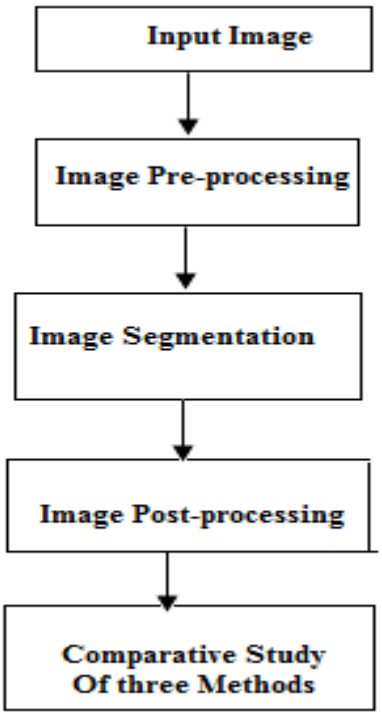

Figure 2: Steps of work flow

In step two, Image Segmentation is a process of image partitioning into multiple segments or regions or structures of interest, so that the contents of each region have similar kind of characteristics or extract the information for our analysis purpose is the primary aim of segmentation.

Here Otsu's thresholding method, YC_bCr conversion method, and FCM algorithms are used to segment the medical images. All of those algorithms are used to extracting and representing information from the image to group of pixels together with region of similarity. It makes an image processing tasks easier for analysis. Image segmentation results in a set of regions that together cover the whole image or set of contours extracted from the images. Appling Otsu's thresholding method we can get quite satisfactory result for blood images. The segmented results can be shown below in the Fig. 3. Fuzzy C Means clustering algorithm is also have been used for the segmentation purpose. From the experimental results it can be observed that Fuzzy C Means clustering technique works efficiently with all the sample blood smear images and identify the white blood cells accurately; Which is a satisfactory result with compare to the other classical techniques such as Otsu's thresholding method and YC_bC_r conversion method. The segmented result of FCM technique is shown below in the Fig. 4.

Similarly, FCM and Otsu's thresholding algorithm are also applied for segmentation of MRI image. Here it has been observed that FCM method shown better result and efficiently separate the region of interest; as brain tumor has been separated from whole MRI image and segmentation is done more accurately. Implementation of those techniques has been displayed in the fig 5.

In step three, Image Post-processing comes after image segmentation. Post-processing refers to the betterment of segmented image by applying morphological operation like Erosion and Dilation on segmented image. Dilation is a transformation that produces an image that is the identical shape as the original, but of a dissimilar size [8]. Erosion reduces the peaks and enlarges the width of minimum regions, so it can remove positive noise but affect on negative impulsive noise.

Step four or in the last stage, a comparative result of three methods for white blood cells (WBC) from blood smear images can be observed. The output images of three techniques are shown in the Fig.3 and Fig. 4. But it seems that these techniques are not working well with all types of Blood smear image.

V. RESULT AND DISCUSSION

For the experimental purpose, three different types of blood smear images and five MRI brain image have been considered with different size and shape of the cells. The experimental results are shown below in the Fig. 3, Fig. 4 and Fig 5.

To compare the result of three techniques Fuzzy Clustering technique, Otsu's method and YC_bC_r conversion algorithm, the parameter of Peak Signal to Noise Ratio (PSNR) is being used. PSNR is an approximation to human perception of reconstruction quality. A higher PSNR generally indicates that the reconstruction is of higher quality. Table 5.1 and Table 5.2 displayed PSNR value of various images. Here we considered segmented image with reference to input image for calculate the PSNR value; we can say that fuzzy clustering method gives the better segmentation result in this medical image segmentation process. But time required for execution is very less in Otsu's thresholding method compared to FCM method.

Table 5.1: Implementation of FCM, Otsu and YC_bC_r for blood images

Image	Method	No. of iteration	Execution time (sec.)	PNSR
Image '**a**'	FCM Otsu YC_bC_r	32 NA NA	10.95 0.11 0.20	9.69 8.89 8.64
Image '**b**'	FCM Otsu YC_bC_r	78 NA NA	2.23 0.08 0.10	12.00 7.65 6.23
Image '**c**'	FCM Otsu YC_bC_r	98 NA NA	6.78 0.12 0.20	10.15 9.15 4.02

Table 5.2: Implementation of FCM and Otsu for MRI brain images

Image	Method	No. of iteration	Execution time (sec.)	PNSR
Image '**1**'	FCM Otsu	22 NA	1.98 0.8	13.00 05.65
Image '**2**'	FCM Otsu	65 NA	7.20 0.22	12.58 07.48
Image '**3**'	FCM Otsu	26 NA	3.72 0.23	14.17 14.04
Image '**4**'	FCM Otsu	38 NA	8.12 0.45	15.39 11.35
Image '**5**'	FCM Otsu	51 NA	7.53 0.22	17.52 07.71

VI. CONCLUSION

It has been found that among these three techniques, fuzzy clustering gives more desirable output for obtaining better region of interest. In future it can be modified further so that the performance of the segmentation can be improved more. Here, we have also checked for Structural Similarity Index (SSIM) for measuring image quality for those images. The average value of structural similarity index is found 0.48 approximately.

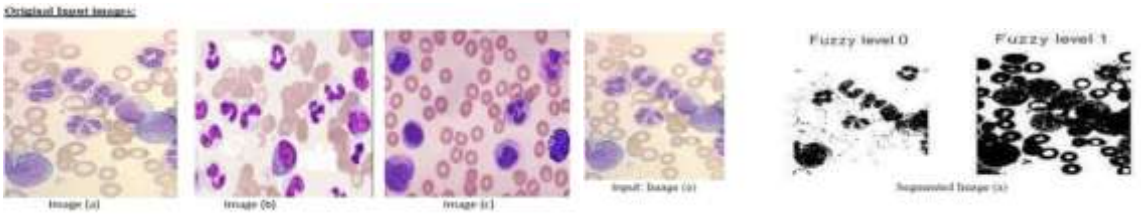

Fig. 3. Images of classical methods.

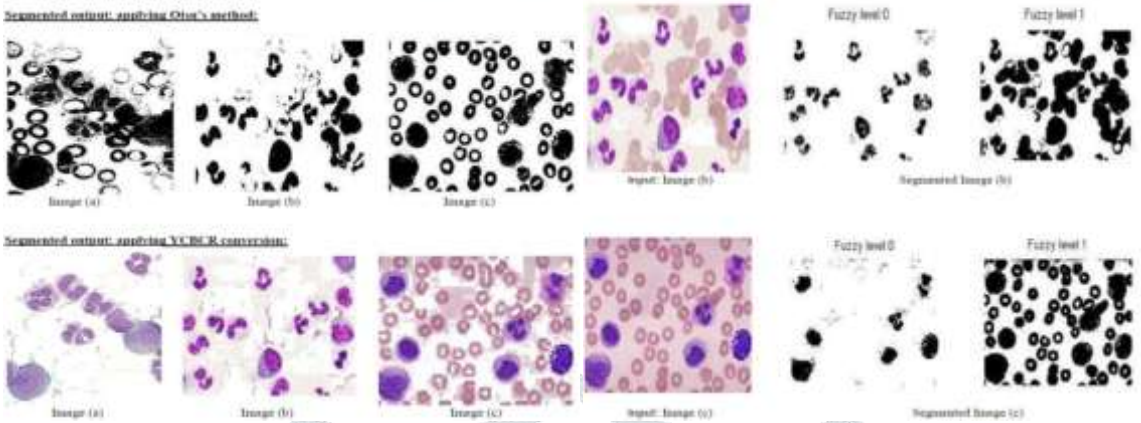

Fig. 4. Images of fuzzy clustering method

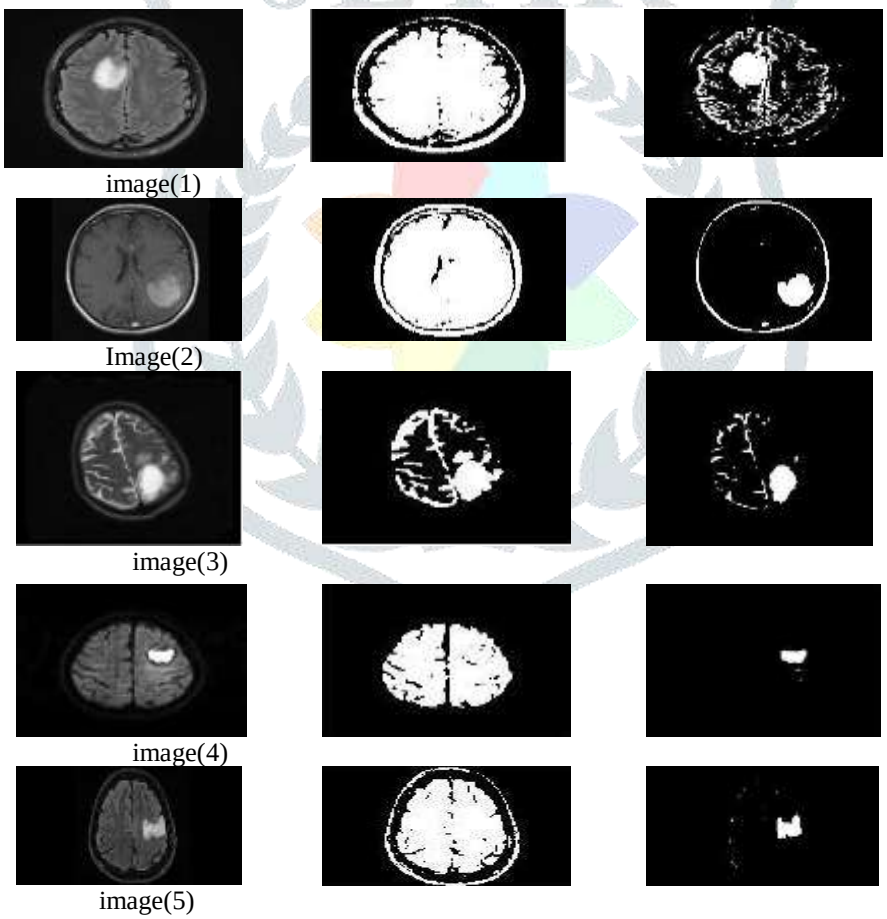

Figure: 5(a) Input as five different MRI brain image (b) Segmented output: with Otsu's method (c)Segmented output: with FCM method.

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