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Brain Tumor Identification using Bilateral Filtering and Adaptive K-Means Clustering

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ABSTRACT: Brain tumor is an abnormal growth of cells within the brain or inside the skull. In biomedical image process tumor is one of the emerging and challenging subject of research. There are so many problems are there in this aspects especially accurate detection is very challenging, when the tumor changes remain varying , irregular and very difficult to assess by clinical examination. In this paper we have approached a method of brain tumor identification using bilateral filtering and adaptive k-means clustering. Firstly we pre-process the input image fallowed by noise removal by Bilateral filter and for segmentation will use adaptive k-means clustering, as a result will get region of interest, based on region of interest tumor part is detected.

KEYWORDS: K-means clustering, bilateral filtering.

I. INTRODUCTION

The past decade had witnessed a rapid and multi faced increase in the applications of image processing. There are plenty of researches are done on medical imaging system, in this field brain disease extraction in Magnetic Resource Imaging (MRI) is a standard process. In medical imaging, many image analysis applications developed for medical diagnosis involves segmentation of tissues and structures. In today's digital era, capturing, storing and analysis of medical image had been digitized. Detailed interpretation of medical image is a challenge due to the constraint of time and accuracy. The challenge gets more demanding especially in regions with abnormal color and shape which needs to be identified and interpreted by radiologists for future studies. The key task in designing such image processing and computer vision applications is the accurate segmentation of medical images. Image segmentation is the process of partitioning different regions of the image based on different criteria. Surgical planning, post-surgical assessment, abnormality detection, and many other medical applications require medical image segmentation. The main challenges in medical image segmentation are unknown and irregular noise, inhomogenity, poor contrast and weak boundaries. MRI and other medical images contain complicated anatomical structures that require precise and most accurate segmentation for clinical diagnosis. The detection of brain disease is a very challenging task, in which special care is taken for image segmentation. A particular part of body is scanned in the discussed applications of the image analysis and techniques such as MRI, CT scan, X rays. MRI technique helps in collecting the best information about the human soft tissue anatomy. We are adopting Histogram equalization technique for image enhancement for better picture quality. K-means clustering is using for image segmentation which is used to extract various features of the image. Image segmentation is a technique of portioning of an image into groups of pixels which are homogenous with respect to some criterion. Different groups must not interact with each other, and adjunct groups must be heterogeneous. Segmentation algorithms are area oriented instead of pixel oriented. The result of segmentation is the splitting up of the image into connected areas. In this paper we have approached a method of brain tumor identification using bilateral filtering and k-means clustering. Firstly we pre-process the input image fallowed by noise removal by Bilateral filter and for segmentation will use k-means clustering, as a result will get region of interest, based on region of interest tumor part is detected.

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II. Related Work

Hakeem Aejaz Aslam Et al. [1] has proposed A New Approach to Image Segmentation for Brain Tumor detection using Pillar K-means Algorithm. In this they explained the approach for image segmentation by comparing with K-means clustering algorithm and Gaussian mixture model and the participation of RGB, HSV, HSL and CIELAB color spaces. Experimental results clarify the effectiveness of our approach to improve the segmentation quality and accuracy aspects of computing time. A.R Kavita Et al. [2] has proposed an effective modified region growing technique for detection of brain tumour. They modified region include comparative for modified region growing using both the Feed Forward Neural Network (FFNN) and Radial Basis Function (RBF) neural network. The MRI image dataset taken from the publicly available sources contains 40 brain MRI images in which 20 brain images with tumour and the other 20 brain images without tumour. Abidin Altıntaşet Et.al [3] Extracorporeal Shock Wave Lithotrispy(ESWL) is a procedure based on sound waves to crash kidney stones on the focus. The sound waves are sent to the body of patient when the kidney stone is not even on the focus. V. Grau Et.al [4] has proposed a system on improved watershed transform for medical image segmentation using prior information. In this they have considered watershed transform to detect the medical image and for segmentation, there will be a less efficiency in the proposed system so they enhanced the technique which they used. J.Mehena Et al. [5] has proposed a model on brain tumor segmentation and extraction of MR images based on improved watershed transform. In this they have done improvement to the watershed transform in this paper for the extraction of brain tumor based on segmentation and morphological operator. The tumor may be benign, pre-malignant or malignant and it needs medical support for further classification.

III. Proposed System

Figure 1 represents the proposed architecture. Initially will consider patient brain scanned imaged as input image, these images is then pre-processed into gray scale conversion and will resize the image according to our input. Next, Histogram equalization technique is used for image enhancement, after enhancement done we have to remove unwanted distractions like noise in the enhanced image will apply Bilateral filtering technique, then the noise free image is subjected to segmentation by applying K-means clustering method, in order to find out the region of interest in an segmented image will make use of segmentation done on the image and segments which contain diseases part is used to detect the tumor part in the image by using morphological operations on the basis of location, area, width and height according to all these factors the size of the tumor will analyzed.

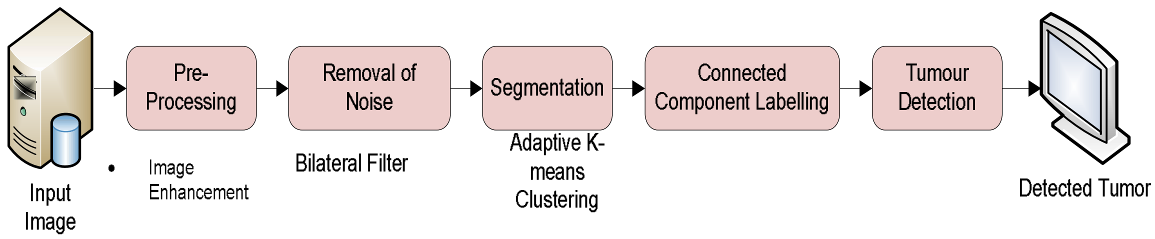

Figure 1: Block Diagram of Proposed Architecture

A. PRE-PROCESSING

Pre-processing is mainly used to convert the image into grace scale image and to adjust the size of the image and removal of noise. Pre-processing is any form of signal processing for which the output is an image or video, the output can be either an image or a set of characteristics or parameters related to image or videos to improve or change some quality of the input. This process will help to improve the video or image such that it increases the chance for success of other processes. In this paper we considered image as input and these images are subjected to pre-processing this will resulting in gray scale conversion and resizing. In pre-processing will use histogram equalization technique for image enhancement.

B. NOISE REMOVEL

In order to get noise free images we are implementing bilateral filtering method. The Bilateral filtering is used for de-noising the image in image processing field. Bilateral filter is a smoothing filter, it does not restore the sharpness of a degraded image. To enhance the results of bilateral filter, we proposed a modified adaptive bilateral filter. This filter is

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the general form of bilateral filter. A bilateral filter has two filter kernels: a spatial filter kernel and a range filter kernel for measuring the spatial and range distance between the center pixel and its neighbors, respectively. The two filter kernels are traditionally based on a Gaussian distribution. Specifically, let I_X be the color at pixel x and I_X^I be the filtered value, we want I_X^I to be

$$I_X^I = \frac{\sum_{y\in N(X)} f_S(X,Y) f_R(I_X,I_Y) I_Y}{\sum_{y\in N(X)} f_S(X,Y) f_R(I_X,I_Y)} \quad (1)$$

Where y is a pixel in the neighbourhood N(x) of pixel x, and

$$f_S(X,Y) = \exp^{\left(-\frac{\|X-Y\|^2}{2\sigma_S^2}\right)} \quad (2)$$

$$f_R(I_X,I_Y) = \exp^{\left(-\frac{\|I_X-I_Y\|^2}{2\sigma_R^2}\right)} \quad (3)$$

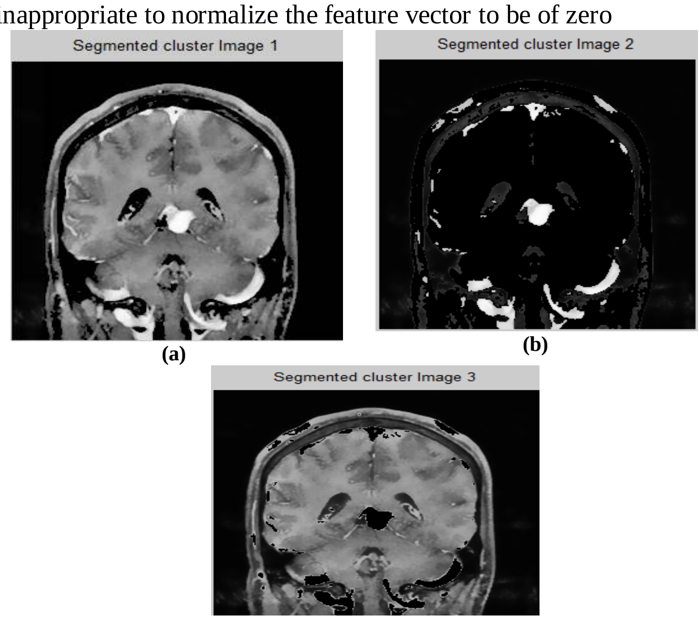
are the spatial and range filter kernels measuring the spatial and range/color similarities. The parameter σS defines the size of the spatial neighborhood used to filter a pixel, and σR controls how much an adjacent pixel is down-weighted because of the color difference. The important modifications done in bilateral filter to increase the picture quality of de-noised image are an offset ζ is introduced to the range filter, values ζ and σ_ri.e. the width of the range filter are made locally adaptive and the CIE-Lab color space is used. If $[m_0, n_0]$ is the center pixel of window defined, $\sigma_d$and $\sigma_r$are the standard deviations of the domain and range Gaussian filters, respectively, then the kernel weight function or normalisation factor used in the proposed technique can be defined as:

$$r_{m_{0,}n_0} = \sum_{m=m_0-N}^{m_0+N} \sum_{n-N}^{n_0+N} e^{\left(\frac{-(m-m_0)^2+(n-n)^2}{2\sigma_d^2}\right)} \times e^{\left(\frac{-\|(g[m,n])-g[m_0,n_0]-\zeta[m_0,n_0]\|^2}{2\sigma_r^2[m_0,n_0]}\right)} \quad (4)$$

By using this Bilateral filtering we are going to get noise free image without any of the distortion. These images are subjected to segmentation b using k-means clustering explained below.

C. ADAPTIVE K-MEANS CLUSTERING

In order to generate a segmented image knowing the number of classes in the beginning itself the popular K-means clustering method is implemented in this paper. According to the criterion of minimizing the Euclidian distance between feature vectors this clustering method is implemented, the fused features must be necessarily normalized. The normalization should comply with a rule that each feature component should be treated equally for its contribution to the distance. This method is implemented to prevent certain features from dominating distance calculations merely because they have large numerical values. As the feature vectors for segmentation are spread due to the presence of subclasses, it can be quite inappropriate to normalize the feature vector to be of zero



(c)

Figure 2: (a) Cluster Image 1; (b) Cluster Image 2; (c) Cluster Image 3

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Adaptive K-means clustering algorithm is given below

Start

Step 1: Initialization – define the number of clusters and randomly select the position of the centers for each cluster or directly generate k seed points as cluster centers.

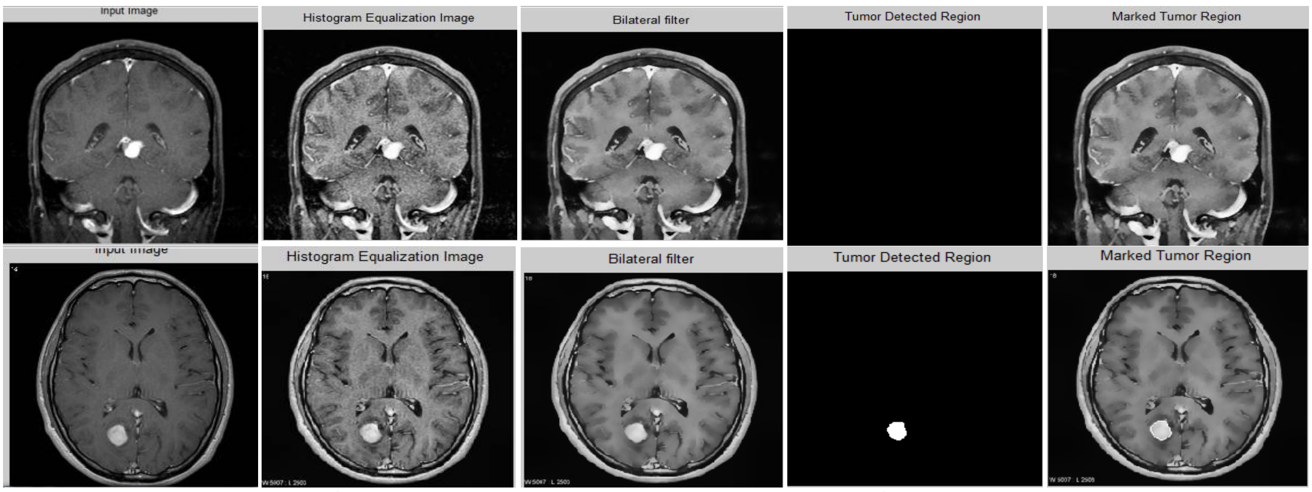
Step 2: Assign each data point to the nearest cluster center.

Step 3: Calculate the new cluster centers for clusters receiving new data points and for clusters losing data points.

Step 4: Repeat the steps 2 and 3 until a convergence criterion is met (when there is no exchange of data points between the k clusters). The main advantages of this algorithm are its simplicity and low computational cost, which allows it to run efficiently on large datasets. Adaptive K-Means algorithm maximizes inter-cluster (or minimizes intra-cluster) variance, but does not ensure that the algorithm will not converge to local minima due to an improper starting condition (initialization of the cluster centers). K-means is a widely used clustering algorithm to partition data into k clusters. Clustering, this process for grouping data points with similar feature vectors into a single cluster and for grouping data points with dissimilar feature vectors into different clusters. Different clusters are shown in the Figure 2 for identifying the tumour. After done with segmentation of the noise free image in order to find out the region of interest will consider the segmented images which are having disease part and will mark those place in the image and will subject those images for result analyze on the basis of efficient image segmentation will find out the tumor in the mage. After segmentation of clustered image we are going for CCL (Connected Component Labeling) for removing extra objects and noise from the clustered images by using height, width and area parameters of the considered image.

IV. EXPERIMENTAL RESULTS

The experimental result for the above discussed methodology is discussed in this section. Figure 3 represents the overall experimental results. Figure 3 (a) represents input image this image is preprocessed and enhanced by using histogram equalization technique shown in Figure 3(b). Next will apply bilateral filtering algorithm as shown in Figure 3(c) for de-noising, after de-noising will go for segmentation and for region of interest will get tumor detection region as shown in Figure 3(d), finally will get marked tumor region and will take image of marked tumor region as shown in Figure 3(e).



(a) Input Image (b) Histogram Equalization Image (c) Bilateral Filter Image (d) Tumor Detected Region (e) Marked Tumor Region

Fig.3 Results of proposed Work

V. CONCLUSION

There are plenty of researches are done on medical imaging system, in this field brain disease extraction in Magnetic Resource Imaging (MRI) is a standard process. MR image segmentation is an important but inherently difficult problem

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in medical image processing. In general, it cannot be solved using straightforward, conventional image processing techniques. Due to the characteristics of MR images, development of automated algorithms is challenging. There is a significant inter-patient variation of signal intensities for one same tissue type because of partial volume effect, inherent noise and wide range of imaging parameters, which affect the tissue intensities. We have proposed an efficient classification system based on k-means clustering approach to detect the brain tumor and effective use of bilateral filtering algorithm for noise removal of images gives the more clarity in images.

VI. FUTURE WORK

Further enhancement for the proposed system can be done by classifying either tumor part ha a benign or malignant and also we can examine any one of the 120 cases of tumor and accuracy part can be increased by combining the fussy c-means and adaptive k-means clustering algorithm.

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