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Hybrid Technique for Medical Image Segmentation to detect Brain Tumour

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***Abstract*— The aim of the paper is to apply image segmentation on medical images to find tumours, if any, in the image. In this paper we proposed a hybrid technique of edge based segmentation and K-means clustering to spot out and show tumours in a medical image.**

***Keywords*— Edge, segmentation, K-means, clustering, tumour, medical, image.**

I. INTRODUCTION

a) Magnetic Resonance Imaging (MRI)

MRI is mostly used in the medical field for detection and visualization of details in the internal structure of the body. It is basically used to detect the differences in the body tissues which have a considerably better technique as compared to computed tomography. Thus, this technique become a special technique especially for the brain tumor detection and cancer imaging. Basically, for comparison, CT uses ionizing radiation while MRI uses strong magnetic field to align the nuclear magnetization that follows by changes the alignment of the magnetization by radio frequencies that can be detected by the scanner. The signal produced can be further processed later to gain extra information of the body [5].

b) Edge Based Segmentation

Segmentation can also be done by using edge detection techniques. In this technique the boundary is identified to segment. Edges are detected to identify the discontinuities in the image. Edges on the region are traced by identifying the pixel value and it is compared with the neighboring pixels. In this edge based segmentation, there is no need for the detected edges to be closed. There are various edge detectors that are used to segment the image [11].

- The edges are detected by calculating the minimum and maximum of first derivative in gradient edge detector.
- Zero Crossing is found in second derivative to identify the edges in Laplacian edge detector.
- Sobel Edge Detector uses Convolution Kernel to detect the edges.
- Magnitude of the spatial gradient is calculated for edges in Robert's Edge Detector.
- Canny Edge Detector also uses high spatial gradient but it takes more computation than Sobel and Robert's Edge Detector [9].

Edges are usually formed between the regions. There are different types of edges as shown below.

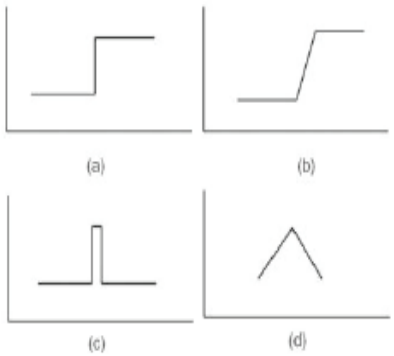

Fig.1 – Types of edges: (a) Step edge (b) Ramp edge (c) Line edge (d) Roof edge.

The three edge detection operators namely Robert's, Prewitt's and Sobel's are shown below. Here Sobel's technique is adopted. As it can find the edges in 45^0 also in addition to horizontal and vertical.

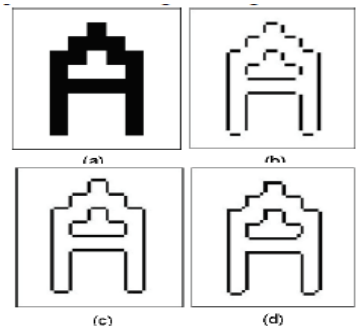

Fig.2 – Comparison of operators: (a) Original image (b) Prewitt's (c) Robert's (d) Sobel's image

Sobel's Operator is as given below:

-1	0	1
-2	0	2
-1	0	1

(c) Sobel $\frac{\partial}{\partial x}$

-1	-2	-1
0	0	0
1	2	1

(d) Sobel $\frac{\partial}{\partial y}$

Fig 3: Sobel's Edge detection operator

c) K-means clustering algorithm

The K-Means algorithm is an iterative technique that is used to partition an image into K clusters. K-means clustering divides an image into sub regions or clusters by appending points to the cluster where the difference between the point and mean is smallest. Hard clustering assumes sharp boundaries between clusters. The basic algorithm is:

- Pick K cluster centres, either randomly or based on some trial and error.
- Assign each pixel in the image to the cluster that minimizes the distance, pixel color difference, intensity, texture, and location between the pixel and the cluster centre
- Re-compute the cluster centres by averaging all of the pixels in the cluster
- Repeat steps 2 and 3 until convergence is attained (e.g. no pixels change clusters)

A drawback of the k-means algorithm is that the number of clusters k is an input parameter. An inappropriate choice of k
may yield poor results [10].

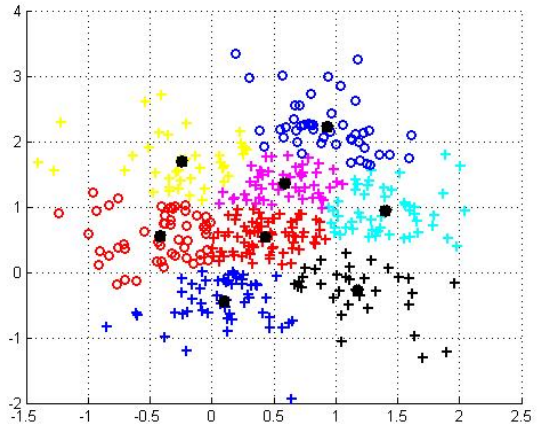

Fig 4: K-means clustering example

d) Filtering of the image

Image which is applied to the high pass filter to remove the noise present so as to improve the image quality and to reduce the miscalculation. The image is again filtered with the help of the median filter to remove the impulse noise. Median filter is less sensitive than outliers as value of each pixel is obtained by the median of the neighboring pixel [4].

II. PROPOSED ALGORITHM

The proposed algorithm consists of k-means clustering, Sobel's edge detection and median filter. Here the medical images used for segmentation. The proposed algorithm is as follows:

Step 1: Load the image

Step 2: Apply Sobel's edge detection operator on the input

Image.

Step 3: Apply k-means clustering on the image on the

resultant image of step 2.

Step 4: Apply median filter on the image obtained in step 3.

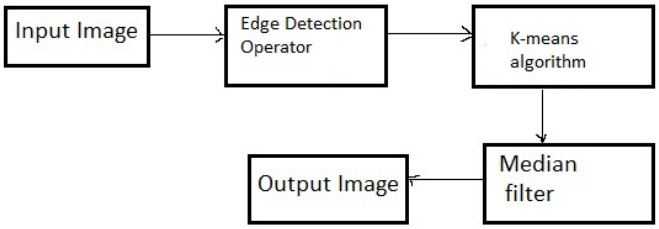

Fig 5: Block diagram of the proposed algorithm.

III. RESULTS

We applied this new technique on various types of images for analysis. Mostly the area of interest is segmented from background. The proposed algorithm is implemented in Matlab. We compared the results of edge detection algorithms with the new hybrid technique and is shown in the Fig 4 and Fig 5.

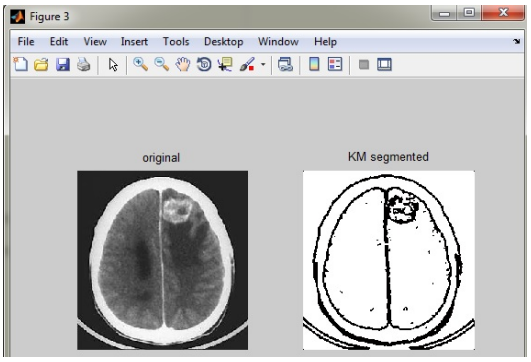

Fig 6: Result of the proposed algorithm.

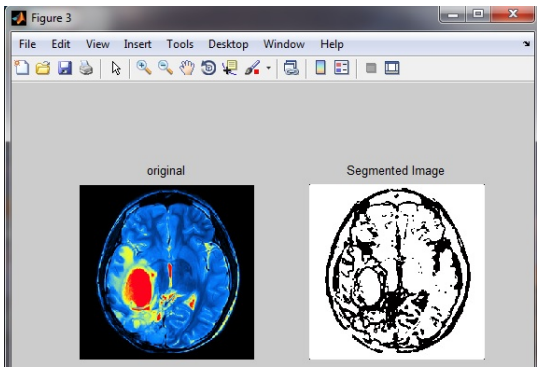

Fig 7: Result of the proposed algorithm.

IV. CONCLUSIONS

We have segmented an image by using a new hybrid technique which is a combination of Sobel's edge detection operator and k-means clustering algorithm. We observed that there is an improvement in the visual details of the tumour in the resultant image. This technique is specific to a class of medical images of brain tumour.

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