A Novel Hybrid Approach Using Kmeans Clustering and Threshold filter for Brain Tumor Detection

S.S. Mankikar[#1]

[#1]*Department of computer Engineering, University of Pune*
MAEER's M.I.T, Pune, India

Abstract— **Medical imaging makes use of the technology to disclose the internal structure of the human body. By means of medical imaging modalities patient's life can be better through a accurate and quick treatment without any side effects. The foremost purpose of this paper is to develop an automated framework that can accurately classify a tumor from abnormal tissues. In this paper, we put forward a hybrid framework that uses the K-means clustering followed by Threshold filter to track down the tumor objects in magnetic resonance (MR) brain images. The main concept in this hybrid framework is to separate the position of tumor objects from other items of an MR image by using Kmeans clustering and Threshold filter. Experiments reveal that the method can successfully achieve segmentation for MR brain images to help pathologists distinguish exactly lesion size and region.**

Keywords: Brain tumor detection, Kmeans clustering, MR image, Segmentation, Threshold filter..

I. INTRODUCTION

Brain tumor is one of the main causes for the increase in immortality among children and adults(see Fig 1). A tumor is a mass of tissue that grows out of control of the normal forces that regulates growth. Imaging is an essential characteristic of medical science to envision the anatomical structures of the human body [2, 3, 6].

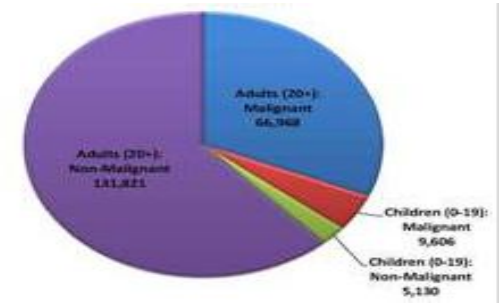


Fig 1.Distribution of incident brain tumors in U.S. Courtesy: http://www.cancer.gov,

Numerous new complex medical imaging modalities as in magnetic resonance imaging (MRI) CT scan mostly depend on computer technology to generate or display digital images. By means of sophisticated computer techniques, multidimensional digital images of physiological structures can be processed to help envision hidden diagnostic features that are otherwise tricky or impracticable to identify. Segmentation is the foremost significant process in the majority of medical image analysis and classification for computer-aided [2, 6] diagnosis. Fundamentally, image segmentation methods can be segregated into three different categories i.e. edge-based methods, region-based methods [4], and pixel-based methods. Since pixel-based methods based on Kmeans clustering are simple and the computational complexity is relatively low compared with other two methods explained above, thus K-means clustering becomes a vital technique in pixel-based classification methods. Thus the application becomes more feasible. Several researchers have projected related research into Kmeans clustering segmentation. Therefore, by using Kmeans clustering followed by Threshold filter to magnetic resonance (MR) brain tumors, the proposed tumor detection framework maintains efficiency. The experimental results also verify that the proposed framework helps pathologists distinguish exact lesion sizes and regions. The remaining paper is organized as follows. Section 2 introduces the proposed framework. Our proposed framework is presented in detail in Section 3, 4, 5. Experimental results are illustrated and discussed in Section 5. Finally we report our findings and give direction to future research in brain tumor detection in the conclusion.

II. PROPOSED FRAMEWORK

The following flow graph (see Fig 2) explains our proposed framework. Each method used to develop the framework is explained in the subsequent sections. The frame work was build using *AForge.Imaging library* and using .net framework

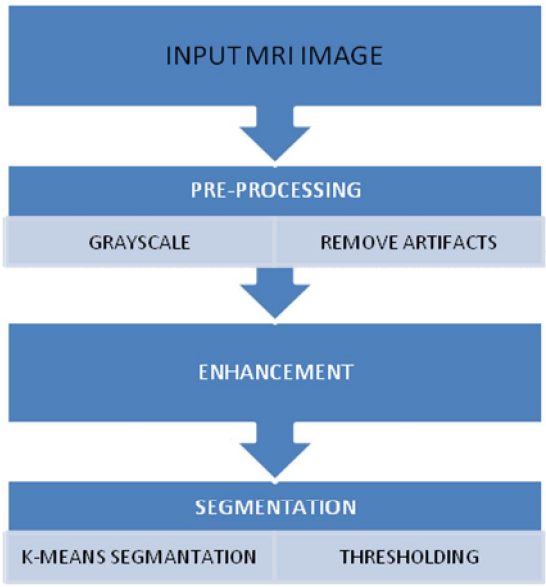


Fig 2. Flow graph of proposed framework

III. IMAGE PREPROCESSING

The first process in Image preprocessing is that the MRI image is converted to grayscale by using *ConvertToGray* function. Fig 1 shows the result of grayscale conversion.

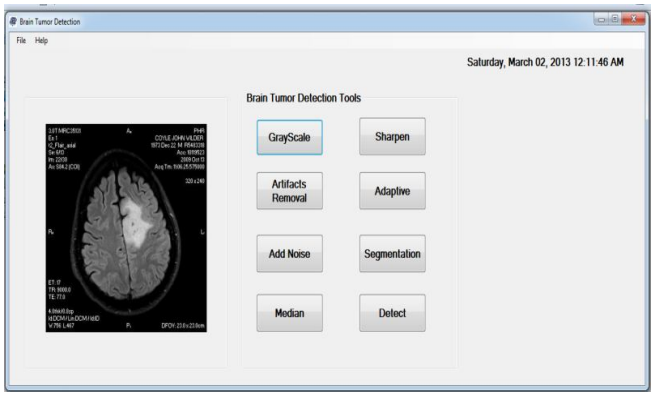


Fig 3. Image acquired in the picturebox and converted to grayscale.

Image pre-processing specifies that the same tissue type may have a different scale of signal intensities for different images. . The pixel intensities of the labels in the MRI scan and tumor look as if they are equal but they are actually not. Hence there is a need for removing film artifacts. The MRI image comprises of film artifact or labels on the MRI such as patient name, age and marks. Film artifacts are removed using tracking algorithm [1]. Here, starting from the first row and the first column, the intensity value, greater than that of the threshold value is removed from MRI. The high intensity value of film artifact is removed from MRI brain image. This is one of the main procedures of the proposed framework since it is necessary to remove artifacts from MRI before sending it for further processing. The Fig 4 displays the result after artifacts have been removed.

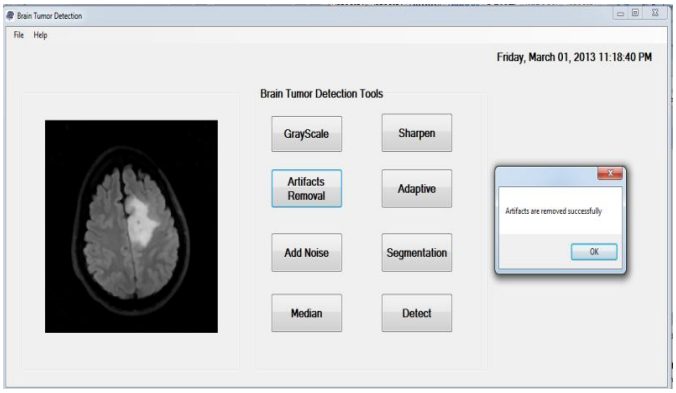


Fig 4. Artifacts removed from the MR image.

IV. ENHANCEMENT

The pre-processed MRI brain image consists of a high intensity salt and pepper noise which comes into sight due to the occurrence of gray scale variations in the image which is removed by applying suitable filters. Hence the objective of enhancement is de-noising the high frequency components. In order to test how efficient median filter is to remove the noise, firstly we added some noise in the MR image and then tested the results by applying Median filter. Fig 5 shows the image in which noise has been incorporated and Fig 6 shows the noise removed by applying Median filter.

Median filter is the nonlinear filter mostly used to remove the impulsive noise from an image .Moreover it is a more robust method than the traditional linear filtering, since it preserves the sharp edges. The filter is available in *AForge.Imaging.Filters* library. The median filter is generally used to reduce noise in an image to some extent like the mean filter. Conversely, it often does a better job than the mean filter of preserving useful detail in the image. The filter substitutes each pixel of the original with the median of neighboring pixel values.

Fig 5.Noisy Image in the picturebox.

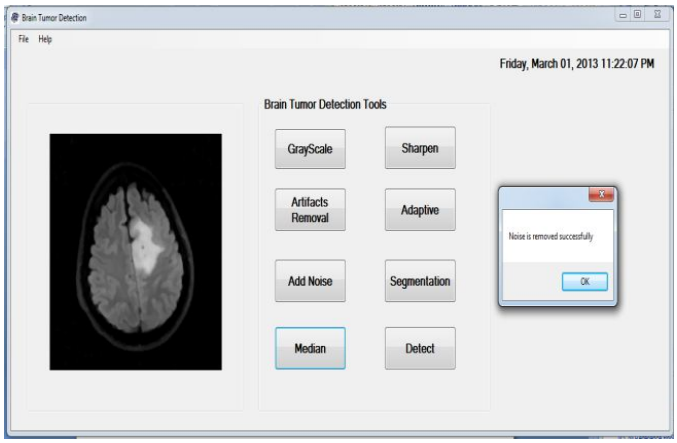


Fig 6. Noised Removed by means of Median filter.

V.SEGMENTATION

Segmentation is a process of discovering an object or pattern in the specified work space[7] The main purpose of segmentation is to separate an image into regions. Method of segmentation is employed to separate the irregular from the regular surrounding tissue to get a genuine identification of involved and distinguish the involved area correctly. K-Means algorithm followed by a threshold filter is used for segmentation.

5.1Kmeans Clustering

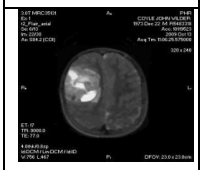
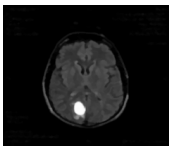
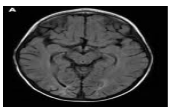
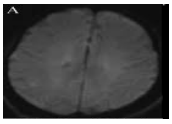
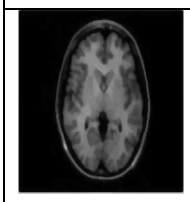
The Kmeans algorithm is an iterative method that is used to partition an image into *K* clusters.

The Algorithm is as follows:
1: Select K points as initial centroid.
2**. Repeat**
3. From K clusters by assigning all points to the closest centroid.
4. Recompute the centroid of each cluster'
5**. Until** The centroid don't change

Complexity:
O(n * K * I * d)
n = number of points,
K = number of clusters,
I = number of iterations,
d = number of attributes

The following table (Table 1) shows the detailed findings of Kmeans clustering algorithm on the MR image. These findings projects the relation between the size of the image and the number of iterations required to segment the image. The table also includes the dataset used for this proposed framework.

Table1. Experimental Results.

DATA SET	SIZE	W x H	DEP -TH	ITERA TIONS
	14.9KB	320x320	24	37
	300KB	320x320	24	31
	1.230M B	720x600	24	29
	71.5KB	145x168	24	29
	68.1KB	136x171	24	18
	21.4KB	240x200	24	37
	58.3KB	145x137	24	26

The major advantages of Kmeans clustering algorithm is that they can be easily parallelized, they use kd-trees or other efficient spatial data structures for some situations. Moreover they are sensitive to initial conditions and finally they give good clustering results with smaller K.
Fig 7 shows the resultant image after applying Kmeans clustering algorithm.

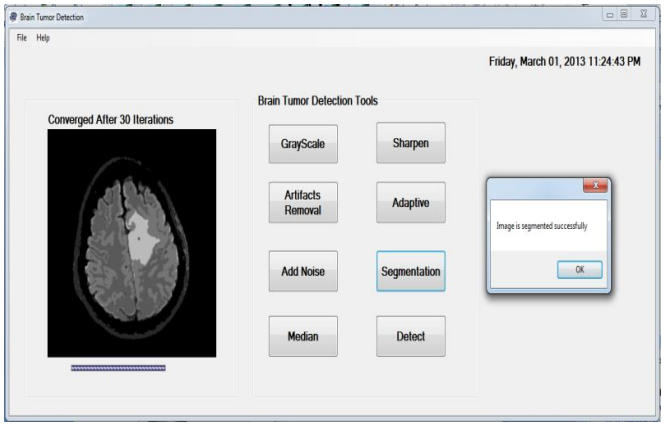


Fig 7.Segmented image after applying Kmeans clustering algorithm.

5.2Threshold Filter

The straightforward method for image segmentation is called the Threshold filter method. This method is based on a clip-level (or a threshold value) to turn a gray-scale image into a binary image. The key of this method is to decide on the threshold value (or values when multiple-levels are selected). It is present in *AForge.Imaging.Filters library*. The filter accomplishes image binarization using specified threshold value. All pixels with intensities equal or higher than threshold value are converted to white pixels [6]. All other pixels with intensities below threshold value are converted to black pixels. The filter accepts 8 and 16 bpp grayscale images for processing. Since the filter can be applied as to 8 bpp and to 16 bpp images, the Threshold value value should be set appropriately to the pixel format. In the case of 8 bpp images the threshold value is in the [0, 255] range, but in the case of 16 bpp images the threshold value is in the [0, 65535] range. Fig 8 shows the resultant image after applying threshold filter in which we can see the tumor has also been detected [6].

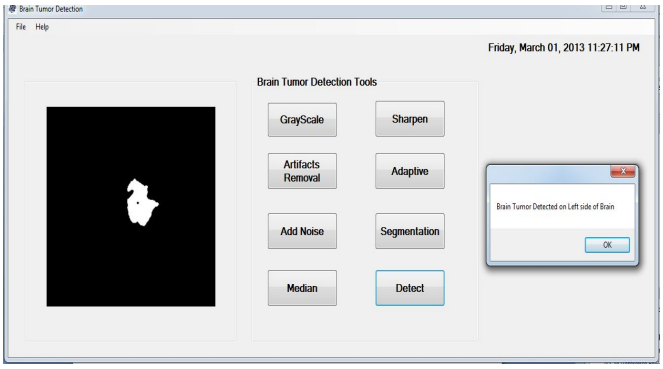


Fig 8. MR Image after applying the threshold filter (Tumor detected).

VII. CONCLUSION

In this paper, a hybrid segmentation method based on K-means clustering followed by threshold filter for tracking tumor in the MRI brain image is proposed. A preliminary experiment conducted on the MRI brain image demonstrates encouraging results. This hybrid method can provide good segmentation performance and the location of a tumor or lesion can be exactly separated from the original image. In the future the framework can be used to improve the accuracy of detecting malignant areas in brain noisy MR images. Particular focus will be on accomplishing high noise suppression rate with no sacrifice of the contents of the image. Bursts of noise unfavorably have an effect on the edges of image pattern.

REFRENCES

[1] J.Jaya, K.Thanushkodi ,M.Karnan,."Tracking Algorithm for De-Noising of MR Brain Images "

[2] Dhawan, A. P., "A Review on Biomedical Image Processing and Future Trends," Computer Methods and Programs in Biomedicine, Vol. 31, No.3-4, 1990, pp.141-183.

[3] Gonzalez, R. C.; Woods, R. E., *Digital Image Processing, 2nd ed.*, Prentice-Hall, Englewood Cliffs, NJ, 2002.

[4] Tsai, C. S., Chang, C. C., "An Improvement to Image Segment Based on Human Visual System for Object-based Coding," *Fundamental Informaticae*, Vol. 58, No. 2, 2004, pp.167-178

[5] Ming-Ni,Wu Nat. Chung Cheng Univ., Chaiyi Chia-Chen Lin Chin-Chen Chang, " Brain Tumor Detection Using Color-Based K-Means Clustering Segmentation",IEEE transactions.

[6]http://www.aforgenet.com

[7]http://elearning.vtu.ac.in