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AN IMPROVEMENT IN THRESHOLDING SEGMENTATION METHODS FOR TUMOR DETECTION IN MRI IMAGES

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ABSTRACT

Tumor segmentation from magnetic resonance imaging (MRI) data is an important but time consuming manual task performed by medical experts. Automating this process is a challenging task because of the high diversity in the appearance of tumor tissues among different patients and in many cases similarity with the normal tissues. MRI is an advanced medical imaging technique providing rich information about the human soft-tissue anatomy. There are different brain tumor detection and segmentation methods to detect and segment a brain tumor from MRI images. These detection and segmentation approaches are research with an importance placed on enlightening the advantages of these methods for brain tumor detection and segmentation. The use of MRI image detection and segmentation in different procedures are also described. Here a brief description of different edge method with segmentation for detection of brain tumor from MRI of brain has been discussed.

Keywords: Brain tumor, MRI image, segmentation, Thresholding, Sobel, Edge detection technique etc.

I. INTRODUCTION

Image Processing is a method to convert an image into digital form & perform some operation on it, in order to get an enhanced image or to extract some useful information from it. All the images used in today's world are in the digital format. Medical Imaging is the techniques, process & art of creating visual representation of the interior of the body for clinical analysis and medical intervention. In MRI, CT scans are performed to analyze the internal structure of various parts of human body which helps doctors to visualize the inner portion of the body. CT scanner, ultrasound, MRI took over conventional X-ray imaging, by allowing the doctors to see the body's third dimension. According to International Agency for Research on Cancer (IARC) approximately, more than 126000 people are diagnosed for brain tumor per year around the world, with more than 97000mortality rate. This paper presents a research of the methods and techniques used during brain tumor detection through MRI image segmentation and we have proposed segmentation of brain MRI image using segmentation algorithm followed by morphological filtering.

The basic concept is that local textures in the images can reveal the typical regularities of the biological structures. Thus, the textural features have been extracted using a co-occurrence matrix approach. The level of recognition, among three possible types of image areas: tumor, non-tumor and back ground. We are into tumor image segmentation.[1] Generally, human brain includes three major parts controls different activity. [2]

A. Cerebrum

The cerebrum controls learning, thinking, emotions, speech, problem solving, reading and writing. It is divided into right and left cerebral hemispheres. Muscles of left side of the body control by right cerebral hemispheres and muscles of right side of the body control by left cerebral hemispheres.

B. Cerebellum

The cerebellum controls movement, standing, balance and complex actions.

C. Brain stem

Brain stem joints the brain with spinal cord. Brain stem controls blood pressure, body temperature and breathing and controls some basic functions.

II. STAGE OF IMAGE ENHANCEMENT

1. PRE-PROCESSING STAGE

In this phase image is enhanced in the way that finer details are improved and noise is removed from the image. Most commonly used enhancement and noise reduction techniques are implemented that can give best possible results. Enhancement will result in more prominent edges and a sharpened image is obtained, noise will be reduced thus reducing the blurring effect from the image. In addition to enhancement, image segmentation will also be applied. This improved and enhanced image will help in detecting edges and improving the quality of the overall image. Edge detection will lead to finding the exact location of tumor.

2. NOISE REMOVAL

Many filters are used to remove the noise from the images. Linear filters can also serve the purpose like Gaussian, averaging filters. For example average filters are used to remove salt and pepper noise from the image. Because in this filter pixel's value is replaced with its neighborhood values. Median filter is also used to remove the noise like salt and pepper and weighted average filter is the variation of this filter and can be implemented easily and give good results. In the median filter value of pixel is determined by the median of the neighboring pixels. This filter is less sensitive than the outliers.

III. TYPES OF TUMOR

Tumor The word tumor is a synonym for a word neoplasm which is formed by an abnormal growth of cells Tumor is something totally different from cancer. There are three common types of tumor:

1) Benign

2) Pre-Malignant

3) Malignant

1) Benign Tumor

A benign tumor is a tumor is the one that does not expand in an abrupt way; it doesn't affect its neighboring healthy tissues and also does not expand to non-adjacent tissues. Moles are the common example of benign tumors.

2) Pre-Malignant

Tumor Premalignant Tumor is a precancerous stage, considered as a disease, if not properly treated it may lead to cancer.

3) Malignant Tumor

Malignancy (mal- = "bad" and -ignis = "fire") is the type of tumor, that grows worse with the passage of time and ultimately results in the death of a person. Malignant is basically a medical term that describes a severe progressing disease. Malignant tumor is a term which is typically used for the description of cancer.

IV. PROPOSED IMPLEMENTATION

The location of brain tumor influences the type of symptoms that occur. Identifying the presence of a brain tumor is the initial step in determining the course of treatment. To identify the location and size of tumor the detection process involves various steps. Firstly the MR image of the brain is obtained. Imaging plays the central role in the diagnosis of brain tumors. Brain scan is the picture of the internal structures in the brain. A specialized machine takes a scan in much the same way a digital camera takes a photograph. MRI is scanning device that uses magnetic fields and computers to capture images of the brain on film. In medical image processing, medical images are corrupted by different type of noises. Low quality image is an obstacle for effective [8] feature extraction, analysis, recognition and quantitative measurements. Presence of noise during image acquisition degrades the human interpretation, or computer aided analysis of the images. Most common type of noises that are usually found in acquired medical images is salt and pepper or Poisson noise. Salt and pepper noise appears as white and black pixels in the image. Due to presence of such noise, the tumor is sometimes not visible properly especially in case of salt and pepper noise. Also the tumor may not be located properly. In some cases combination of both salt & pepper and poison noise may also be present. So it becomes necessary to remove such type of noise from these images. Thus next step is the removal of noise which is very important step in medical imaging applications [8] to enhance and recover anatomical details that may be hidden.

Gaussian filter is the appropriate technique for removal of noise. In Gaussian filter each pixel is set to median of the pixel values in the neighborhood of the corresponding input pixels. Next step after removal of noise is to identify the location of the tumor. This is done by creating an edge detection technique around the brain abnormality in MR image. The edge detection method is based on the property of the symmetrical structure of the brain [5, 9]. That is left and right lobes are almost identical. The left right parts are similar until an abnormality occurs in any part of the brain. For creating edge detection, first the skull is detected. Then line of symmetry [4] is drawn to create leftright symmetry of brain. Assumption is made that tumor is located in one of the two halves of the brain. One half acts as reference image while other as test image. The vertical and horizontal scan is performed on both sides, comparing to obtain the region of abnormality. This is done by obtaining a score plot function ‘E’ based on average intensities of the region of abnormality. All maximum and minimum points are obtained from the graph. From all the pairs, the pair (m, n) is found for which difference (E(m)-E(n)) is maximum. This defines the boundary of edge detection.

A. SEGMENTATION USING THRESHOLDING TECHNIQUE

After finding the image gradient, the next step is to automatically find a threshold value so that edges can be determined. The algorithm to automatically determine image dependent threshold is as follows:

1. Let the initial threshold be Th0 which is equal to the average intensity of gradient image g(x, y), as defined in (1).

$$Th^0 = \frac{\sum_{j=1}^{h}\sum_{i=1}^{w} g(x,y)}{h\times w} \quad (1)$$

where, h and w are height and width of the image under consideration.

2. Set iteration index l = 0, separate g(x,y) into two classes, where the lower class consists of those pixels of g(x,y) which have gradient values less than Th^l , and the upper class contains rest of the pixels.

3. Compute the average gradient values mL and mH of lower and upper classes respectively.

4. Set iteration l = l+1 and update threshold Value as:

$$Th^l = \frac{m_L + m_H}{2} \quad (2)$$

Repeat steps 2 to 4 until $[Th^l - Th^{l-1}] \leq \epsilon$ is satisfied, where ϵ and take Th^l as final threshold and denote it by Th.
It means we follow the steps 2 to 4 because it need to reach Threshold value to adjust the output image.

B. SOBEL OPERATOR

Sobel Operator uses a 3×3 mask shown in Fig. 1a and applied on part of the image shown in Fig. 1b. Given an image f (x, y), its gradient along x and y-axis are calculated according to (3) and (4).

$$g_x = \frac{\delta f}{\delta x} = (z_7 + 2z_8 + z_9) - (z_1 + 2z_2 + z_3) \quad \textbf{(3)}$$

$$g_y = \frac{\delta f}{\delta y} = (z_3 + 2z_6 + z_9) - (z_1 + 2z_4 + z_7) \quad \textbf{(4)}$$

Then the gradient of image is defined as: $\nabla f(x,y) = \frac{\delta f}{\delta x}\hat{\imath} + \frac{\delta f}{\delta y}\hat{\jmath} = g_x\hat{\imath} + g_y\hat{\jmath}$ (5)

Where, I and j are unit vectors along x and y axis respectively. The magnitude of gradient is given by,

$$g(x,y) = |\nabla f(x,y)| = \sqrt{{g_x}^2 + {g_y}^2} \quad \textbf{(6)}$$

C. SIMULATION TABLE

Input parameter	Technique
For segmentation	Thresholding method
For Noise removal in Images	Salt and Pepper
For Image Filtering	Gaussian Filter
For edge detection	Various technique like (Prewitt, Canny, Sobel, Robert, and Log)
Simulation tool	MATLAB 2012a

V. RESULT

In this section, the results of each stage are shown and how result obtained is better and accurate.

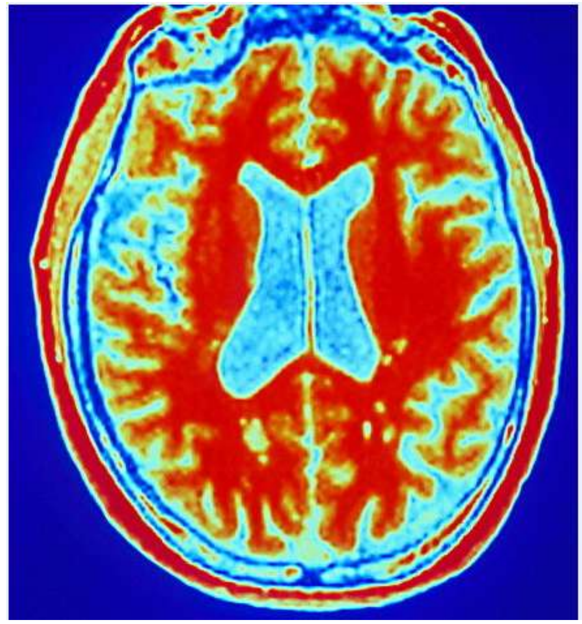

Figure1: Input Brain Image

Firstly the input image is shown here, Fig 1 shows input images which has brain tumor. Threshold segmentation is applied on this image which contains brain tumor.

In the first step, the color image is transformed from RGB to gray scale. Although, traditionally, RGB is the most commonly used model for fMRI images.

Basically we are applying edge detection operator such as prewitt, canny, log, Robert and sobel operator are used and result from this five operator are shown in below. As seen these three results, canny edge detection operator gives an efficient of boundary extraction of brain tumor.

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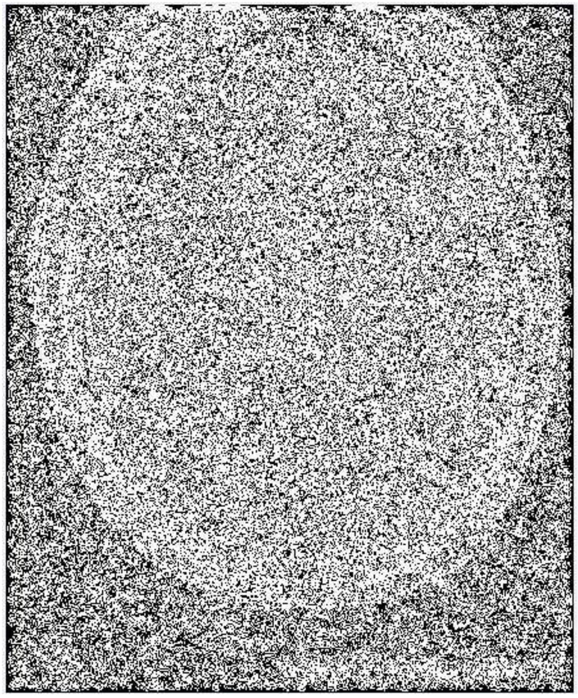

Figure 2: Log edge detection of brain tumor image

This edge detector extracts the edge by using a combination of Gaussian filtering and laplacian operator. In second step, the noise in an image is decreased by convoluting the particular image with a Gaussian filter resulting into the filtering of the all the noisy points out of the image. In the next step, gradient is measured for the image being analyzed by detecting the zero-crossings of the second order difference of the image resulting into edges. The image is first smoothed by convolution with a Gaussian kernel of width σ to filter out all the noise present in the image given by:

$$G_\sigma(x,y) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{\left[\frac{-(x^2+y^2)}{2\sigma^2}\right]}$$

The laplacian of the image whose intensity values are represented as f (x ,y) is defined as

$$L(x,y) = \frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2}$$

Since the input image is shown as having discrete pixels, we need to approximate the second derivatives in the equation for laplacian operator for which either of the shown convolution kernels can be used. As the convolution operation is associative, the Gaussian filter can be convolved with the laplacian filter and then the hybrid filter can be convolved with the image to get the results.

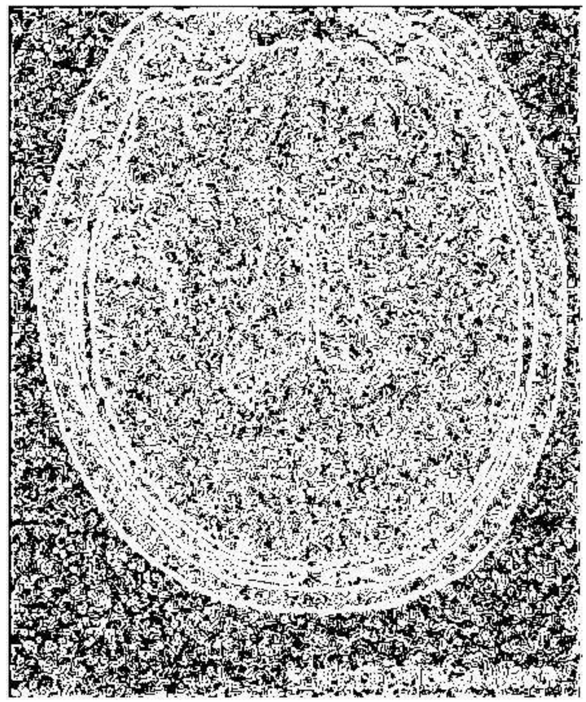

Figure 3: Prewitt edge detection of brain tumor image

Prewitt edge detection

The Prewitt operator uses two 3×3 kernels which are convolved with the original image to calculate approximations of the derivatives - one for horizontal changes, and one for vertical. If we define A as the source image, and Gx and Gy are two images, which at each point contain the horizontal and vertical derivative approximations.

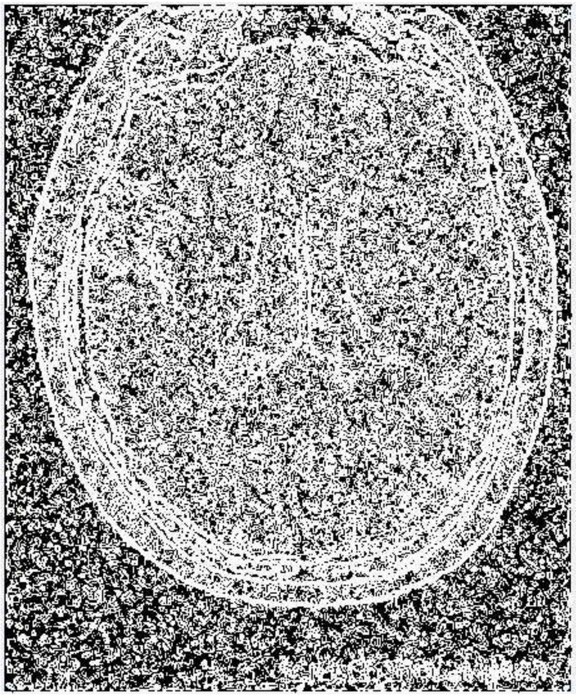

Figure 4: Robert edge detection of brain tumor image

The Robert Cross operator performs a 2-D spatial gradient measurement on a source image resulting into the regions of high spatial frequency corresponding to edges. This operator makes use of a pair of 2x2 convolution kernels as shown in Fig. 4. The source image is convolved with the presented kernels, resulting in both horizontal and vertical gradients. The absolute magnitude of gradient at a point is evaluated by:

$$|P| = \sqrt{(P_x)^2 + (P_y)^2}$$

The direction of the gradient is given by:

$$\alpha = \arctan\left(\frac{P_y}{P_x}\right)$$

The advantage of the Roberts edge detector is that it works quite fast because of its small size. However it is irresistent to noise and also fails in detecting very sharp edges. The sobel operator makes use of this point in detecting edges by comparing the gradient value at a particular pixel with a predefined threshold value, and if it exceeds the threshold, it is concluded as an edge location.

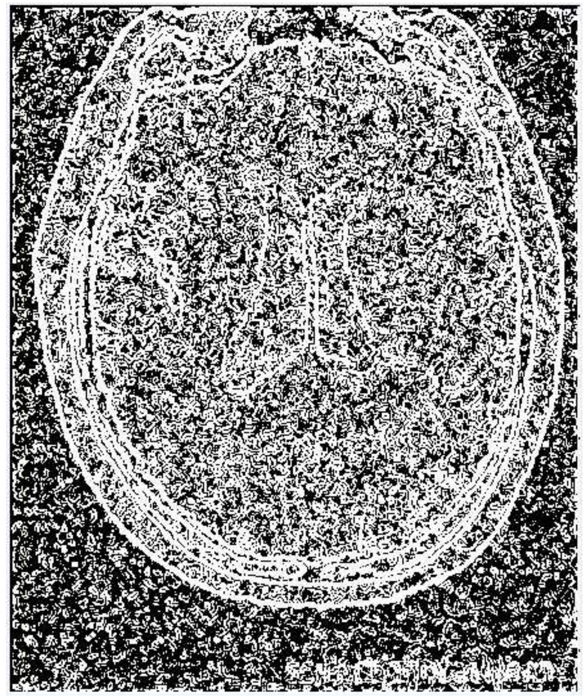

Figure 5: Sobel edge detection of brain tumor image

Sobel edge detection Sobel edge detection uses sobel operator. Sobel operator is a gradient operator. Gradient corresponds to the first derivative. The Sobel operator performs a 2-D spatial gradient measurement on an image. Typically it is used to find the approximate absolute gradient magnitude at each point in an input grayscale image. The Sobel edge detector uses a pair of 3x3 convolution masks, one estimating the gradient in the x-direction (columns) and the other estimating the gradient in the y-direction (rows). A convolution mask is usually much smaller than the actual image. As a result, the mask is slid over the image, manipulating a square of pixels at a time. The actual Sobel masks are shown in Figure 5.

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

Gx

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

Gy

The magnitude of the gradient operator is calculated by: |G|= (Gx 2 +Gy2) 1/2 .

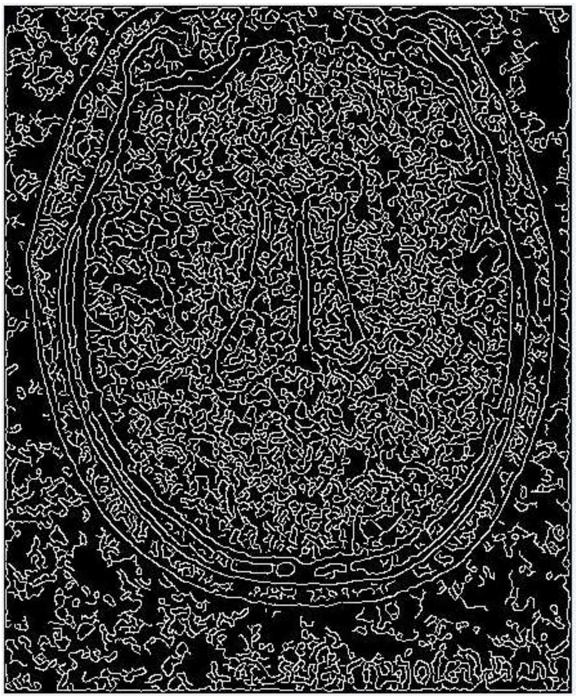

Figure 6:Canny edge detection of brain tumor image

Canny Edge Detector

Canny specified three tissues that an edge detector must address. They are:

i). Error rate:-The edge detector should respond only to edges, and should find all of them; no edges should be missed.

ii). Localization: - The detected edges should be as close as possible to the real edges.

iii). Response: - The edge detector should not identify multiple edge pixels where only a single edge exists.

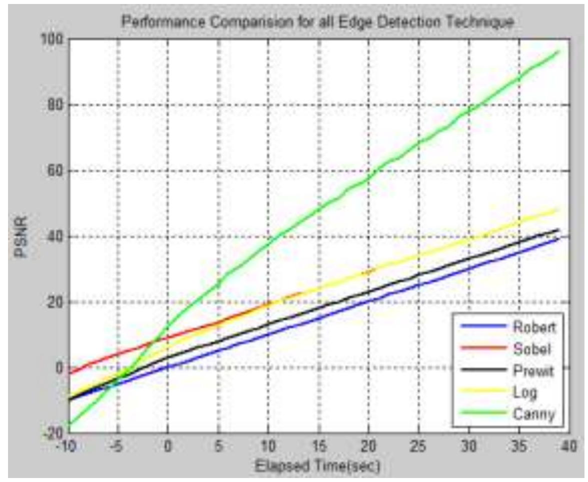

Figure 7:PSNR of various edge detection on Elapsed time (sec)

Quality of noisy image and de-noised image are measured by four quality measures. Let x(i,j) represents the original image and y(i,j) represents distorted (modified) image of size MN.

- This graph is plotted between ratio of peak signal to noise ratio (y-axis) and images (x-axis).
- Blue line shows the value of peak signal noise ratio in case of noisy images of Robert.
- Green line is the result of canny edge detection.
- Here yellow line is the result when images are subjected to noise of Log.
- Red line is using for the Sobel.
- Black line is the result of Prewitt edge detection.

Formula of PSNR
M and *N* are the number of rows and columns in the input images, respectively. Then the block computes the PSNR using the following equation:

$$PSNR=10 \log_{10} (R^2 /MSE)$$

VI. CONCLUSION

Brain tumor analysis is done by doctors but its grading gives different conclusions which may vary from one doctor to another. So for the ease of doctors, a research was done which made the use of software with edge detection and segmentation methods, which gave the edge pattern and segment of brain and brain tumor itself. Medical image segmentation had been a vital point of research, as it inherited complex problems for the proper diagnosis of brain disorders. In this research, it provides a foundation of segmentation and edge detection, as the first step towards brain tumor grading. Current segmentation approaches are reviewed with an emphasis placed on revealing the advantages and disadvantages of these methods for medical imaging applications. The use of image segmentation in different imaging modalities is also described along with the difficulties encountered in each modality.

REFERENCES

[1] P.Tamije;V. Palanisamy T. Purusothaman: "PerformanceAnalysis of Clustering Algorithms in Brain Tumor Detectionof MR Images" European Journal of Scientific Research, ISSN1450-216X Vol.62 No.3 (2011), pp. 321-330.

[2] Ratan, Rajeev, Sanjay Sharma, and S. K. Sharma. "Braintumor detection based on multi-parameter MRI imageanalysis." International Journal on Graphics, Vision andImage Processing vol 9.no.3, pp.9-17,2009.

[3] S.K.Bandyopadhyay and D.Saha, "Brain region extractionvolume calculation," UNIASCIT, vol. 1, no. 1, pp. 44-48,2011.

[4] Gopal, N.N.; Karnan, M., "Diagnose brain tumor throughMRI using image processing clustering algorithms such asFuzzy C Means along with intelligent optimizationtechniques," IEEE International Conference onComputational Intelligence and Computing Research(ICCIC),vol.2, no.3, pp.1-4, 2010.

[5] AmanpreetKaur; Gagan Jindal "Tumor Detection UsingGenetic Algorithm" International Journal on ComputerScience and Technology, vol. 4, no.1,pp. 423-427 2013.

[6]S. Datta; M. Chakraborty. "Brain Tumor Detection from Pre-Processed MR Images using SegmentationTechniques". Special Issue on 2nd National Conference-Computing, Communication and Sensor Network(CCSN) Published by Foundation of Computer Science, NewYork, USA. vol.2, pp.1-5, 2011.

[6] P.TamijeSelvy, V. Palanisamy, T.Purusothaman, "Performance Analysis of Clustering Algorithms in Brain Tumor Detection of MR Images", EuropeanJournal of Scientific Research, Vol.63, No.3, 2011

[7] Mrs. Bharati R. Jipkate, Dr. Mrs. V. V. Gohokar, " A Comparative Analysisof Fuzzy C-means Clustering and K-means Clustering Algorithms",International Journal of computational Engineering Research, Vol.2, Issue 3,May-June 2012.

[8] R. C. Gonzalez and R. E. Woods, "Digital Image Processing", 2nd Ed.

[9] National cancer Institute, "What you need to know about Brain tumors".

[10] http://www.braintumor.org