



Detecting, Demarking and Quantifying Brain Tumor using a Hybrid Approach

Ms. Navneet Kaur^{*}, Dr. Mamta Juneja
C.S.E., U.I.E.T., P.U., CHD,
India

Abstract— *The paper presented explains how the gradient differential plays an inseparable part in demarking the tumor in brain. Areas that do not match with the benchmark set are skipped by the algorithm i.e. eminent entropy and intensity which are considered as major feature of tumor identification. The picture is finally rebuilt by evaluating regional maxima and extended maxima transformation which at the end gives us the most impressionable part of tumor. To generate final output the algorithm takes just 3.98 seconds (as an average statistics). At the end the proposed algorithm detects the tumor with high accuracy.*

Keywords— *Include at least 5 keywords or phrases*

I. INTRODUCTION

A lump of body tissues which took birth by continuous expansion of peculiar cells is termed as tumor. Normally, in human bodies everyday thousands of cells are born then they get oldie, then die and finally are being replaced by the cells which are freshly born. Due to the disturbance of the cells which occurs in situation of diseases like tumor and cancer these cells starts growing up even after the body does not needs them. They does not get expire as in the case of normal cells. As more and more cells joined up the effected parts converts into a cyst. In broad classification there are basically two types of tumor i.e. primary and secondary tumor. Cell tissues who are generated from the brain parts are which later on converted into tumor are classify a primary tumor and tissues which are formed from the different parts of the body causes cancer are secondary tumors. Not all tumor are dangerous, harmless tumors are called benign primary tumor and on the other side cancer causing brain tumors are called malignant.

Benign brain tumors can easily detected as they have clear outlines around them and are not strongly immense into the brain cells. The growth of malignant tumor is faster than benign tumor

A malignant brain tumor ordinarily grows faster than benign tumors.

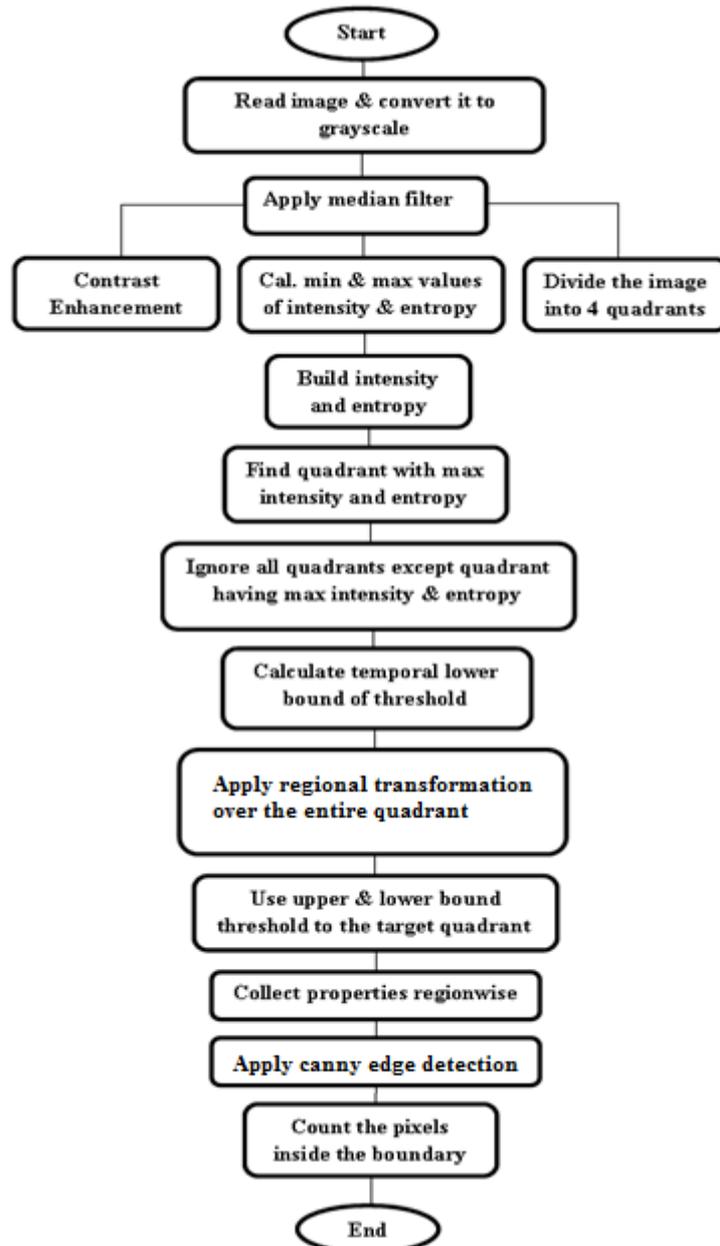
Our research paper “Detecting Demarking and Quantifying Using A Hybrid Approach” focused on the brain tumor detection in brain and also calculates the effective area. Brain tumor detection is a irksome task as it requires the skillful techniques to exactly identifying the affected area. This method has to detect, locate and evaluate the tumor effected portion. The location of benign brain tumor is an easy task as it has a natural outlining around it and does not have deep marks as in case of malignant tumor. The brain image is classify into number of parts when MRI is done and through analysis are performed on the image to find the tumor part. The type of tumor is discriminated by analyzing the parts if there is benign tumor it is seen in some parts of image only but if tumor is malignant in nature it goes into deeper parts of tissue. This property helps us to identify the type of tumor and also we have to study some other prominent features to generate the exactly tumor portion which cause abnormality in the brain functions..

II. RELATED WORK

Tumor segmentation from magnetic resonance (MR) images by hybrid approach helps to detect tumor and tumor treatment by tracking the tumor growth. Nobuyuki Otsua [1] has given a technique of automatic threshold the picture segmentation. Michael R. Kaus et.al [2] had made an automatic brain tumor analysis method which was gives precise results as compare to manual segmentation with 3-D magnetic resonance images. Lynn M. Fletcher-Heath et.al [3] in their research stated that the automatic analysis method which separate brain tumors which are non-enhancing from cells in MR images which helps in calculating tumor size over time. Alain Pitiot et.al [4] presented a fully automated technique for medical figures. Djamal Boukerroui et.al [5] proposed strong method to specially analyse noisy images, within a Bayesian framework. Kristin R. Swanson et.al [6] Inspects the aspects of advancements in mathematical modeling of gliomas in the study. Yuri Boykov et.al [7] gives low/high flow graphs to determine energy in low level vision. Stuart S. C. Burnett et.al [8] developed a deformable-template algorithm for the semiautomatic delineation of normal tissue structures on computed tomography images. Weibei Dou et.al [9] proposed a framework of fuzzy information fusion in this paper to automatically segment tumor areas of human brain from multispectral magnetic resonance imaging (MRI) such as T1-weighted, T2-weighted and proton density (PD) images. Kyungsuk (Peter) Pyun et.al [10] has developed a multiclass image segmentation method using hidden Markov Gauss mixture models (HMGMs) and provide examples of segmentation of aerial images and textures. Hassan Khotanlou et.al [11] has

presented a new general method for segmenting brain tumors in 3D magnetic resonance images. Under the scope of this paper the basic features of tumors demarcation such as texture information have not been taken into consideration while designing the algorithm. Jason J. Corso et.al [12] presented a new method for automatic segmentation of heterogeneous image data that takes a step toward bridging the gap between bottom-up affinity-based segmentation methods and top-down generative model based approaches. T. Logeswari et.al [13] in their paper had described a segmentation method consisting of two phases. Sufyan Y. Ababneh et.al [14] has proposed a new, fully automated, content-based system is proposed for knee bone segmentation from magnetic resonance images (MRI). P. Narendran et.al [15] tried to segment brain tumors, their components (edema and necrosis) and internal structures of the brain in 3D MR images. Sudipta Roy et.al [16] in their work introduced a fully automatic algorithm to detect brain tumors by using symmetry analysis. Mukesh Kumar et. Al [17] used the texture analysis and seeded region growing method which is based on texture of the MRI. Although the author tried to minimize the total execution time of this method but still it takes minimum more than 8 seconds to provide its results..

III. PROPOSED WORK



The presented research paper constitutes of an algorithm that was crafted using the hybrid approach of combination of the technique of image model, another is extended maxima transformation, followed by regional maxima transformation. Later on through canny edge detection algorithm the edges of the tumor has been outlined for clear cut view of the tumor portion. Before applying hybrid approach onto the image the combination of filters i.e. gabor filter and median filter are also being applied.

Step 1: Read the image and convert it to RGB from grey scale: The picture or image is the collection of data or say information that is organized in matrix (matrices) fashion. The image data matrix consists of numerals that indicate RGB (red, blue and green) pixels and their alterations at a distinct position. In matlab to read an image the imread command is

used and through this command the image from graphics file is being read. Next task is the conversion of colored image into grayscale image and for that matter there are 2 key mechanisms: first one is the average mechanism and the second mechanism is weighted or luminosity mechanism. The very first method i.e. average method is very uncomplicated one as it evaluates the grayscale image by calculating the mean (average) of red, green and blue.

$$\text{Grayscale image} = (R + G + B / 3) \dots\dots\dots (1)$$

But the above mentioned conversion has a major drawback that it turns the image black because of determining the average of the three colors red, green and blue. Moreover these 3 colors have 3 various wavelengths that devote accordingly in generating an image in their own possible way. To overcome such situation another mechanism i.e. luminosity method was developed. Technical fact about these colors is that the wavelength of red color is more than the wavelengths of green color and the blue color. The green color provides calming effect to the eyes of the seeker and its wavelength is lesser than the red color. In simple words, the influence of red color has to be reduced and on other hand the green color must be enhanced so that the limit of blue color can be set between red and green. The equation formed for luminosity method is:

$$\text{New Grayscale image} = ((0.3 * R) + (0.59 * G) + (0.11 * B)) \dots\dots\dots (2)$$

Now according to this equation the red color has devoted 33%, the contribution of green color is 59% (which is more than red and blue) and blue has committed only 11% of it.

Step 2: Preprocessing steps: The adaptive filter and the gabor filter have been applied for removing the noise from the image and extracting the useful features from the image respectively.

Step 3: Grayscale Figure Contrast Augment: The technique of contrast augment of images plays a vital role in improving the quality of MRI images and detection of tumor will be lot easier after removing the noisy & brightening up the images. The more clear the image we get it is more easier by the doctor to detect the tumor effected portion in the brain. Imadjust function in the matlab is performed to increase the contrast in the MRI grayscale pictures by creating gamma (γ) transformation. We can brighten up (if $\gamma < 1$) and darken up (if $\gamma > 1$) the images by using the gamma compression. Gamma compression is defined by following terms:

$$V_{out} = AV_{in}^{\gamma} \dots\dots\dots (3)$$

where A is a constant.

Step 4: Than the picture is cut into four equal parts to calculate max and min pixels and working on parts is more easier way to detect tumor in whole image. Than entropy is applied over it by the algorithm below

$$etp = - \sum(p.*\log_2(p)) \dots\dots\dots (4)$$

where p contains the histogram counts returned from imhist.

Than Intensity is adjustment by an image enhancement technique

Step 5: Entropy and intensity of each part is calculated and collected to build up a matrix. The quadrant with maximum intensity is separated out as this is more spectacle of having tumor. After getting that quadrant next step is to work on that quadrant to locate the tumor region in that part.

Step 6: The lower and upper bound threshold is applied to the selective quadrant and calculated temporal values like non linearity, signal dependent and independent noise is derived. Lower bound is derived by average mean-square errors method for any unbiased image restoration scheme. It is expressed analytically as a parameter of degradation of imaging methods. After that calculated values of upper and lower bound threshold is applied onto the selected quadrant.

Step 7: Transformation: Next step is to apply transformations to get tumor portion with highest value of intensity. Two type of transformation is applied i.e. extended maxima transformation, regional maxima transformation. The part with lower pixels will have no chance of having tumor hence neglected and transformations is applied on every part to get highest pixels region

Step 8: Properties of the region: The properties of the region is analysed and tries to find the properties of tumor present in the brain which is a connected component. The most probable region with tumor properties is selected and to sure it when it's a tumor or not regionprops command of matlab over the selected portion is applied to clarify it. We also look solidity property of the selected region which is convex in nature to ensure tumor as they are generally uneven in shape.

Step9: Canny Egde Detection: The canny edge detection technique in image processing that detects the edges of an object. In our proposed work canny edge detection has been used for the detection of tumor portion in human brain.

Step 10: The outside boundary of a suspected area is marked which matches the maximum intensity profile. The detected tumor portion is separated out and tumor effected part is clearly visible to analyzed and easily differentiated with other parts.

Step 11: The number of pixels in the separated tumor part is counted within the highlighted portion. At last the tumor portion is clearly visible with highest intensity of pixels and different color is shown for it

IV. RESULTS AND ANALYSIS



Fig 1. Snapshots of results

Table 1: RESULTS OF 5 DIFFERENT CASES

Image name	Image size	Tumor size (in pixels)	Execution time (in sec)
Tumoring1	300 X 300	50128	1.564
Tumoring2	300 X 300	156432	3.336
Tumoring3	300 X 300	44612	2.183
Tumoring4	300 X 300	95483	2.451
Tumoring5	300 X 300	127340	3.148

V. CONCLUSIONS

The results shown above signify that the proposed algorithm is superior to the preceding because the total time for execution taken by this method is far less than that. Another important benefit of the presented work is that it divides the image into 4 equal quadrants and will look for the quadrant having highest entropy, intensity and solidity matrix and finally transforming the image. Due to these characteristics it would be easy to locate the area where there is tumor. Due to which the computation has also been reduced. In future further to this, it is recommended that the researcher must take asset of non-parameterized machine learning algorithms which makes use of regression decision tree to reach onto the allotment of areas with and without tumor.

REFERENCES

- [1] Nobuyuki Otsu, "A Threshold Selection Method from Gray-Level Histograms", IEEE Transactions on systems, Man, and Cybernetics, Vol. SMC-9, No. 1, January 1979.
- [2] Michael R. Kaus, Simon K. Warfield, Arya Nabavi, Peter M. Black, Ferenc A. Jolesz, Ron Kikinis, "Automated Segmentation of MR Images of Brain Tumors" Radiology; 218:586–591, Magnetic resonance (MR), Volume measurement, 10.121412, 10.12143, 2001.
- [3] Lynn M. Fletcher-Heath, Lawrence O. Halla, Dmitry B. Goldgofa, F. Reed Murtagh, "Automatic segmentation of non-enhancing brain tumors in magnetic resonance images" Artificial Intelligence in Medicine 21: 43-63, Elsevier Science B.V., 2001.
- [4] Alain Pitiot, A.W. Toga, P.M. Thompson, "Adaptive elastic segmentation of brain MRI via shape-model-guided evolutionary programming" IEEE Transactions on Medical Imaging, Vol.: 21, Issue: 8, Aug. 2002.
- [5] DjamelBoukerroui, AtillaBaskurt,J.Alison Noble, Olivier Basset, "Segmentation of ultrasound images—multiresolution 2D and 3D algorithm based on global and local statistics" Elsevier Science B.V, Vol. 24, Issues 4–5, February 2003.
- [6] Kristin R. Swanson, Carly Bridge, J.D. Murray, Ellsworth C. Alvord Jr, "Virtual and real brain tumors: using mathematical modeling to quantify glioma growth and invasion" Elsevier B.V, Vol. 216, Issue 1, 15 December 2003.
- [7] Yuri Boykov, Vladimir Kolmogorov, "An Experimental Comparison of Min-Cut/Max-Flow Algorithms for Energy Minimization in Vision" IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol. 26, No. 9, September 2004.
- [8] Stuart S. C. Burnett, George Starkschall, Craig W. Stevens, Zhongxing Liao, "A deformable-model approach to semi-automatic segmentation of CT images demonstrated by application to the spinal canal" The International Journal of Medical Physics Research and Practice, Medical Physics 31, 251 (2004), 22 January 2004.
- [9] Weibei Dou, Su Ruan, Yanping Chen, Daniel Bloyet, Jean-Marc Constans, "A framework of fuzzy information fusion for the segmentation of brain tumor tissues on MR images" Elsevier B.V, Vol. 25, Issue 2, 2006.
- [10] Kyungsuk (Peter) Pyun, Johan Lim, Chee Sun Won, Robert M. Gray, "Image Segmentation Using Hidden Markov Gauss Mixture Models" IEEE Transactions on Image Processing, Vol. 16, No. 7, July 2007.
- [11] Hassan Khotanlou, Olivier Colliot, Isabelle Bloch "Automatic brain tumor segmentation using symmetry analysis and deformable models" Bu Ali Sina University and Paristechile de France, 2008.
- [12] Jason J. Corso, Eitan Sharon, ShishirDube, Suzie El-Saden, Usha Sinha, Alan Yuille, "Efficient Multilevel Brain Tumor Segmentation With Integrated Bayesian Model Classification" IEEE Transactions on Medical Imaging, Vol. 27, No. 5, May 2008.
- [13] T. Logeswari, M. Karnan, "An improved implementation of brain tumor detection using segmentation based on soft computing" Journal of Cancer Research and Experimental Oncology Vol. 2(1) pp. 006-014, March, 2010.
- [14] Sufyan Y. Ababneh, Jeff W. Prescott, Metin N. Gurcan, "Automatic graph-cut based segmentation of bones from knee magnetic resonance images for osteoarthritis research" Elsevier B.V., Vol. 15, Issue 4, August 2011.
- [15] P. Narendran, Mr. V.K. Narendira Kumar, Dr. K. Somasundaram, "3D Brain Tumors and Internal Brain Structures Segmentation in MR Images" I.J. Image, Graphics and Signal Processing, 1, 35-43, February 2012.
- [16] Sudipta Roy, Samir K. Bandyopadhyay "Detection and Quantification of Brain Tumor from MRI of Brain and it's Symmetric Analysis" International Journal of Information and Communication Technology Research, Vol. 2 No. 6, June 2012.
- [17] Mukesh Kumar, Kamal K.Mehta "A Texture based Tumor detection and automatic Segmentation using Seeded Region Growing Method" International Journal of Computer Technology and Applications, Vol 2 (4), 855-859, August 2011.

- [18] Ngah, U. K., Ooi, T. H., Sulaiman, S. N. & Venkatachalam, P. A. (2002). Embedded Enhancement Image Processing Techniques on A Demarcated Seed Based Grown Region. Proc. of Kuala Lumpur Int. Conf. on Biomedical Engineering. 170-172.
- [19] Lim, E. E., Venkatachalam, P. A., Ngah, U. K. & Khalid, N. E. A. (1999). "Liver Disease Diagnosis by Region Growing". Proceedings of International Conference on Robotics, Vision and Parallel Processing for Automation. 1. 38-45.
- [20] Khalid, N. E. A., Venkatachalam, P. A. & Ngah, U. K. (1999). "Diagnosis of Bone Lesion Based on Histogram Equalization". Proceedings of International Conference on Robotics, Vision and Parallel Processing for Automation. 1. 91-96.