Australian Journal of Basic and Applied Sciences, 9(5) March 2015, Pages: 1-7

ISSN:1991-8178

Australian Journal of Basic and Applied Sciences

Journal home page: www.ajbasweb.com

Comparative Analysis of Zernike Moments With Region Grows Algorithm on Mri Scan Images for Brain Tumor Detection

[1]G.Nallasivan, [2]Dr. S. Janakiraman and [3]Ishwarya

[1]*Einstein College of Engineering, Asssociate Professor, Computer Science and Engineering Department, 627 012.Tirunelveli. Tamilnadu, India*
[2]*Pondichery University, Assistant Professor, Department of Banking Technology, Pondichery-14.India*
[3]*Einstein College of Engineering, PG Student, Computer Science and Engineering Department, 627 012.Tirunelveli. Tamilnadu, India*

ARTICLE INFO

Article history:
Received 12 November 2014
Received in revised form 26 December 2014
Accepted 29 January 2015
Available online 10 February 2015

Keywords:
Zernikemoments;MRI;RegionGrowing method;RootMeanSquareError;Time Complexity;

ABSTRACT

Orthogonal moment functions are very useful in Image feature representation in many applications like invariant pattern recognition of images, identification of objects and reconstruction of images. Zernike moments are popular in the sense that, feature representation can be achieved with a minimal information redundancy measure. The objective of the proposed work is to estimate the efficiency of Zernike Moment over Region Growing method for the detection of tumor on MRI images and this work is a modest part of a quite complex system. Tumor is a disorder that occurs due to the abnormal growth of tissues. For the detection of tumor, an efficient method is required which can detects the tumor efficiently with little time complexity and error factor. In this paper, we are comparing the Zernike Moment with Region Growing Algorithm. Detecting tumor with Region Grows approach has some drawbacks in terms of time complexity and error analysis. For overcoming the crucial methodology it is proposed that the Zernike moments based feature extraction of the image. In this paper the brain tumor is detected with the usage of low order Zernike moments. The brain image is feed in to different stages like preprocessing using High pass kernel filter, segmenting the image using K Means and Watershed method, feature extraction and finally the tumor part of the brain image is identified efficiently. In the feature extraction part, the image is divided in to two portions from the center and the pixels average value located at the central are calculated. Now the new feature vectors are formed based on the average value of the pixel calculated. The value obtained from the low order Zernike moments are found to be suitable for calculation and hence to obtain the threshold value to extract the tumor from the image. The Magnetic Resonance Image (MRI) scan images of the brain with and without tumor is applied as input and the results of the two methods are compared with Time Complexity and Root Mean Square Error (RMSE), and the superiority of Zernike Moments have been proved.

To Cite This Article: G.Nallasivan, Dr. S. Janakiraman and Ishwarya., Comparative Analysis of Zernike Moments With Region Grows Algorithm on Mri Scan Images for Brain Tumor Detection. ***Aust. J. Basic & Appl. Sci.***, *9(5): 1-7, 2015*

INTRODUCTION

Brain tumor is one of the major causes for the increase in mortality among children and adults. The motivation for this paper is to overcome the difficulties in tumor detection by the surgeons using Image analysis. In India, totally 80,271 people are affected by various types of tumor. Like this all over the world according to The National Brain Tumor Foundation (NBTF) many people lost their lives who have diagnosed with primary brain tumors each year. Thus for detecting tumor there are some techniques by using Artificial Neural Networks and some computerized techniques are essential at the moment for easy diagnose. The techniques generally used to detect brain tumor are ultrasound, Computer Tomography (CT scan) and Magnetic Resonance Imaging (MRI). From these techniques we are using MRI scan images for the detection of Brain tumor. MRI images are the medical imaging technique that records changing magnetic fields also called Nuclear Magnetic Resonance (NMR) and can give different kinds of images based on the pulse sequence which makes it capable of complete body scans, but commonly used for brain. A brain tumor is defined as an abnormal growth of cells within the brain. Due to some unknown reasons, some brain cells multiply in an uncontrolled manner and form these types of

Corresponding Author: G.Nallasivan, Einstein college of Engineering, CSE department,627 012. Tamilnadu, India

tumors in the brain. These tumors can occur from any part of the brain like spinal cord or from the nerves. Widely these tumors can be divided into benign and malignant tumors. Tumors are formed by an abnormal and uncontrolled cell division, normally in the brain itself. The threat level depends on the combination of factors like the type of tumor, location, size and its state of development. As the brain is protected by the skull, the fast detection of a brain tumor only occurs when diagnostic tools are directed at the intracranial cavity. The aim of this work is to design an automated tool for brain tumor quantification using MRI image data sets. This is to segment a tumor in a brain, which makes surgeons able to identify the tumor and then ease the treatment without any open surgery.

MATERIALS AND METHODS

The proposed architecture for the Brain tumor detection from the MRI Scan image is given in the Figure.1

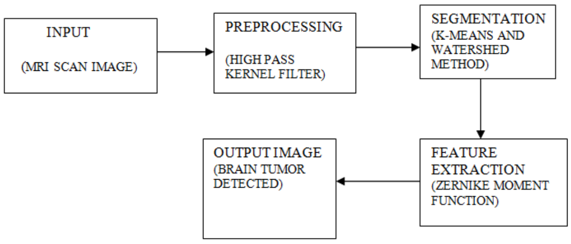

Fig. 1: Proposed architecture using Zernike moments.

In the proposed technique an MRI image is given as the input and the preprocessing is done by using the high pass kernel filter manually. After the preprocessing segmentation of the image is done through k-means algorithm and watershed method k-means algorithm to segment the image by threshold values and the watershed method is used to enhance the quality of the segmented image. After the segmentation the feature extraction and selection of the image is done for the tumor detection and through the morphological operations of the Zernike moment the output image is obtained.

Preprocessing:

Preprocessing is done to remove the noise from the image and is done by using hi pass kernel filter. The original input image is first converted into gray scale image and by using a high pass kernel filter the image is filtered to remove the noise and to enhance its quality the image is again passed through a median filter.

Segmentation:

The procedure for segmenting the preprocessed image is given below:

1. The first step is to read a chosen test image
2. Secondly, the test image had to be converted to a gray level image so that thresholding would be possible.
3. The result of merging the test image can be as in this image that each of the objects in the original image has a unique gray-level value. This is done so that each object can be recognized.

To convert a gray image into a binary image, we have to choose a threshold, and then if the gray value of the given image is greater than that threshold, we assign a value and if less than or equal to threshold we will assign some other value. So that the resultant image will have only two values (binary).

The different ways to choose the threshold are:

i). Threshold= Average of all the gray values of the given image.
ii). Threshold= (minimum value + maximum value)/2
iii). Threshold= Median of given gray values.

Feature Extraction:

Zernike moments are based on complex polynomials that form a complete orthogonal set on a unit circle. In the feature extraction process the Zernike moment function is applied. The image is divided into two portions of hemispheres which can contain complex Zernike Moment value of the pixels located at the center boundary The of the image. Let us assume that f(x,y) is the image generated by the complex Zernike Moment value. b(x,y) is the image pixels value which are placed at the center boundary of the image (Kiran Thapaliya, 2013). We can calculate the average pixel value at the center of the circle by using the following equation

$$Avg\,value = \frac{1}{N}\sum_{x=0}^{x=x-1}\sum_{y=0}^{y=y-1} b(x,y) \quad (1)$$

Where N is the total number of pixels placed at the center boundary of the scan image. The image is divided into left and right hemispheres and by choosing the minimum pixel value from the left hemispheres of the divided image and then occur vector of all the pixels that lies between the minimum value of pixels from the right hemispheres of the image to the Average value of the central boundary of the image .Thus the vector created is in the range of minimum value of pixel from the left and right hemispheres to the average value of the calculated central boundary pixel (Kiran Thapaliya, 2013).

Then applying the Zernike moment function (2) the tumor can be efficiently retrieved. The complex Zernike polynomial that form a complete orthogonal set on a unit circle are given by

$$A_{nm} = \frac{n+1}{\pi}\sum_x\sum_y f(x,y)v_{nm}^*(\rho,\theta) \quad (2)$$

$$= \frac{n+1}{\pi}\sum_{\rho=0}^{1}\sum_{\theta=o}^{2\pi} f(\rho,\theta)R_{nm}(\rho)e^{-im\theta}$$

$$= \frac{n+1}{\pi}\sum_{\rho=0}^{1} R_{nm}(\rho)\sum_{\theta=0}^{2\pi} f(\rho,\theta)e^{-im\theta}$$

$$v_{nm} = v_{nm}(\rho,\theta) = R_{nm}(\rho)e^{im\theta}$$

Where n is the non negative integer and m is a non zero integer under the condition n-|m| is even and |m|<=n. We are using Low order Zernike Moments for the morphological operations for the efficient detection of Tumor.

Region Growing Method:

The Region growing algorithm way of detecting the Brain tumor is the second task of this paper and the performance is compared with the proposed method. The block diagram for the Region Grow method is shown in the figure 2.

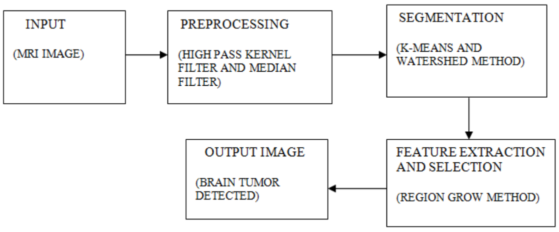

Fig. 2: Region grow method of Brain Tumor Detection.

Results:

The proposed method is tested with different MRI scan images and the brain tumor having different intensity, shape and size. The method was tested with Matlab2013 .For calculating the efficiency; we are using two methods RMSE and Time complexity calculation for proving the superiority of the proposed method.

Discussion:

Time Complexity:

The time complexity to detect the Brain tumor of the proposed method and the Region Grows method are shown in the following table.

From the Table1, the time complexity for the Zernike moments is very less when compared to Region Grows Method.

RMSE: Root Mean Square error method:

RMSE is a quadratic scoring rule which measures the average magnitude of the error. The RMSE is calculated as

$$RMSE = \sqrt{\frac{\sum_{i=1}^{n}(Q_m - Q_A)^2}{n}} \quad (3)$$

Qm and Qn are tumor voxels segmented manually and n is the size of the image. RMSE value for different images using different method is shown in the Table.2

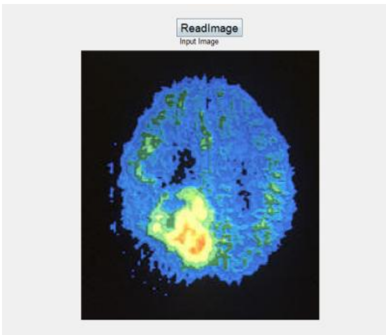

Fig. 3: Input MRI Scan Brain Image1.

Australian Journal of Basic and Applied Sciences, 9(5) March 2015, Pages: 1-7

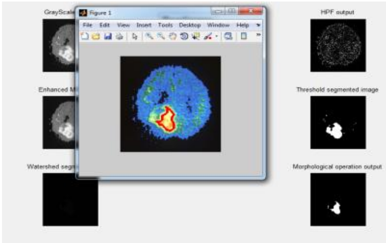

Fig. 4: Region Grows output for Input image1.

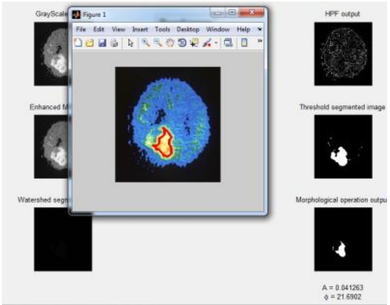

Fig. 5: Zernike Moment Output for Input image1.

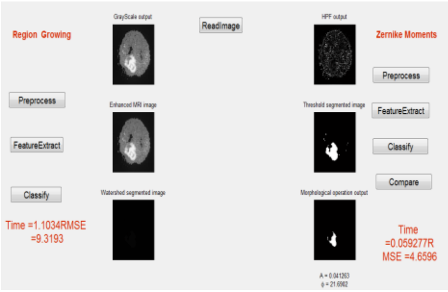

Fig. 6: Comparison of Region Grows with Zernike Moment.

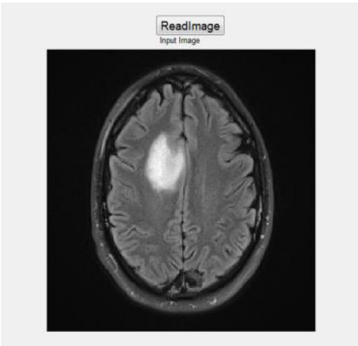

Fig. 7: Input image 2.

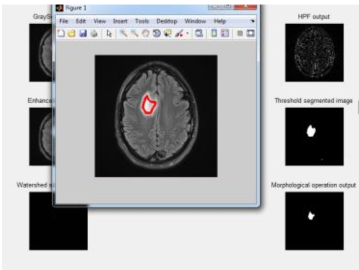

Fig. 8: Region Grows Output for Input image2.

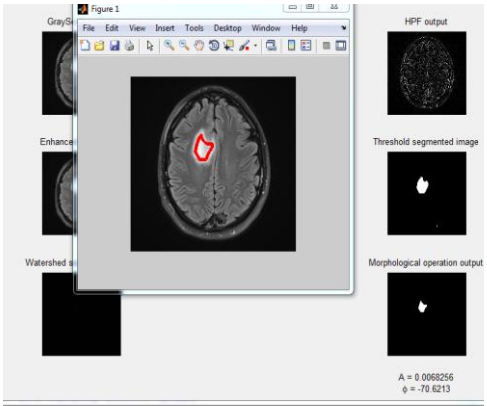

Fig. 9: ZernikeMoment Output for input image2.

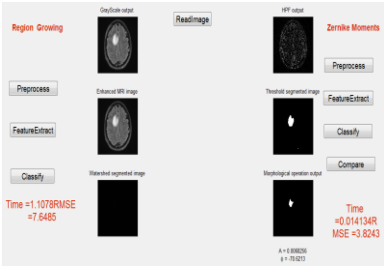

Fig. 10: Comparisons of Region Grows with Zernike moments for Input Image 2.

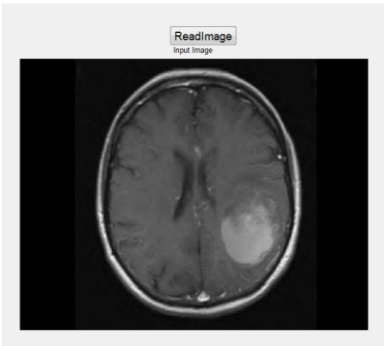

Fig. 11: Input image 3.

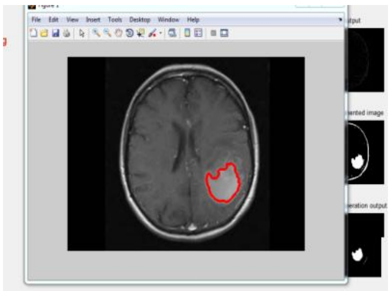

Fig. 12: Output image of Zernike moment for input3.

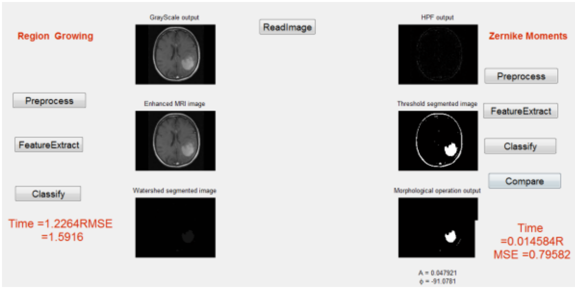

Fig. 13: Comparison of Region grows with Zernike moments for Input image 3.

Table 1: Time Complexity of 3 Input images of Region Grows with Zernike Moment.

Input Image	Region Grows in Sec	Zernike Moment in sec
1	1.1034	0.059277
2	1.1078	0.014134
3	1.2264	0.014584

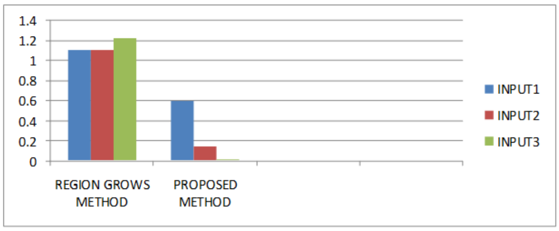

Fig. 13: Comparison chart of Time complexity of Proposed Zernike moment with Region grow method.

Table 2: RMSE of 3 Input Images with Region Grows and Zernike Moments.

Input Image	Region Grows	Zernike Moment
1	9.3193	4.6596
2	7.6485	3.8243
3	1.5916	0.79582

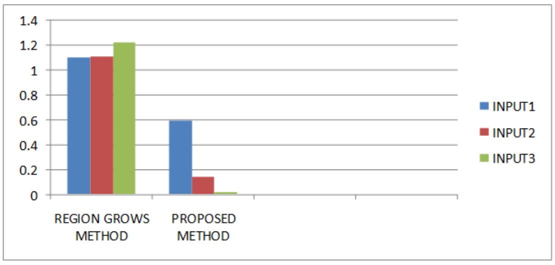

Fig. 14: Comparison of RMSE of Proposed Zernike moment with Region Grow method.

Conclusion:

From the proposed work, it is observed that for the detection of brain tumor on the given MRI scan images the feature extraction using Zernike Moment and Region grow methods have been implemented and compared. On comparison, it is observed that the Zernike moment based feature extraction has maintained good performance in terms of error analysis and time complexity when compared with Region grows method. The computed lower order Zernike moments can play a vital role in extracting the tumor part efficiently from the brain tumor images. The method suggested in this paper is simple and even it is capable to extract the tumor part with less time and error when compared to Region grow method for the various MRI brain scan images.

REFERENCES

Bailey R.R. and M. Srinath, 1996. 'Orthogonal Moment Features for use with Parametric and Non-parametric Classifiers', IEEE Trans. Pattern anal. Mach. Intel., 18: 389-400.

Chunyan, J., 2004. 'Segmentation and Quantification of Brain Tumor', IEEE international Conference on Virtual Environment, Human-Computer Interfaces and Measurement Systems, pp:

Australian Journal of Basic and Applied Sciences, 9(5) March 2015, Pages: 1-7

61-66. Sh. Li, M.Ch. Lee, and Ch.M. Pun, “Complex Zernike Moments.

Clark, 1998. ‘Automatic Tumor Segmentation using Knowledge based Techniques,’ IEEE Transactions on Medical Imaging, 117: 187-201.

Fletcher-Heath, 2001. ‘Automatic Segmentation of Non enhancing Brain Tumor in MR Images,’ Artificial Intelligence in Medicine, 21: 43-63.

Haddadnia, J., 2003. ‘An Efficient Feature Extraction Method with Pseudo-Zernike Moment in RBF Neural Network-based Human Face Recognition System,’ Journal of Applied Signal Processing, 9: 890-901.

Hwang S.K. and W.Y. Kim, 2006. A Novel Approach to the Fast Computation of Zernike Moments,” Pattern Recognition, 39: 2065-2076.

Khotanzad, A. and Y.H. Hong, 1990. ‘Rotation Invariant Image Recognition Using Features Selected via a Systematic Method,’ Pattern Recognition, 23(10): 1089-1101.

Kiran Thapaliya, 2013. ‘Detection of Brain Tumor Using Zernike Moments on Magnetic Resonance Images*’ ICCGI*: The Eighth International Multi-Conference on Computing in the Global Information Technology.

Li, X. and A. Song, 2010. A New Edge Detection Method Using Gaussian–Zernike Moment Operator,’ In Proceedings of the IEEE, 2nd International Asia Conference on Informatics in Control, 1: 276-279.

Moon, N., 2002. ‘Model based Brain and Tumor Segmentation,’ Proc. of ICPR, pp: 528-531.

Otsu, N., 1979. ‘A Threshold Selection Method from Grey level Histogram ,’IEEE Transactions on System, Man and Cybernetic, 9: 62-66.

Prastawa, M., E. Bullitt, S. Ho and G. Gerig, 2004. ‘A Brain Tumor Segmentation Framework based on OutlierDetection,’ Medical Image Analysis, 8: 275-283.

Rajamani V and Murugavalli S(2006), ‘A High Speed Parallel Fuzzy C-means Algorithm for Brain Tumor Segmentation,’ ICGIST International Journal on BIME, 6: 29-34.