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Brain Tumour Extraction using Otsu Based Threshold Segmentation

Kirti Mittal, Abhishek Shekhar, Prashant Singh, Manish Kumar
Computer Science Engineering, Galgotias College of Engineering and Technology, Greater Noida, Uttar Pradesh, India

Abstract: Brain tumor is a serious life altering disease condition. It occurs by means of abnormal cells which form within the brain. Tumour Detection is one of the most important methods used in image processing. In the past few years, there are numerous techniques that have been proposed. In this paper, we presented an abstract automated and accurate method to classify a given MR brain image as normal or abnormal. The proposed method first employs high pass filters for noise removal from images, followed by applying medium pass filters to enhance the quality of image. The extracted features were submitted to segmentation technique followed by morphological filtering which avoids the misclustered regions that can inevitably be formed after segmentation of the brain MRI image for detection of tumor location.

Key Words: MRI, segmentation, morphology, Otsu algorithm, topological gradient, watershed transformation.

I. INTRODUCTION

The brain is the anterior most part of the central nervous system. Nature has tightly safeguarded the brain inside a skull that hinders the study of its function as well as makes the diagnosis of its diseases more intricate. Brain tumour is the collection or growth of abnormal cells in the brain. Brain tumors can be cancerous and non cancerous, and either malignant or benign. Malignancy is the type of tumor that grows worse with the passage of time and ultimately results in the death of a person. It is risk compared to the non cancerous brain tumour.The other type is the non cancerous brain tumor which is called as Benign. It is the normal brain tumour present in the brain. It is less risk compared to the malignant tumour since it is the initial stage of tumour.

MRI is a medical imaging technique and radiologists use it for visualization of the internal structure of the body. In Magnetic Resonance Imaging (MRI), by means of a strong magnetism field and radio waves three dimensional images of hidden organs were obtained for diagnosing. These MRI techniques were completely free from ionized radiations. This fact makes MRI more popular and enables effective medical imaging techniques among the rest . It is an advanced medical imaging technique used to produce high quality images of the body parts. From these high-resolution images, we can derive detailed anatomical information to examine human brain development and discover abnormalities.

The primary step in image analysis is pre-processing of MRI images which perform image enhancement and noise- reduction techniques which are used to enhance the image quality, then some morphological operations are applied to detect the tumor in the image.

Based on some assumptions about the size and shape of the tumour, the morphological operations are applied on the image. In the end, the tumour is mapped onto the original gray scale image with 255 intensity to make it visible.

II. PROPOSED METHODOLOGY

In order to segment tumour regions from MRI image an efficient algorithm is used.This algorithm is mainly used for segmentation process. It is performed by dividing the whole process into three stages such as Pre-processing stage, Segmentation stage and Output stage. Each stage performs a specific function. Steps of algorithm are as following:-

A. Pre-Processing Stage
B. Segmentation Stage
C. Output Stage

Finally output will be a tumour region.

A. Pre-Processing Stage

In the pre-processing stage, we have four steps namely

1) MRI Input Image
2) Gray Scale Image
3) High pass filter
4) Median pass filter

MRI images are magnetic resonance images which can be acquired on computer when a patient is scanned by MRI machine. It has the RGB (Red Green Blue) mixing present in it. Since MRI input image contains some RGB mixing in it, we cannot get a clear expected output. Hence the input image is converted to gray scale image which is the black and white image.

Grayscale is a range of shades of gray without apparent color. The image ranges from 0 to 255. The range 0 defines the black colour and the range 255 defines the white colour.The converted gray scale image consist of some noise in the image. The output will not be clear with the noise present in the gray scale image. Hence we use High pass filter to remove such noise and also to sharpen and brighten the image.

A high pass filter is the basis for most sharpening methods. A high-pass filter is a filter that passes high frequencies well, but attenuates frequencies lower than the cut-off frequency.The kernel of the high pass filter increases the brightness of the center pixel relative to neighboring pixels.Its array usually contains a single positive value at its center, which is completely surrounded by negative values.

After passing through high pass filter, image is passed through a median pass filter.This filter enhance the quality of the MRI image. It is very widely used in digital image processing because, under certain conditions, it preserves edges while removing noise.

B. Segmentation Stage

The second stage is the segmentation stage where we use threshold segmentation along with watershed technique. Segmentation is the process of partitioning a digital image into multiple segments.The goal of segmentation is to simplify the representation of an image into something that is more meaningful and easier to analyze.

Threshold Segmentation is one of the simplest method in the segmentation techniques. In this method, the pixels are divided according to the intensity value and are separated. The basic idea of thresholding is to select an optimal gray-level threshold value for separating objects of interest in an image from the background based on their gray-level distribution.

Thresholding operation is defined as:

T = M [x, y, a(x, y), b (x, y)]

In given equation , T stands for the threshold; a (x, y) is the gray value of point (x, y) and b(x, y) denotes some local property of the point such as the average gray value of the neighborhood centered on point (x, y)

Based on this, there are two types of thresholding methods.

1) Global thresholding: When threshold T depends only on gray-level values i.e. a(x,y) and the value of T solely relates to the character of pixels, this thresholding technique is called global thresholding.

2) Local thresholding: If threshold T depends on b(x, y) and a(x, y), this thresholding is called local thresholding. This method divides an original image into several sub regions, and chooses various thresholds T for each sub region reasonably.

Otsu method is type of global thresholding in which it depend only on gray value of the image. It is widely used because it is simple and effective. Otsu's thresholding chooses the threshold to minimize the intraclass variance of the thresholded black and white pixels. Otsu's method is implemented in MATLAB as "graythresh".

In this method, two dimensional histogram is projected onto the diagonal and then applied to 2D Otsu on that histogram to find the optimal threshold value. The result of experiment showed that it operates directly on the gray level histogram so it greatly enhanced the speed of thresholding and has better noise immunity.

As a result of the segmentation, a set of contours extracted from the image. Each of the pixels in a region are similar with respect to some characteristic such as color, intensity, or texture whereas adjacent regions are significantly different with respect to the same characteristic When applied to a stack of images, the resulting contours after image segmentation can be used to create 3D reconstructions.

In order to avoid oversegmentation of image, we propose a watershed algorithm based on the topological gradient method. The main idea of this work is to take advantage of the topological gradien efficiency, to detect the main contours with an interesting computational cost (the topological gradient algorithms require only three system resolutions) and to overcome the drawback of the topological gradient approach by using a method giving closed contours.

Topological gradient algorithm

Let Ω be an open bounded domain of R^2 and

$j(\Omega) = J(u\Omega)$ be a cost function to be minimized,

where $u\Omega$ is the solution to a given PDE problem defined in Ω. The initial problem reads as follows:

for a given function v in $L^2(\Omega)$, we have to find $u \in H1(\Omega)$ such that

$$\mathrm{div}(c\nabla u)+u = v \quad \text{in } \Omega ,$$
$$\partial n u = 0 \quad \text{on } \partial\Omega , \quad \text{Eq. (1)}$$

where c is a positive constant.

For a small $\rho \geq 0$, let $\Omega\rho = \Omega$¥$\sigma\rho$ be the perturbed domain by the insertion of a crack $\sigma\rho = x0 + \rho\sigma(n)$, where $x0 \in \Omega$, $\sigma(n)$ is a straight crack, and n a unit vector normal to the crack. The topological sensitivity theory provides an asymptotic expansion of j when ρ
tends to zero. It takes the general form

$$j(\Omega\rho) - j(\Omega) = f(\rho)G(x0,n) + \circ(f(\rho)) , \quad \text{Eq. (2)}$$

where $f(\rho)$ is an explicit positive function going to zero with ρ and $G(x0,n)$ is called the topological gradient at point $x0$.

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For a given function v in $L2(\Omega)$, we consider the following problem: find $u\rho \in H1(\Omega\rho)$ such that

$$\mathrm{div}(c\nabla u\rho) + u\rho = v \quad \text{in } \Omega\rho ,$$
$$\partial n u\rho = 0 \quad \text{on } \partial\Omega\rho . \quad \text{Eq. (3)}$$

by considering $v0$, the solution to the adjoint problem

$$\mathrm{div}(c\nabla v0) + v0 = -\partial u J(u) \text{ in } \Omega ,$$
$$\partial n v0 = 0 \quad \text{on } \partial\Omega . \quad \text{Eq. (4)}$$

Algorithm

- Initialization : $c = c0$.
- Calculation of $u0$ and $v0$ the solutions of the direct (Eq. 3) and adjoint (Eq. 4) problems .
- Computation of the 2×2 matrix M and its lowest eigenvalue λmin at each point of the domain W.
- Set
- $c1 = e$ if $x \in W$, $l min < a < 0$, $e > 0$
  $c0$ elsewhere.
- Compute $u1$, the solution of Eq. 1 with $c = c1$.

C. Output Stage

It gives the final output from given MRI input. In this stage, morphological operations are carried out on segmented image. Morphological image processing is a collection of non- linear operations related to the shape or morphology of features in an image.These techniques probe an image with a small shape or template called a structuring element. The structuring element is a small binary image, i.e. a small matrix of pixels, each with a value of zero or one.The dimensions of the matrix specify the size as well as the shape of the structuring element. The origin of the structuring element is one of its pixels which is generally outside the structuring element. It is positioned at all possible locations in the image and compared with the corresponding neighbourhood of pixels. Some operations test whether the element "fits" within the neighbourhood, while others test whether it "hits" or intersects the neighbourhood:The tumour present in the brain is segmented and it is shown in the white colour segmented image. It also specifies the type of the tumour.

III. RESULT AND CONCLUSION

As diagnosis tumor is a complicated and sensitive task; therefore,accuracy and reliability are always assigned much importance. Hence, an elaborated methodology that highlights new vistas for developing more robust image segmentation technique is much sought.Here figures show the images as an output. i.e grayscale image, high pass filtered image , threshold image, watershed segmented image, Finally input image and extracted tumour from MRI image. For this purpose real time patient data is taken for analysis.As tumour in MRI image have an intensity more than that of its background so it become very easy locate it and extract it from a MRI image.

Fig 1. Brain MRI Image

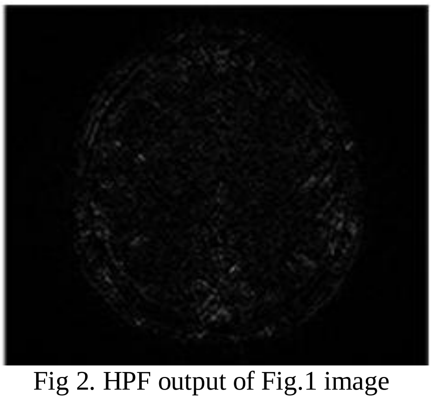

Fig 2. HPF output of Fig.1 image

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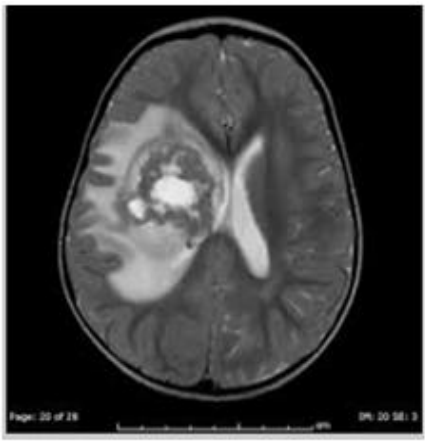

Fig 3. Otsu Thresholded Image

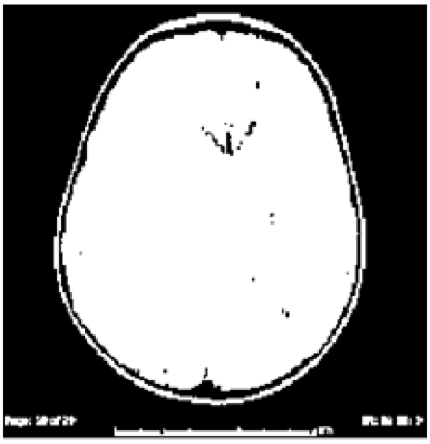

Fig 4. Enhanced MRI Image

Fig 5. Segmented Tumour

REFERENCES

[1] Roy.S and Bandyopadhyay S. K., "Detection and Quantification of Brain Tumor from MRI of Brain and it's Symmetric Analysis", International Journal of Information and Communication Technology Research, Volume 2 No. 6, June 2012.

[2] Dr.G.Padmavathi, Mr.M.Muthukumar and Mr. Suresh Kumar Thakur, "Non linear Image segmentation using fuzzy c means clustering method with thresholding for underwater images", IJCSI International Journal of Computer Science Issues, Vol. 7, Issue 3, No 9, May 2010

[3] N. Plataniotis, A.N. Venetsanopoulos, GGColor Image Processing And Applications", Springer (2000).

[4] Pitas, "Digital Image Processing Algorithms", Prentice Hall (1993).

[5] Er. Nirpjeet kaur and Er Rajpreeet kaur, "A review on various method of image thresholding",IJCSE-2011.

[6] Zhong Qu andLi Hang"Research on Iimage Segmentation Based on the Improved Otsu Algorithm.",2010

[7] T .Logeswari and M.Karnan "An improved implementation of brain tumor detection using segmentation based

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on soft computing" Journal of Cancer Research and Experimental Oncology Vol. 2(1) pp. 006-014 , March, 2010

[8] P. K. Sahoo, S. Soltani, A. K. C. Wong, and Y. Chen, "A survey of thresholding techniques," Computer Vision Graphics Image Processing, Vol. 41, 1988, pp. 233-260.

[9] P.V. Himali, M. Hardik, P. Manoj, M.B. Potdar, "Leukemia Detection Using Digital Image Processing Techniques". International Journal of Applied Information Systems, Vol:10, No:1, November. 2015.

[10] Brain Tumor MRI image segmentation and detection in image processing, Rohini Paul Joseph, eISSN: 2319-1163 | pISSN: 2321-7308

[11] Brain tumour extraction from MRI images using MATLAB,Rajesh.C, International Journal of Electronics, Communication & Soft Computing Science and Engineering,ISSN: 2277-9477, Volume 2,