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Research Article

AN APPROACH TO DETECT TUMOUR USING BOUNDARY TRACE AND IMAGE SUBTRACTION METHOD

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A R T I C L E I N F O

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A B S T R A C T

Morphometric assessment of tumor cells is important in the prediction of biological behaviour of brain cancer. In order to mechanize the process, the computer-based system has to develop, which can recognize the boundary of the cells. Many methods were proposed for the boundary detection in the literature. However, there is no such reliable method which locates the exact boundary of tumor in human brain. In the paper, a boundary edge detection method is used and is based on gamma correction, pseudo Coloring and Laplace mask. After applying the suitable method, image subtraction is applied over it. The method enhances the sharpness of pixels and effectively distinguishes between the tumorous cell and non-tumorous cell from the MRI image background.

INTRODUCTION

Brain MRI is a popular tool, which is used by clinical experts to diagnose various diseases and disorders of the brain like Alzheimer's disease, multiple sclerosis, Parkinson's disease, etc. These are usually affected by various artifacts and thermal noise; due to the limitations associated with the equipment used for imaging. The noise related factor degrades the quality of MR images and affects further quantitative assessment of the data. Therefore, it is desirable to remove noise from these images – a process referred to as image denoising [1].

The tumor is one of the abnormal growth tissues in the human body. Brain tumor is a tissue which grows in an irregular mass and multiplies uncontrollably. It seems that mechanisms use to control the growth of normal cells are still unchecked. Brain tumors can be categorized as primary or metastatic. It can be either malignant or benign or may be localized or extended. Secondary tumors could be in different locations whereas primary brain tumors seem to grow in brain cells, the membranes around the brain (meninges), nerves, or glands. These tumors can directly destroy cells of the brain. They can damage the cells by producing various inflammations, placing lots of pressure on other parts of the brain, and by increasing pressure within the skull. To identify a tumor, a patient will undergo several tests [1]. One should be careful when dealing with sensitive organs like the brain and hence most commonly techniques like Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) are used to locate brain tumor.

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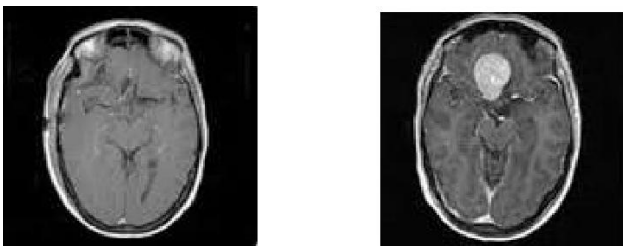
MRI is also called as Nuclear Magnetic Imaging or Magnetic Resonance Tomography. MRI makes a revolution in the medical field. Magnetic Resonance Imaging (MRI) is a medical imaging technique used to visualize the internal Structure of the body and provide high quality images. MRI provides a greater distinguishing between the different tissues of the body. MRI image texture contains a rich source of information such as characterize brightness, color, shape, size, and other features. MRI contains useful and fine information that can be used in improving the quality of diagnosis and treatment of brain [2].



(a) Normal tissues image (b) Abnormal tissues Image Fig 1 Tumorous image

The incidence of having brain tumors is increasing rapidly, mainly in the grown-up population as compared to the newer population. Over the last 20 years, brain cancer has increased by more than 10% as reported in the National Cancer Institute statistics (NCIS). The National Brain Tumor Society is committed to identifying and responding to the needs of the brain tumor community. In January of 2009, it released findings from a national survey of over 1,400 patients that were affected by brain tumors. Therefore, it is becoming increasingly important for us to detect a brain tumor at the

earliest stage of the tumor. Many different kinds of image processing techniques are used for diagnosing and visualizing the anatomical structures and metabolic or functional information on the human body. Nowadays there are several methodologies for classifying MRI brain images, which are fuzzy methods, neural network methods and knowledge based techniques etc. variation segmentation technique were used [3].

Brain tumor detection is totally based on image enhancement. The image should be clearly visible to the physician. Any technique which is used to detect the tumor requires the image quality should be good. To have proper clarity, it requires a noise free image. Image enhancement technique when applied over the image a couple of instruction has to carry. First the mask of an image should be fixed, because large mask value decreases the possibility of detection and second Proper key value should be used for image Enhancement. If the value of key exceeds particular limit the feature may disappear. Many descriptors are defined for brain tumor detection such as Fuzzy C-mean; Region is growing, canny algorithm and Morphological. In fuzzy C-mean, the clusters of values are made. The cluster is divided into two groups depending upon their selection criteria. In region growing techniques, the region of interest is selected and then it is enhanced to make it visible. ROI works well when an interested area is properly visible. Canny algorithm is one of the edge detection methods which are used to detect the tumor. The size is the factor to detect the tumor. The image is divided into equal size and then among those group techniques is applied to detect the tumor. Morphological operation is also some time used to detect the tumor. It works either the image lies inside or outside the particular region.

In this paper, the algorithm deals with pre-processing enhancement, pseudo Coloring, image sharpening and finally boundary edge detection operation. Pre-processing of MRI image is the primary step in image analysis, which performs image enhancement and noise reduction technique. Pseudo Coloring is the simplest method used to convert gray level into RGB color. Image sharpening of an RGB color image is done by using the Laplacian. Then boundary traces method is applied to detect the boundary of the tumor in an image. This operation is applied to obtain the image from image sharpening. Finally image subtraction method is applied to get only tumors image of brain.

In this paper, our main aim is to detect the tumor on the base of its type, size and location. Density factor plays an important role to detect the tumor, because tumorous tissues are denser than non-tumorous tissues.

The paper is organized as: in section II gives a brief description of related work; section III describes methodology includes pre-processing of an image using gamma correction and then pseudo Coloring carried by image sharpening and then boundary trace method with image subtraction. The performance evaluation is based on Density factor and PSNR value; and section IV finally concludes the paper and suggests some future work.

Related Study

In the medical field, which are not diagnosed at their early stage? Initially the problem is not easily visible due to poor quality. Therefore, to work with tumor detection is difficult because; First quality has two raised and second it should be detected. Many researchers have different methodology to deal with tumor detection problem in order to improve the detection accuracy.

[5] The author present an approach that the boundary detection problem is formulated as an optimization process that seeks the boundary points to minimize energy functional based on the active contour model. It constructs a modified version of Hopfield network, which is to solve the optimization problem by exploiting the collective computational ability and the convergence capability of the neural network, the proposed method is faster and more stable for boundary detection

The author of [6] presented a concept where an initial slice with an obvious tumor is selected from the image sequence. The segmentation of the tumor is done by using fuzzy c-means Algorithm and its boundary can be further refined by region and contour deformation for the rest of the slices, the initial plan applied on each slice from which new slice is extracted from the resulting boundary of the previous slice. The boundary of the tumor is located using region and contour deformation the tumor information between Consecutive MR images is utilized, as the shape and Position of tumor in one slice are assumed to be Similar to that in its neighbouring slices.

[7] The author proposed a new approach to detect the boundary of brain tumor based on the generalized fuzzy operator (GFO). One typical example is used for evaluating this method with the contour Deformable model. The modified Generalized Fuzzy Operator has been presented. It is a simple but effective method using in Boundary detection. As shown by the author in its example that it is very Accurately in searching the boundary of the brain Tumor, and is a useful method in pre-processing for 3D Reconstruction.

[8] The author present the technique where the competency of point-arc distance calculation compress the data dynamically during the process of tracing the closure of borderline; Apply self-adaptive Grouping and the divide-and-conquer algorithm applied to the set of buffer targets, and so on. Test results and analysis, specify that, these optimizations have a great advantage in the aspects of decreasing EMS memory Consumption and improving calculation accuracy, and its computational efficiency can fully meet the demand of usual application of GIS. The procedure of point-arc distance calculation is called frequently in boundary tracing algorithm and its Performance would affect the efficiency of Implementation directly

[9] The author proposed that Canny algorithm detecting the weak Edge of the brain, then labelling all the 8-connected edge with a different number and classifying with the that edge, for the Size of all the 8-connected edge circumference being Different, So we can plot the histogram according to the size of the edge, At last, we can detect the sole weak edge by the Histogram segmentation. This way can help us get the deformable edge such as brain tumor all the edges of the brain, including weak edge by the canny algorithm, which can make us get all. This edge, by 8-connected labelling will give all the connected edges with the same number, and no connected edge having the different number, At last, we get the edge by Interactive histogram.

[10] The author proposed a Traditional Boundary tracing algorithm, especially under the condition when there is a break in the circle of contour, an improved method of boundary tracing algorithm to extract the circular contour is proposed.

Based on the break in circle of contour. According to this property of circle Contour, the new tracing principle is proposed. The experiment shows that the method, which can extract the circular contour effectively and quickly, carries the good ability of anti-disturbance to inside the branch and false boundary extraction can put up for a good ability in real time and hence robustness is given.

[11] The author present the boundary of tumor tissue is irregular. Deformable models and Region based methods are widely used in medical image segmentation, as to locate the boundary of the tumor. So problems associated with non-linear Distribution of real data, user interaction and poor convergence to the boundary region, all these factor limited their utility. As compared to proposed algorithm Clustering of Brain tumor images, using Fuzzy C means is robust and effective but does not carry high computational complexity. On compared to proposed algorithm, it shows superior results in Segmentation efficiency and convergence rate. The Fuzzy C Means clustering with the lean-to the Feature extraction and Classification are very promising in the field of brain tumor detection.

METHODOLOGY

The process starts with the brain MRI image which is an input image. Second step is the pre-processing of this input image, after that pseudo Coloring method applied to it. After applying pseudo color technique, image sharpening method is applied to them and then tumor boundary is detected by applying the boundary trace method. After applying image subtraction method only that portion, which is affected from tumor, is visible.

MRI image

MRI image acts as the powerful tool for solving the diagnosis problem. MRI provides a matchless view inside the human body. The level of detail that we can see is extraordinary for being compared with any other imaging modality. Proper, reliable and fast detection of brain cancer is of major technical and economic importance for the doctors. Common practices based on specialized techniques are slow, and possess a degree of subjectivity which is hard to quantify [13].

Pre-processing

This technique is used to improve the detection of the suspicious region from a magnetic resonance image (MRI). The aim of the pre-processing step is to remove the artifacts from the image and enhance it. It includes that operation whose main goal is to analysis and extraction of the desired information [13]. At this stage we are using Gamma correction of an image.

Gamma correction

Gamma can be any value between 0 and infinity. If its value is 1 (the default), Then the mapping is linear otherwise if gamma is less than 1, then the mapping is weighted toward higher (brighter) output values. And if gamma is greater than 1, the Mapping is weighted toward lower (darker) output values. It specifies the shape of the curve that's mapped the intensity value of an image to create another image with gamma (g) intensity over its [14].

Depending on the gamma value. The curve between the input image and the output image results in nonlinearity. The values are falling in between low to the bottom and high to top. But the default, the values between low and high are mapped linearly to values between bottom and top [14].

Pseudo colouring

It is an image processing consists of assigning color to gray values based on a specified criterion. This is a kind of gray scale transformation. The individual brightness in the input of a monochromatic image is coded to some color. Since the human eye is much more sensitive to change in color than to change in brightness, much more detail can be perceived in it. The term emphasizes on the color that were assigned artificially opposing to the true (real) color. It is done to make the image more meaningful form which will make it easier for us to identify the tumor in the brain. It assigns a shade of color to a particular monochrome intensity of ranges of intensity. It can be carried out by different approaches such as intensity slicing, gray level to color transformation and filtering approach. Gray level for color transformation is carried out in this algorithm. Since the range of gray level is divided into a number of intervals, it is easy to assign different color to each interval. After that three different transformations are performed on each interval that Red, Green and Blue. The electron gun of three color trigger respective color on particular regions to look like an RGB image [14].

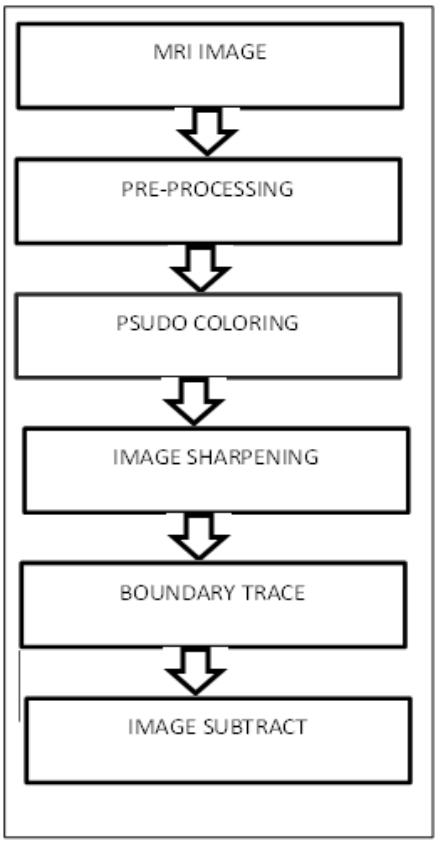


Fig 2 steps of an Algorithm

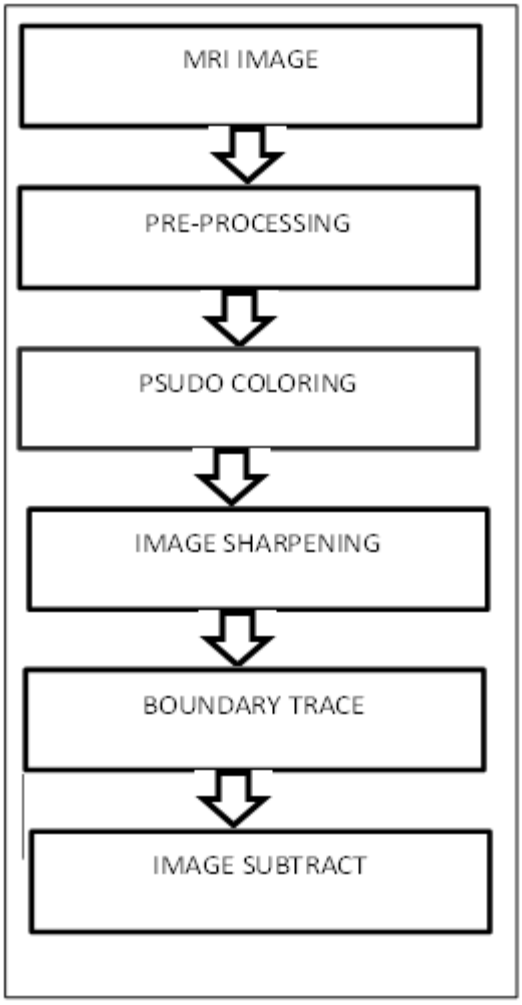
Image sharpening

Sharpening an RGB color image is done by Laplacian method. A factor analysis is made in which vector whose component is equal to the Laplacian of the individual scalar component of the input vector.

$$\nabla^2[\,c(x,y)] = \begin{bmatrix} \nabla^2 R(x,y) \\ \nabla^2 R(x,y) \\ \nabla^2 R(x,y) \end{bmatrix}$$

This vector equation helps us to compute the Laplacian of a full RGB image by computing the Laplacian of each component of an RGB image. It can be constructed in any way, but still we are using 3-by-3 kernel. It enhances the sharpness of an image that is slightly blurred. It uses 5*5 averaging filter.

The Laplacian operator is a second order or second derivative method of enhancement. It looks for zero crossings in the second to a particular monochrome intensity of ranges of intensity. It can be carried out by different approaches such as intensity slicing, gray level to color transformation and filtering approach. Gray level for color transformation is carried out in this algorithm. Since the range of gray level is divided into a number of intervals, it is easy to assign different color to each interval. After that three different transformations are performed on each interval that Red, Green and Blue. The electron gun of three color trigger respective color on particular regions to look like an RGB image [14].



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The Laplacian operator is a second order or second derivative method of enhancement. It looks for zero crossings in the second derivative of the image as to find the boundary. A boundary has the one-dimensional shape of a ramp and calculating the derivative of an image can highlight its location. It is good at finding the fine detail inside an image. Sharp discontinuity feature (like noise, Unfortunately) will be enhanced by a Laplacian operator. Thus, the application of a Laplacian operator is to bring back fine detail of an image which is pressed during removable of noise. This noise should be filtered out before edge detection [14].

Boundary traces

The boundary traces method is very necessary after an image has been segmented in order to get the boundary of any object in an image such as the tumor cells. Boundary tracing is also designed in the tumor cell diagnosis system. In this pixel of an object must be chosen to start boundary tracing. Some pixels of high value often appear around some object's boundary in a gradient image. So the pixel of higher value may be chosen as the original boundary pixel [4]. The necessary condition for tracing the object is that the image containing the object should be in binary form. It extracts the actual coordinate's boundaries of the entire region in a binary image. The boundaries of the nested region such as (parent and held region) are also extracted. It is also useful to construct or display a binary image that contain boundary of interest. It is also useful for tracing multiple boundaries of interest in a given object. An image with the foreground pixels labelled 1 and background pixels labelled zero), trace either boundary of the foreground [14].

Image subtraction

Image subtraction method allow the image to feature only that of image which is not in common in both the images.it takes two images as input and produce the third image ,which is having pixel values that are simply subtracted from first image to corresponding pixel value in second image. In this, only tumor location is extracted and presented in the image. This is done on the most closely packed pixel principle. The pixel which are present in the image .hence the tumor whose boundary are obtained from boundary trace method, subtracted the image from an original image. Thus only extracted image of tumor is available. Due to this method, obtained image is from all the other noise and contains only the tumor.

Performance Evaluation

The performance of a proposed work using above mention technique can be tested on the basis of pixel intensity or density calculation and PSNR calculation. Since the tumor affected pixel are denser as compared to the non-tumorous pixel. The pixel value of tumor pixel is more. The boundary across the tumor pixel contains a much higher value in term of intensity as compared to non-tumours pixel. The binarization of image also helps to detect the tumor part of an image. Since it converts the whole image in two sections via Black and white portion. The tumor pixel falls in white portion and non-tumours pixel fall in black portion which make easier to detect it.

Performance of de-noising is measured using quantitative measures such as peak signal-to-noise ratio (PSNR). PSNR is the ratio of maximum possible power in the image to the noise quantity on the image. Mathematically represented as:

$$PSNR = 10 \cdot \log_{10}() = 20 \cdot \log_{10}\left(\frac{MAX}{\sqrt{MSE}}\right)$$

Where MAX is the maximum possible pixel value in the image, MSE is the mean-square error in the image.

The unit of PSNR is „DB‟ (Decibel). If both images are identical, then PSNR values become infinity because in such cases MSE will become zero. So binarization and boundary trace both detect the tumor and their performance is measured in term of pixel intensity spread all over the image.

CONCLUSION

The boundary traces method has proved miraculously helpful in various boundary detection. The boundary operator is applied only on binary image and gives its useful result. Dimensional size of an image played a vital role for selection of tumor boundary because since we know that image is stored in the form of the matrix so proper row and column value is necessary for the tumor location in an image. Pre-processing is done by Gamma correction. After applying image sharpening method; image is more clearly visible to us. Thus, applying boundary method the final tumor position is visible to us [12]. In conclusion, the pseudo Coloring method and the Laplacian sharpening mask technique followed by boundary trace method and image subtraction provide a more expedient result.

Future Work

As a part of the defined operations, the author tries to record the output. The record outputs are able to distinguish between the affective and the non-affected parts of the brain.

In future, this program can be made more advanced so that the tumor can be classified according to its type. Also, tumor growth can be analysed by analysing the data, which Can be obtained by studying sequential images of the tumor affected patient.

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