Brain Tumour Threshold Segmentation using Image Processing

Rashmi S.[1] Pushpalatha R.[2]
[1]M.Tech Student [2]Assistant Professor
[1,2]Department of Computer Science & Engineering
[1,2]Department of PG Studies, Visvesvaraya Technological University, Mysuru, India

Abstract— The field of medical imaging is gaining importance with an increase in the demand for automated, reliable, fast and efficient diagnosis which can provide insight to the image better than human eyes. Brain tumor is the second leading cause for cancer-related deaths in men in age 20 to 39 and fifth leading cause cancer among women in same age group. Brain tumors are painful and may result in various diseases if not cured properly. Diagnosis of tumor is a very important part in its treatment. Identification plays an important part in the diagnosis of benign and malignant tumors. A prime reason behind an increase in the number of cancer patients worldwide is the ignorance towards treatment of a tumor in its early stages. This paper discusses such an algorithm that can inform the user about details of tumor using basic image processing techniques. These methods include noise removal and sharpening of the image along with basic morphological functions, erosion and dilation, to obtain the background. Subtraction of background and its negative from different sets of images results in extracted tumor image. Plotting contour and c-label of the tumor and its boundary provides us with information related to the tumor that can help in a better visualization in diagnosing cases. This process helps in identifying the size, shape and position of the tumor. It helps the medical staff as well as the patient to understand the seriousness of the tumor with the help of different color-labeling for different levels of elevation. A GUI for the contour of tumor and its boundary can provide information to the medical staff on click of user choice buttons.

Key words: Brain, CT, Contrast Adjust, Structural Element, Erosion, Dilation, Negation, Tumor Detection, Contour

I. INTRODUCTION

A brain tumor is defined as abnormal growth of cells within the brain or central spinal canal. Some tumors can be cancerous thus they need to be detected and cured in time. The exact cause of brain tumors is not clear and neither is exact set of symptoms defined, thus, people may be suffering from it without realizing the danger. Primary brain tumors can be either malignant (contain cancer cells) or benign (do not contain cancer cells) [7].

Brain tumor occurred when the cells were dividing and growing abnormally. It is appear to be a solid mass when it diagnosed with diagnostic medical imaging techniques. There are two types of brain tumor which is primary brain tumor and metastatic brain tumor. Primary brain tumor is the condition when the tumor is formed in the brain and tended to stay there while the metastatic brain tumor is the tumor that is formed elsewhere in the body and spread through the brain [4].

The symptom having of brain tumor depends on the location, size and type of the tumor. It occurs when the tumor compressing the surrounding cells and gives out pressure. Besides, it is also occurs when the tumor block the fluid that flows throughout the brain. The common symptoms are having headache, nausea and vomiting, and having problem in balancing and walking. Brain tumor can be detected by the diagnostic imaging modalities such as CT scan and MRI. Both of the modalities have advantages in detecting depending on the location type and the purpose of examination needed. In this paper, we prefer to use the CT images because it is easy to examine and gives out accurate calcification and foreign mass location [4].

The CT image acquired from the CT machine give two dimension cross sectional of brain. However, the image acquired did not extract the tumor from the image. Thus, the image processing is needed to determine the severity of the tumor depends on the size [4].

The reasons for selecting CT images upon MRI images are as follows:

1) CT is much faster than MRI, making it the study of choice in cases of trauma and other acute neurological emergencies. CT can be obtained at considerably less cost than MRI.
2) CT can be obtained at considerably less cost than MRI.
3) CT is less sensitive to patient motion during the examination.

The focus of this project is CT brain images' tumor extraction and its representation in simpler form such that it is understandable by everyone. Humans tend to understand colored images better than black and white images, thus, we are using colors to make the representation simpler enough to be understood by the patient along with the medical staff. Contour plot and c-label of tumor and its boundary is programmed to give 3D visualization from 2D image using different colors for different levels of intensity. A user-friendly GUI is also created which helps medical staff to attain the above objective without getting into the code.

A. Aim & Objective – Problem Description

The aim of the paper is tumor identification in brain CT images. The main reason for detection of brain tumors is to provide aid to clinical diagnosis. The aim is to provide an algorithm that guarantees the presence of a tumor by combining several procedures to provide a foolproof method of tumor detection in CT brain images. The methods utilized are filtering, contrast adjustment, negation of an image, image subtraction, erosion, dilation, threshold, and outlining of the tumor.

The objective of this work is to bring some useful information in simpler form in front of the users, especially for the medical staff treating the patient. Aim of this paper is to define an algorithm that will result in extracted image of the tumor from the CT brain image. The resultant image will be able to provide information like size, dimension and position of the tumor, plotting contour and c-label of the tumor and its boundary provides us with information related to the tumor that can prove useful for various cases, which

will provide a better base for the staff to decide the curing procedure. Plotting contour-f plot and c-label plot of the tumor and its boundary will give easy understanding to the medical staff because humans comprehend images better with the help of different colours for different levels of intensity, giving 3D visualization from a 2D image.

II. LITERATURE SURVEY

According to Mustaqeem, Anam, et.al, in "An efficient brain tumour detection algorithm using watershed and thresholding based segmentation" published in "International Journal 4" in 2012 [7], benign also can be growth as malignant which is consists of cancerous cells. Malignant is the rapid growing tumor which is invasive and life threatening. It is also called as brain cancer since the malignant contains cancerous cells that able to destroy any nearby cell.

The paper "Tumour Detection using Threshold operation in MRI Brain Images" by Natarajan P. et.al, [10] states that Primary brain tumours include any tumour that starts in the brain. Primary brain tumors can start from brain cells, the membranes around the brain (meninges), nerves, or glands. Tumors can directly destroy brain cells. They can also damage cells by producing inflammation, placing pressure on other parts of the brain, and increasing pressure within the skull. A metastatic brain tumor is a cancer that has spread from elsewhere in the body to the brain.

In the paper "A novel anatomical Structure segmentation method of CT head images" by X. Zang et.al [12] Histogram contains intensity value of 0-255. The zero value is the darkest part while the 255 was the white or the brightest side. Using the histogram analysis approached used the mixture Gaussian filter for the extracted part pixel intensity.

However, most of the technique used is more on MRI modality compared to CT images because it is higher resolutions. CT images of human body parts help medical doctors in diagnosing illness like brain tumor, colon cancer, lung cancer and so forth. However, it is quite difficult to obtain the important features in the images because it is limited by the image processing level and also doctor's experience. This is expressed in "Automatic Classification and segmentation of brain tumour in CT images using optimal dominant gray level run length texture features," by A. Padma and R. Sukanesh [13].

III. PROPOSED SYSTEM & MODULES

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:-

1) Pre-Processing Stage
2) Segmentation Stage
3) 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 centre pixel relative to neighboring pixels. Its array usually contains a single positive value at its centre, 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

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.

3) Implementation

In this section, a novel approach is presented for brain tumour segmentation on MRI images which is fully automatic and does not need any user interaction. Fig. 1 shows the block diagram of the proposed algorithm.

The algorithm has two stages, first is pre-processing of given MRI image and after that segmentation and then performs morphological operations. Steps of algorithm are as following:

1) In the first step the extra and useless parts outside the skull are removed. For this task, at first the boundary of the skull is determined by automatic global thresholding, then with creating a binary image which is head mask indeed, the extra regions from outside of the skull are removed. With this operation, the required calculations in later steps and total time of segmentation are decreased.
2) This step is to remove the noise. MRI images include image and some noise. This noises cause some disorders in image. They should be removed for segmentation process improvement without destroying the edges of the image and decreasing its clarity. Here, anisotropic diffusion filter with 8- connected neighborhood is applied on the image for removing noise. The essential idea of this approach is quite simple.

1) Step 1: Give MRI image of brain as input.
2) Step 2: Convert it to gray scale image.
3) Step 3: Apply high pass filter for noise removal.
4) Step 4: Apply median filter to enhance the quality of image.
5) Step 5: Compute threshold segmentation.
6) Step 6: Calculate the number of white points in the image.
7) Step 7: Calculate the size of the tumour using the formula.
8) Step 8: Display the size and stage of tumour. All above steps are explained here in detail.

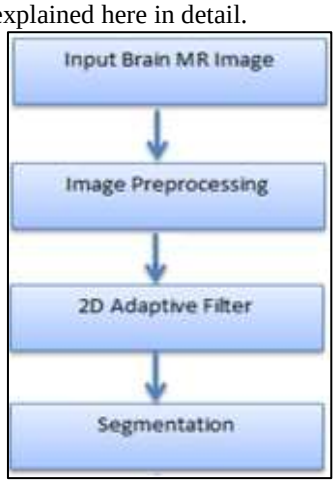

Fig. 1: Block Diagram

IV. Results & Conclusion

As diagnosis tumour 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 greyscale 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.

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