Brain Tumor Detection based on Thresholding and Morphological Operations

Dr.S.Swapna Rani[1]

Associate Professor, ECE Department, M.V.S.R Engineering College, Telangana, India

K. Soumya[2]

Student, ECE Department, M.V.S.R Engineering College, Telangana, India

K.S Ramyaja Kashyap[3]

Student, ECE Department,M.V.S.R Engineering College, Telangana, India

ABSTRACT-Biomedical Image Processing is a growing and demanding field. MRI Imaging play an important role in brain tumor for analysis, diagnosis and treatment planning. Tumor detections using MRI images is a challenging task, becauseof the complex structure of the brain and alsothe degraded quality of image due to noise and delay. Most of the Segmentation techniques for tumor detection involve complex processing steps taking more processing time for detection of the tumor and its size accurately which may lead the disease entering into critical stage. Concentrating only on detection of the tumor makes it possible to detect in early stage where the size of the tumor is not an important constraint. In this paper, a new segmentation method is proposed where detection of the tumor in early stage is achieved with moderate accuracy. The proposed method combines the effect of adaptive thresholding with morphological operations. In the proposed algorithm, the noise inherent in MRI image is filtered and this pre-processed image is further processed to detect the tumors. This segmentation for tumor detection helps in further analysis and diagnosis. The algorithm is implemented on MRI images of multiple patients.

The proposed technique is developed in PYTHON with the help of GUI interface Programming. The use of GUI along with QT designer makes the segmentation easy to customize it to all different MRI image characteristics.

KEYWORDS-*Brain Tumor, MagneticResonance Imaging (MRI), Threshold.*

INTRODUCTION

The brain tumor is an abnormal growth of cell of a tissue in the brain or around thebrain. Brain tumourdetection is very challenging problem due to complexstructure of brain, diverse shape, size, location and appearance of tumor in brain. Identifying the tumor in early stage makes it curable with proper treatment.

Advances in the field over the years have made medical imaging an indispensable part of medicine. The use of medical images is often critical for diagnosis and treatment planning. The interest in digital biomedical image processing methods takes a most important position in two principal and important areas. The most important one is an improvement of pictorial information for human studies and processing of biomedical image data for storage.

Biomedical Image Processing is a growing and demanding field. The various types of medical imagingtechnologies are; Magnetic resonance Imaging (MRI),Computed Tomography (CT) scan, Ultrasound, SPECT, PET and X-ray. MRI does not involve X-rays and the use of ionizing radiation, which distinguishes it from CT scan. Magnetic Resonance Imaging is a medical imaging technique used in radiology to form pictures of the anatomy and the physiological processes of the body in both health and disease. MRI does not involve X-rays and the use of ionizing radiation, which distinguishes it from CT scan. However, MRI may often yield different diagnostic information compared with CT as it provides greater contrast betweendifferent soft tissues of human body.

Brain tumor identification can be achieved by implementing various segmentation methods available in the literature each has its own advantages and disadvantages. In this paper, a new threshold based segmentation method is proposed which provides information about the object of interest and is best suitable for early detection of tumor. The algorithm helps to analyze MRI images for correct diagnosis. The proposed segmentation algorithm is based on thresholding and morpohological operations which is used to analyze MRI images for brain tumor detection.

PROPOSED SEGMENTATION TECHNIQUE

Processing an image is a complicated task. Before any image can be processed, it is important to remove any unwanted artefacts it may hold. Only then can the image be processed successfully.

Processing a medical image involves two main steps. The first is the pre-processing of the image. This involves performing operations like noise reduction and filtering so that the image is suitable for the next step. This step may also

include the image enhancement if the quality of the image is to be improved for further processing.

The second step is to perform segmentationand morphological operations. These determine the size and the location of the tumour.

Image Histogram and Thresholding: Thresholding is a simple and effective way of partitioning an image into a foreground and background. From a grayscale image, thresholding can be used to create binary images. The simplest thresholding methods replace each pixel in an image with a black pixel if the image intensity is less than some fixed constant T, or a white pixel if the image intensity is greater than that constant.Selecting proper value of Threshold is an important step and it can be found based on the type of the image to be processed.

In this paper, initially threshold is selected by finding the histogram of the MRI input image. This **histogram** is a graph showing the number of pixels in an **image** at each different intensity value found in that **image**.

In this paper Adaptive thresholding is implemented. Thresholding is called adaptive thresholding when a different threshold is used for different regions in the image.

a. Consider an initial threshold T.
b. The image is segmented into object and

background pixels as described above, creating two

sets:

G1 = {f(m,n):f(m,n)>T} (object pixels)
G2= {f(m,n):f(m,n)≤T} (background pixels)

(note, f(m,n) is the value of the pixel located in

themthcolumn, nthrow)

c. The average of each set is computed.

m1= average value of G1

m2= average value of G2

d. A new threshold is created that is the average of m1 and m2

T' = (m1+m2)/2

e. Go back to step two, now using the new threshold computed in step four, keep repeating until convergence has been reached.

Morphological Operation: Morphological operation used as an image processing tools for sharpening the regions. [2] Morphological image processing is a collection of non-linear operations related to the shape or morphology of features in an image. Theerosion and dilation methods are used for morphological operation.

Histogram, Segmentation and Morphological operations play a vital role for classification and detecting the tumor of brain.

The functional block diagram of the proposed technique to identify a tumor is shown in the Fig 1.

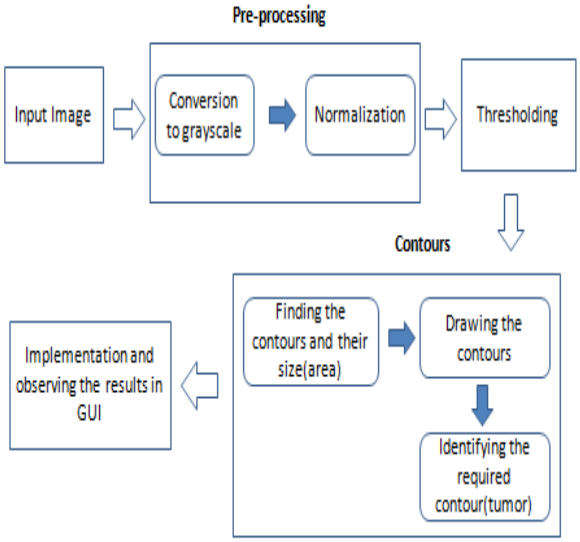


Fig 1:Functional block diagram of the Proposed technique

The steps involved in the proposed technique are

1. The process starts with MRI image acquisition and extraction to proper image format (jpg or pngetc) for processing.
2. The acquired images are subjected to normalization or standardisation.
3. The pre-processed images undergo threshold based segmentation.
4. The thresholded image is given as the input for finding the contours of the image. The number of contours their size, area are also obtained. These contours are drawn on the original image.
5. The required contour is extracted and a rectangle is drawn around it.

All the results at each step of the process are implemented and displayed in PyQt designer GUI tool. The Qt designer tool is designed as per the requirements and the call back functions for them are written in Pycharm.

3. Step-by-Step resultant images:

Implementation of proposed technique is explained pictorially with the help of results obtained at every step of processing and are shown in Fig 2a to Fig 2e.The tumor indicated in a rectangular box is shown in Fig. 2e

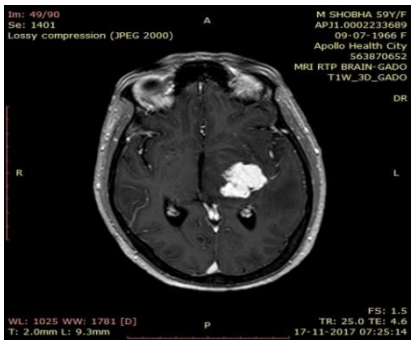
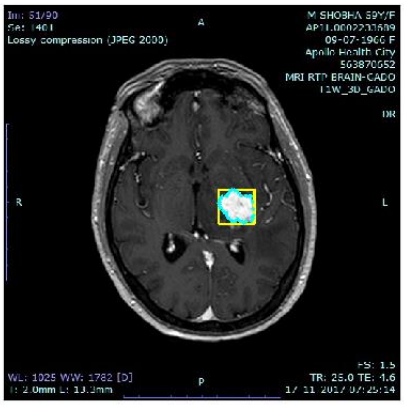


Fig 2a:Input image



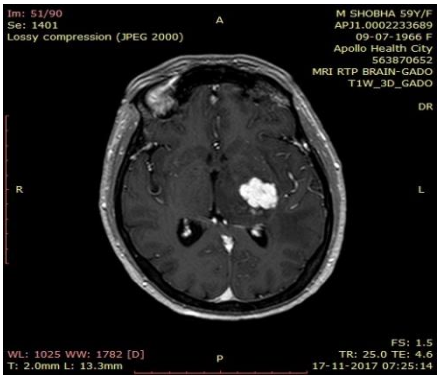


Fig 2c: Thresholded image

['BINARY THRESH']

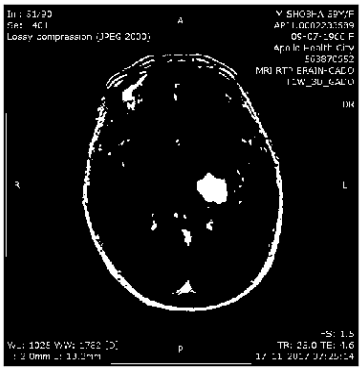


Fig 2b: Normalized image

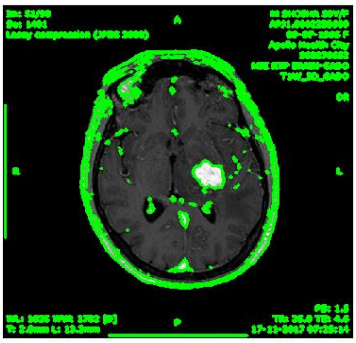


Fig 2d: Drawing the contours

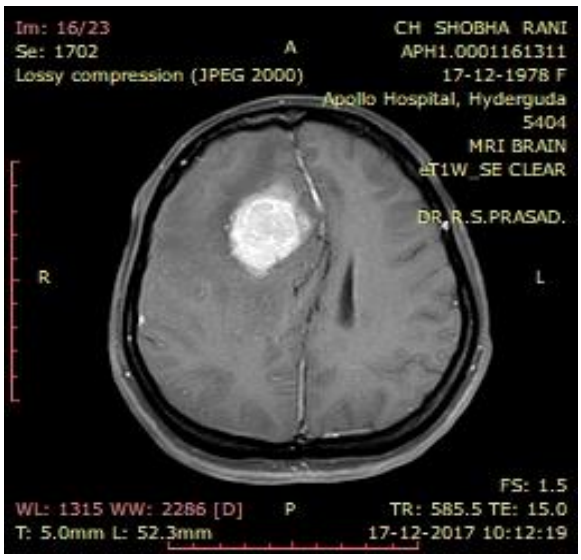


Fig 2e: Output image

RESULTS

Proposed method is implemented on MRI images of four different patients. The input and the corresponding output

image after processing is shown in Fig 3, Fig 4, Fig 5 and Fig 6.

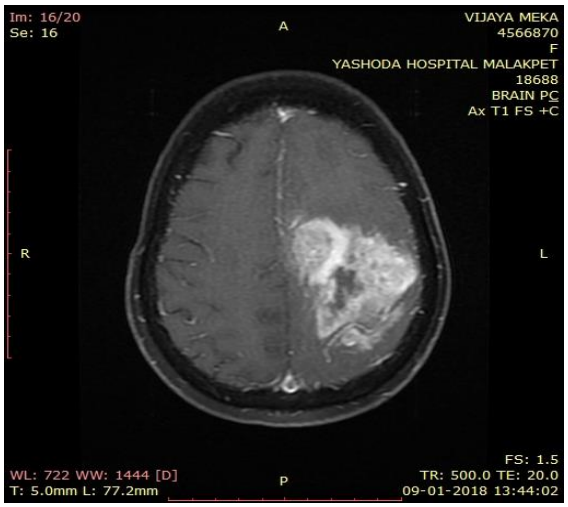


Fig 3a: Input image of patient-1

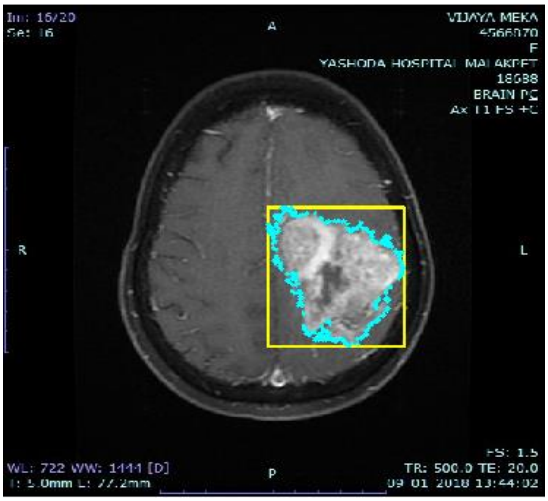


Fig 3b: Output image of patient-1

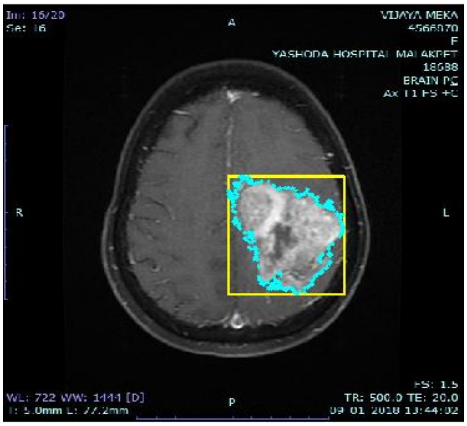


Fig 4a: Input image of patient-2

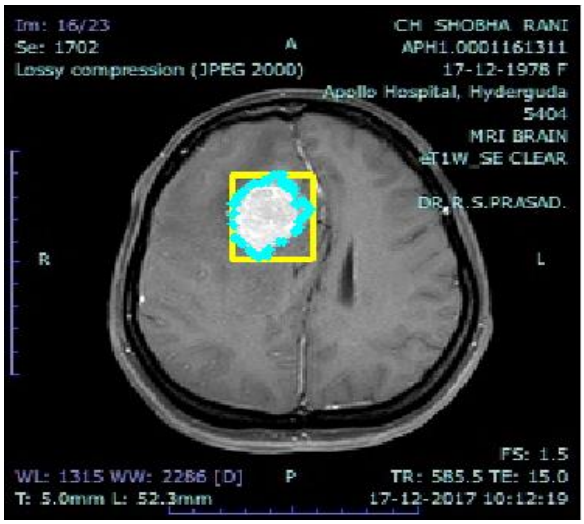


Fig 4b: Output image of patient-2

Fig 5a: Input image of patient-3

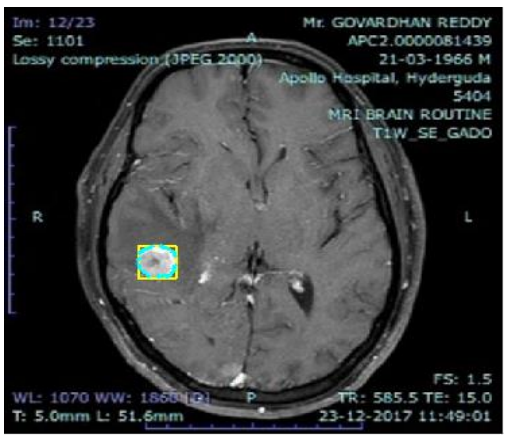


Fig 5b: Output image of patient-3

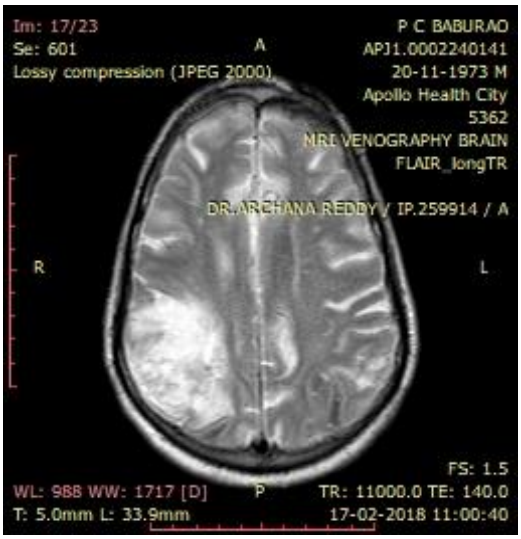


Fig 6a: Input image of patient-4

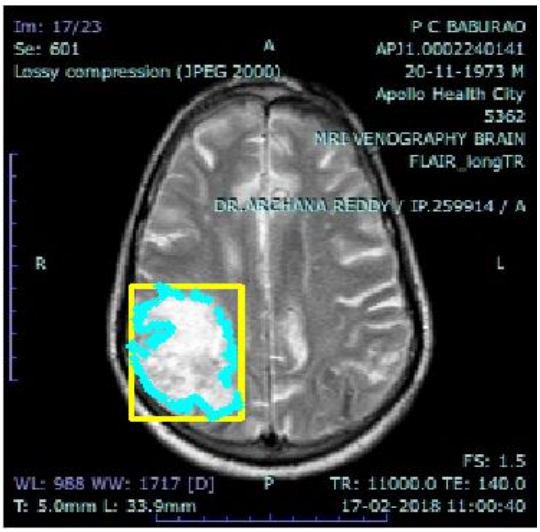


Fig 6b: Output image of patient-4

CONCLUSIONS

A method of threshold based segmentation has been implemented for tumor detection which identified contours of the image and the contour detection algorithm located the tumor in the MRI image. The process of locating brain tumor from an MRI image is explained in detail by showing resultant images at each step. The same algorithm has been run on MRI images of multiple patients and the tumors have been identified. It is verified that loss of accuracy in finding the size of the tumor is not an important criteria. With the proposed implemented technique, tumors can be identified in less time so that it can be detected in early stage which makes the disease curable with less cost.

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