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A Review on Brain Tumor Detection Using Segmentation And Threshold Operations

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***Abstract*—The brain is the anterior most part of the central nervous system. The location of tumors in the brain is one of the factors that determine how a brain tumor effects an individual's functioning and what symptoms the tumor causes. Along with the Spinal cord, it forms the Central Nervous System (CNS). Brain tumor is an abnormal growth caused by cells reproducing themselves in an uncontrolled manner. Magnetic Resonance Imager (MRI) is the commonly used device for diagnosis. In MR images, the amount of data is too much for manual interpretation and analysis. During past few years, brain tumor segmentation in magnetic resonance imaging (MRI) has become an emergent research area in the field of medical imaging system. Accurate detection of size and location of brain tumor plays a vital role in the diagnosis of tumor. An efficient algorithm is proposed for tumor detection based on segmentation and morphological operators. Firstly quality of scanned image is enhanced and then morphological operators are applied to detect the tumor in the scanned image. We also propose an efficient wavelet based algorithm for tumor detection which utilizes the complementary and redundant information from the Computed Tomography (CT) image and Magnetic Resonance Imaging (MRI) images. Hence this algorithm effectively uses the information provided by the CT image and MRI images there by providing a resultant fused image which increases the efficiency of tumor detection.**

***Keywords*—Brain Tumor, MRI, Morphological & Watershed Operators, Threshold Operations & Text- Noise Removal.**

I. INTRODUCTION

A tumor can be defined as a mass which grows without any control of normal forces. Real time diagnosis of tumors by using more reliable algorithms has been the main focus of the latest developments in medical imaging and detection of brain tumor in MR images and CT scan images has been an active research area. The separation of the cells and their nuclei from the rest of the image content is one of the main problems faced by most of the medical imagery diagnosis systems. The process of separation i.e. segmentation, is paid at most importance in the construction of a robust and effective diagnosis system. Images Segmentation is performed on the input images. This enables easier analysis of the image thereby leading to better tumor detection efficiency. Hence image segmentation is the fundamental problem in tumor detection. A number of methods have been proposed in the past for brain tumor detection.

A. *Operations and Types of Tumor:*

In medical imaging, 3D segmentation of images plays a vital role in stages which occur before implementing object recognition. 3D image segmentation helps in automated diagnosis of brain diseases and helps in qualitative and quantitative analysis of images such as measuring accurate size and volume of detected portion. Accurate measurements in brain diagnosis are quite difficult because of diverse shapes, sizes and appearances of tumors. Tumors can grow abruptly causing defects in neighboring tissues also, which gives an overall abnormal structure for healthy tissues as well. We will develop a technique of 3D segmentation of a brain tumor by using segmentation in conjunction with morphological operations.[1]

B. Tumor:

The word tumor is a synonym for a word neoplasm which is formed by an abnormal growth of cells Tumor is something totally different from cancer.

C. Types of Tumor:

There are three common types of tumor: *1)* Benign; *2)* Pre-Malignant; *3)* Malignant (cancer can only be malignant).[1]

) Benign Tumor: A benign tumor is a tumor is the one that does not expand in an abrupt way; it doesn't affect its neighboring healthy tissues and also does not expand to non-adjacent tissues. Moles are the common example of benign tumors.

2) Pre-Malignant Tumor: Premalignant Tumor is a precancerous stage, considered as a disease, if not properly treated it may lead to cancer.

3) Malignant Tumor: Malignancy (mal- = "bad" and -ignis = "fire") is the type of tumor, that grows worse with the passage of time and ultimately results in the death of a person. Malignant is basically a medical term that describes a severe progressing disease. Malignant tumor is a term which is typically used for the description of cancer.

D. Magnetic Resonance Imaging (MRI):

MRI is basically used in the biomedical to detect and visualize finer details in the internal structure of the body. This technique is basically used to detect the differences in the tissues which have a far better technique as compared to computed tomography (CT). So this makes this technique a very special one for the brain tumor detection and cancer imaging. [2]

CT uses ionizing radiation but MRI uses strong magnetic field to align the nuclear magnetization then radio frequencies changes the alignment of the magnetization which can be detected by the scanner. That signal can be further processed to create the extra information of the body.

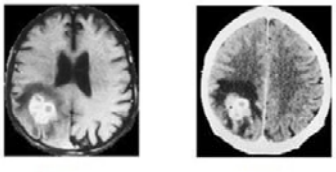

Fig. 1: (a) CT Scan Image and (b) MR Image.

- MRI and CT Analysis :
  Fused images from CT and MRI imagers are used for detection of tumor. The fused images are obtained from multiple modality images like Computed Tomography (CT) and Magnetic Resonance Image (MRI) as shown in Fig. (a) and (b). These multiple modality images play a key role in medical image processing; CT images which are used to ascertain the difference in tissue density andMRI provide an excellent contrast between various tissues of the body. CT images signify the difference in tissue density depending upon the tissues ability to react the X-rays, while MRI images provide contrast between different soft tissues. The above features make CT and MRI more suitable for the detection of tumor. The complementary and redundant information of both the source images are retained in the fused image, these information including the tumor size and location, which enable better detection of tumor, when compared to the source images.

II. LITERATURE REVIEW AND RELATED WORK

Brain tumor cells have high proteinaceous fluid which has very high density and hence very high intensity, therefore watershed segmentation is the best tool to classify tumors and high intensity tissues of brain. Watershed segmentation can classify the intensities with very small difference also, which is not possible with snake and level set method. A similar method for tumor detection is proposed by Rahul Malhotra, but multi-parameter extraction was not used. Hossam and P Vasuda have proposed a method for brain tumor detection and segmentation using histogram thresholding detects the tumor but the result shown crops excessive area of brain. An efficient and improved brain tumor detection algorithm was developed by Rajeev Ratan, Sanjay Sharma and S. K. Sharma which makes use of multi-parameter MRI analysis and the tumor cannot be segmented in 3D unless and until we have 3D MRI image data set. So, a relatively simple method for detection of brain tumor is presented which makes use of marker based watershed segmentation with improvement to avoid over & under segmentation. The Segmentation of an image entails the division or separation of the image into regions of similar attribute. The ultimate aim in a large number of image processing applications is to extract important features from the image data, from which a description, interpretation, or understanding of the scene can be provided by the machine. The segmentation of brain tumor from magnetic resonance images is an important but time-consuming task performed by medical experts.[4] The digital image processing community has developed several segmentation methods, many of them ad hoc. Four of the most common methods are:

- Amplitude Thresholding,
- Texture Segmentation,
- Template Matching, and
- Region-growing Segmentation.

  It is very important for detecting tumors, edema and necrotic tissues. These types of algorithms are used for dividing the brain images into three categories:

- Pixel based
- Region or Texture Based
- Structural based.

Several authors suggested various algorithms for segmentation (Hillips et al., 1995; Aidyanathan et al., 1995; Sai et al., 1995; HanShen et al., 2005; Livier et al., 2005). Suchendra et al. (1997) suggested a multiscale image segmentation using a hierarchical self-organizing map; a high speed parallel fuzzy c-mean algorithm for brain tumor segmentation; an improved implementation of brain tumor detection using segmentation based on neuro fuzzy technique designed a method on 3D variational segmentation for processes due to the high diversity in appearance of tumor tissue from various patients. When experts work on tumor images then they use three different types of algorithms. Some of the techniques based on pixel based, some based on texture of images and some of them based on structure of images. Gopal, N.N. Karnan, suggested an algorithm which used multi-scale image segmentation, this algorithm was based on fuzzy c-mean algorithm for the detection of brain tumor.[13]

III. ANALYSIS OF PROBLEM

Now days, one of the main cause for increasing mortality among children and adults is brain tumor. It has been concluded from the research of most of the developed countries that number of people suffering and dying from brain tumors has been increased to 300 per year during past few decades.The National Brain Tumor Foundation (NBTF) for research in United States estimates the death of 13000 patients while 29,000 undergo primary brain tumor diagnosis. This high mortality rate of brain tumor greatly increases the importance of Brain Tumor detection. Real time diagnosis of tumors by using more reliable algorithms has been the main focus of the latest developments in medical imaging and detection of brain tumor in MR Mages and CT scan images has been an active research area. The separation of the cells andtheir nuclei from the rest of the image content is one of the main problems faced by most of the medical imagery diagnosis systems. The process of separation i.e. segmentation, is paid at most importance in the construction of a robust diagnosis system. Image segmentation is performed on the input images. This enables easier analysis of the image thereby leading to better tumor detection efficiency. Hence image segmentation is the fundamental problem in tumor detection.

IV. PROPOSED WORK

The present work implements a system for the improved detection of brain tumor using various steps of processing steps. The implemented work can be useful for biomedical early and improved brain cancer detection. The proposed work will also take input from the output of this application and integrate them with the concept of ontology. Fig 2. shows a steps for the proposed algorithm.

Following are the steps of Tumor Detection-

A. Image Acquisition: Images are obtained using MRI scan and these scanned images are displayed in a two dimensional matrices having pixels as its elements. These matrices are dependent on matrix size and its field of view. Images are stored in Image File and displayed as a gray scale image. The entries of a gray scale image are ranging from 0 to 255, where 0 shows total black color and 255

shows pure white color. Entries between these ranges vary in intensity from black to white.

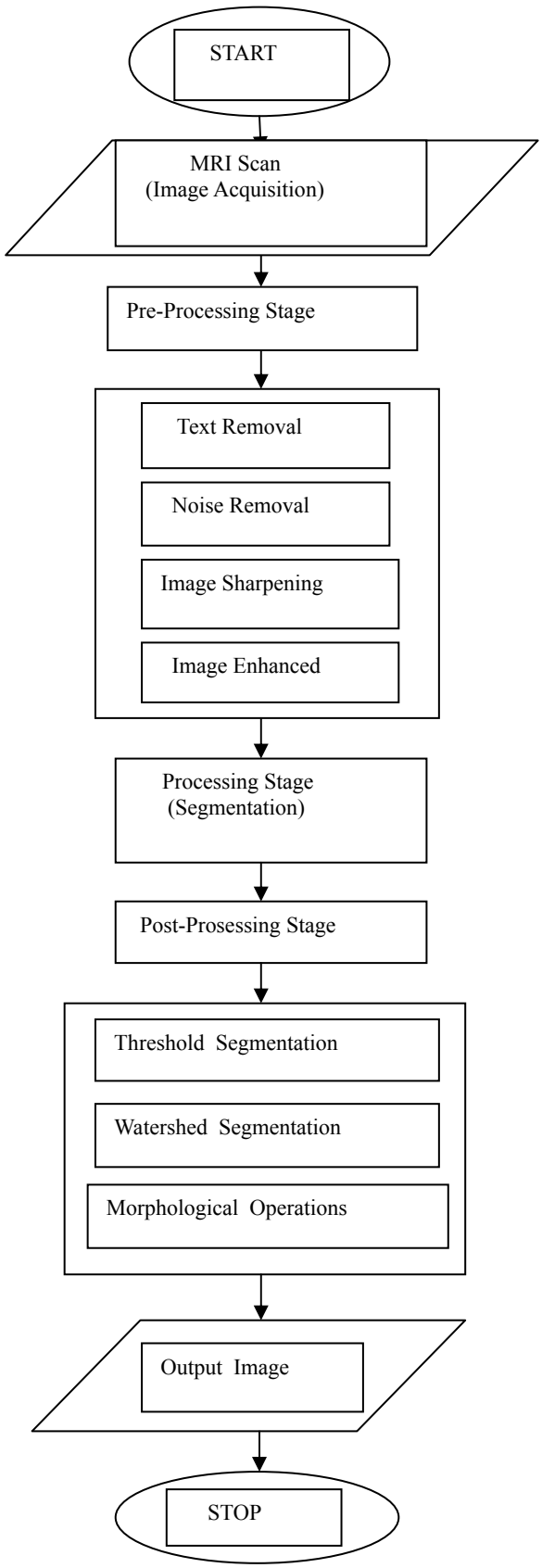

Fig 2 : Steps Of Tumor Detection

B. Pre-Processing Stage: In this phase image is enhanced in the way that finer details are improved and noise is removed from the image. Most commonly used enhancement and noise reduction techniques are implemented that can give best possible results. Enhancement will result in more prominent edges and a sharpened image is obtained, noise will be reduced thus reducing the blurring effect from the image. In addition to enhancement, image segmentation will also be applied. This improved and enhanced image will help in detecting edges and improving the quality of the overall image. Edge detection will lead to finding the exact location of tumor.[5]

1) *Text Removal*: In this phase all unwanted text-noise will be removed. MRI scan images may contain some text such as first image in sample.

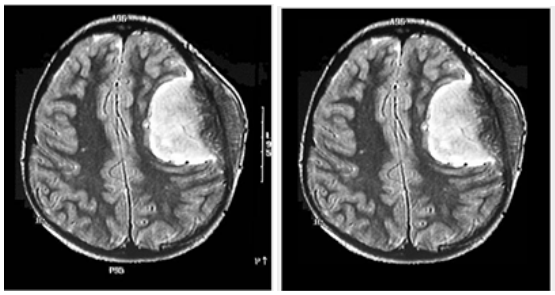

Fig 3: (a) Image with Text Noise. (b) Image without Text Noise.

2) *Noise Removal: Many* filters are used to remove the noise from the images. Linear filters can also serve the purpose like Gaussian, averaging filters. For example average filters are used to remove salt and pepper noise from the image. Because in this filter pixel's value is replaced with its neighborhood values .

   Median filter is also used to remove the noise like salt and pepper and weighted average filter is the variation of this filter and can be implemented easily and give good results. In the median filter value of pixel is determined by the median of the neighboring pixels. This filter is less sensitive than the outliers.

3) Image *Sharpening:* Sharpening of the image can be achieved by using different high pass filters. As now noise is been removed by using different low pass filters, we need to sharpens the image as we need the sharp edges because this will help us to detect the boundary of the tumor.

   Gaussian high pass filter is used to enhance the boundaries of the objects in the image. Gaussian filter gives very high rated results and used very widely to enhance the finer details of the object.

C. Processing Stage:

Image segmentation is based on the division of the image into regions. Division is done on the basis of similar attributes. Similarities are separated out into groups. Basic purpose of segmentation is the extraction of important features from the image, from which information can easily be perceived. Brain tumor segmentation from MRI images is an interesting but challenging task in the field of medical imaging.[7]

D. Post-Processing Stage:

In processing segmentation is done using following methods.

1) Threshold Segmentation: Threshold segmentation is one of the simplest segmentation methods. The input gray scale image is converted into a binary format. The method is based on a threshold value which will convert gray scale image into a binary image format. The main logic is the selection of a threshold value. [7],[9]

2) Watershed Segmentation: It is one of the best methods to group pixels of an image on the basis of their intensities. Pixels falling under similar intensities are grouped together. It is a good segmentation technique for dividing an image to separate a tumor from the image. Watershed is a mathematical morphological operating tool. Watershed is normally used for checking output rather than using as an input segmentation technique because it usually suffers from over segmentation and under segmentation.[14]

3) Morphological Operators: After converting the image in the binary format, some morphological operations are applied on the converted binary image. The purpose of the morphological operators is to separate the tumor part of the image. Now only the tumor portion of the image is visible, shown as white color. This portion has the highest intensity than other regions of the image. Morphological operators are applied after the watershed segmentation.

Some of the commands used in morphing are given below:

- **Strel:** Used for creating morphological structuring element;
- **Imerode ():** Used to erode (Shrink) an image;
- **Imdilate ():** Used for dilating (filling, expanding) an image.[11]

V. APPLICATIONS

The Magnetic Resonance Imaging (MRI) method is the best due to its higher resolution than the other methods. Its resolution is approximately 100 microns. MRI is currently the method of choice for early detection of brain tumor in human brain. Generalization of brain screening programs requires efficient double reading of MRI, which allows reduction of false negative interpretations, but it may be difficult to achieve. Computer aided detection systems are dramatically improving and can now assist in the detection of suspicious brain lesions, suspicious masses. The task of manually segmenting brain tumors from MRI is generally time consuming and difficult. An automated segmentation method is desirable because it reduces the load on the operator and generates satisfactory results. The aim of this work is to provide an automated tool which locates the tumor on MR image and predicts the area of tumor.[2]

3D segmentation of images plays a vital role in stages which occur before implementing object recognition. 3D image segmentation helps in automated diagnosis of brain diseases and helps in qualitative and quantitative analysis of images such as measuring accurate size and volume of detected portion.[9]

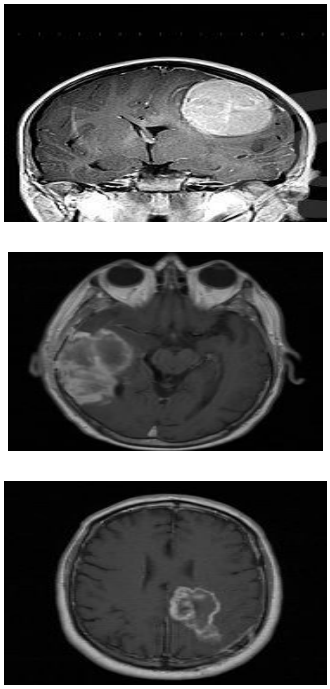

Fig.4 : Brain Tumor MR Images

VI. CONCLUSION

This research was conducted to detect brain tumor using medical imaging techniques. The main technique used was segmentation, which is done using a method based on threshold segmentation, watershed segmentation and morphological operators. The proposed segmentation method was experimented with MRI scanned images of human brains: thus locating tumor in the images. Samples of human brains were taken, scanned using MRI process and then were processed through segmentation methods thus giving efficient end results.

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