Brain Tumor Segmentation from MRI Images Using Morphological Operation

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Abstract

Medical image processing is the most important and challenging field nowadays. MRI image processing is one of the parts of this field. Brain tumor segmentation in magnetic resonance imaging (MRI) has become an emergent research area in the field of a medical imaging system. Brain tumor analysis is done by the doctor, of which the conclusion may vary from one doctor to another. To ease doctor judgment, in this paper, we have applied some morphological operation on tumor shape and extracted the tumor area using MATLAB. Furthermore, we have calculated the affected area of tumor shape and then saved the result for the next observation with a unique id for a specific patient. After a few weeks, when the patient will come for the next observation, again, our system will take a unique id and recent MRI image of the affected patient for showing the result after calculating the previous and present results. Our system totally removes the doctor's insipidness and abstains from the wrong diagnosis.

Keywords: MRI Image, Morphological operation, Brain tumor segmentation, *Opening(Morphology)*.

I. INTRODUCTION

Tumor is an abnormally increasing growth of tissues in any part of the body. They are of different types and hold different characteristics and treatment [8]. The brain image of abnormal patient is taken by MRI machine.

MRI is short for Magnetic Resonance Imaging. It is a procedure used in hospitals to scan patients and determine the severity of certain injuries. An MRI machine uses a magnetic field and radio waves to create detailed images of the body [2]. Magnetic Resonance Imaging (MRI) is done for many reasons. It is used to find problems such as tumors, bleeding, injury, blood vessel diseases, or infection. MRI also may be done to provide more information about a problem seen on an X-ray, ultrasound scan, or CT scan [7]. Contrast material may be used during MRI to show abnormal tissue more clearly [3].

MRI is of mainly 2 types:

- T1-weighted MRI Spin-lattice relaxation time
- T2-weighted MRI Spin-spin relaxation time

Another type of MRI is:

- T*2-weighted MRI (Contrast Enhance)

After taking MRI image, our system provides a easy diagnosis system for tumor area detection and observation, which overcomes the doctor and patient dullness and boringness. To extract brain tumor from MRI images, simply we use morphological operation. Morphological operations are affecting the form, structure or shape of an object. They are used in pre or post processing (filtering, thinning, and pruning) or for getting a representation or description of the shape of objects/regions (boundaries, skeletons convex hulls) [8]. The two principal morphological operations are dilation and erosion [4]. Another important morphological operation that we have used in this paper is open operation. Simply Open operation is the combination of dilation and erosion. Very simply, an opening is defined as an erosion followed by a dilation using the same structuring element for both operations. The opening operator, therefore, requires two inputs: an image to be opened, and a structuring element.

$$o(A, B) = A \circ B = D(E(A, B), B) \quad \text{----------} \quad (1)$$

Actually Brain tumor segmentation is done by morphological open operation on Binary converted MRI image which removes the small dot in the image that not belongs an affected area. Because this salt and pepper noise appear during the capturing process. We have tested our system on 20 images and we have got accurate result.

After extracting the brain tumor, we have traced affected area and calculated the tumor area by the counting of pixel number [6]. Then we save the result for next observation and give a unique id for a specific patient.

II. METHODOLOGY

Our proposed system shows several stages to segment brain tumor from MRI images. Those are (a) Preprocessing , (b) Segmentation (c) Observation

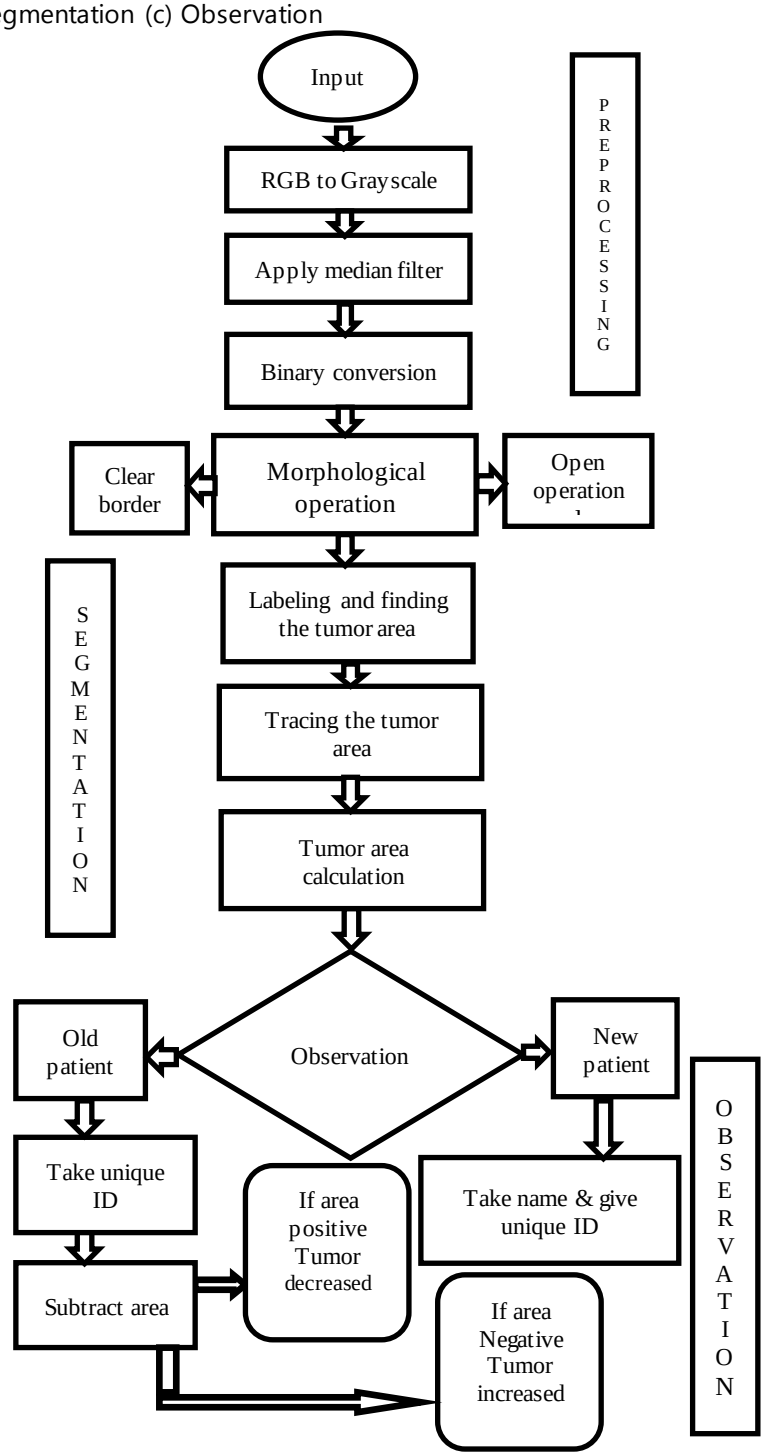

Fig. 1: Major stages of the Algorithm

III. IMPLEMENTATION

At preprocessing stage, we first take a RGB image from the MRI machine as an input to the system. In this stage, this image is first converted into grayscale image format the grayscale shades is (0-255) 0 means black and 255 means white one pixel value is equal to 8 bit. The outputs of gray scale images are noisy. So, we need to remove the noise. Then this gray image is enhanced with the help of median filtering method. Which removes salt & pepper noise [9]. Better enhanced image gives better segmentation. It is easy to segmentation with morphological operation into binary image format and so, it is necessary to converts the enhanced image into binary image. A threshold value is assigned depending on image intensity value. The individual pixel is above is 1 and 1 means white and less than the threshold value is 0 and 0 means black.

In segmentation stage we need to extract the object having less than 100 pixels because the object less than 100 pixels is a minor object which encountered when the image was taken by MRI machine. For this purpose we have used Morphological open operation. Open operation consists of two fundamental Morphological operations such as erosion and dilation with structure element. At first, it determines the connected component depending on the structure element. Then it finds the area and removes small object. This open operation is used here as a filter.

Again, The image which is taken from the MRI machine have a circular border which is mainly the image of skull so, it is necessary to remove this border and in this stage it is removed by the morphological operation. The cleared border image is given below. Actually border clearing is a morphological reconstruction process. To detect the tumor area, it is necessary to label the tumor object and then it is traced by a red border which actually gives the tumorous area. The tracing of tumorous area is given by red border. The unit of traced area is counted into pixels.

In the observation stage, If the patient is new, the new patient is to be registered and then our proposed system takes the patient name and give a unique ID which is stored in database for further observing. But if the patient is old one, our proposed system takes the unique ID of old patient which is stored in database earlier. This unique ID is used to search into the database and it is matched and compared (i.e. the previous result is subtracted from the present result). If the compared result is zero it means the tumor growth is not increased or decreased [10]. If the compared result is positive, it means the tumor growth increased and the condition of the patient becomes dangerous. If the result is a negative value, it means the growth of tumor decreased and the condition of patient is improved.

IV. RESULTS

The proposed model has been performed on the patients of the collected data sets by MATLAB in 2013 on a computer with Intel Core (TM) i3, 2.13GHz CPU, 4GB RAM, and Windows 8.1 operating system. At each stage, the desired output is estimated by the algorithm Open operation with the morphological method. Fig. 1 describes the major stage of the Algorithm. Fig. 2 is the interface of our system. We have done our study on 50 patient's recent and previous brain MRI images data. We can store the patient's previous MRI data and compare it with recent MRI data to find out the progress reports easily by the doctor.

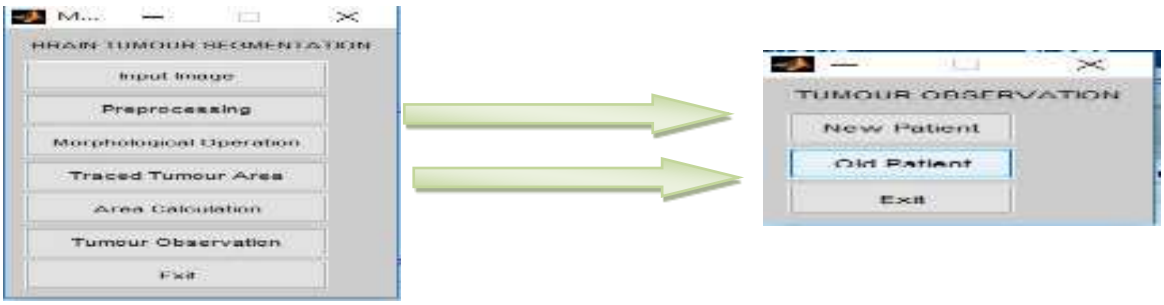

Fig. 2 Interface of our system

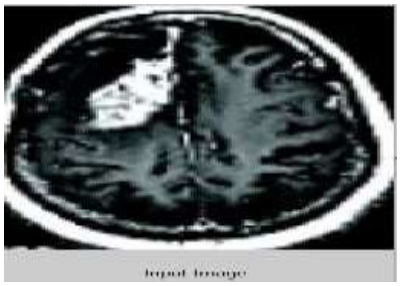

Fig. 3 Input noisy RGB image image

Fig.4 RGB to gray image conversion

Fig.5 Median filtered

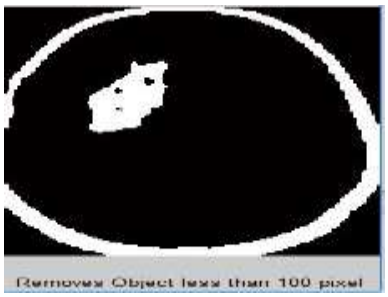

Fig.6 Open operation on tumor shape segmented area traced

Fig.7 Border clearing process

Fig.8 Tumor

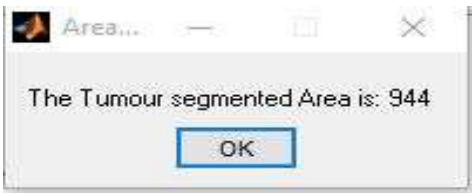

Fig. 9 Tumour area calculation

To observe the result, the result is applying into observation section. Which is given below, If the patient is new, it generates a unique id for the patient,

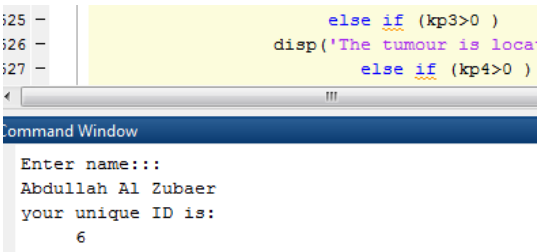

Fig. 10 Generated unique ID for new user

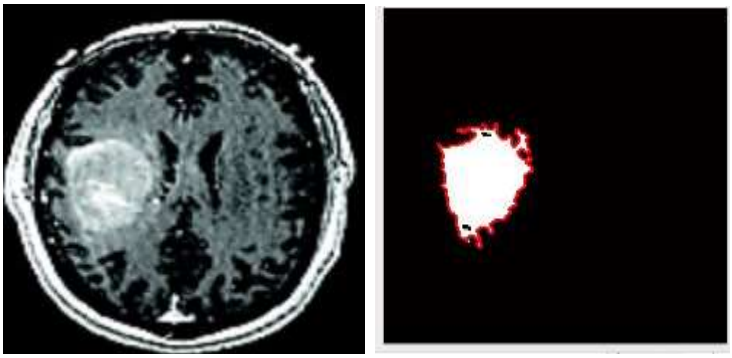

Fig. 11 Noisy Input and corresponding output image for the same patient

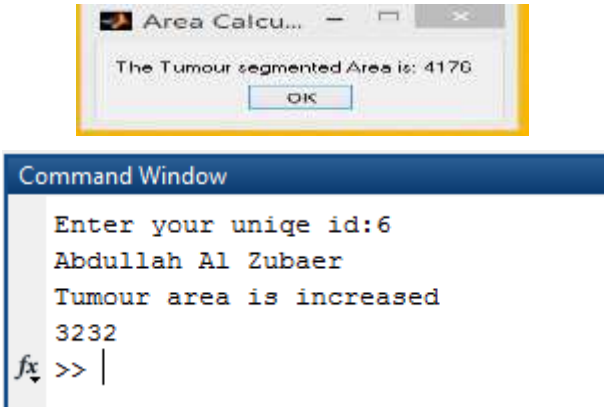

Fig. 12 Tumor Area Observation

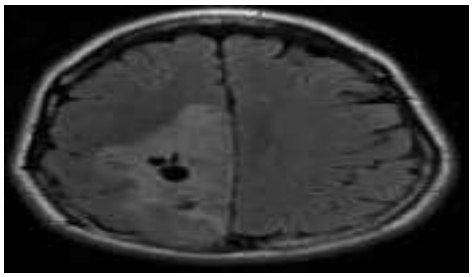

Fig. 13: Input Noisy MRI image without tumor

Fig. 14: There are no tumor present of this patient

V. CONCLUSION

We have developed a model-based segmentation method for segmenting head MR image datasets with tumors. Our proposed system is a semi-automated system using the concept of morphological operation. Here morphological operation followed by some preprocessing step. This step is very sensitive for segmenting the tumor area accurately. Here user supervision is needed to take the image from MRI machine and fed to our system input. Our system applies some operation and extracts the tumor area automatically which removes the headache of doctors. It is because our doctor gives the result approximately. It's not an accurate result. So our developed system gives the accurate result by using full classification of brain tissue into white matter, gray matter, binary, tumor. Because the method is automatic, its results are fully reproducible in repeated observation.

References

1. Halder, A., Pradhan, A., Dutta, S.K. and Bhattacharya, P., 2016, April. Tumor extraction from MRI images using dynamic genetic algorithm based image segmentation and morphological operation. In *2016 International Conference on Communication and Signal Processing (ICCSP)* (pp. 1845-1849). IEEE.
2. Vishnumurthy, T.D., Mohana, H.S. and Meshram, V.A., 2016, December. Automatic segmentation of brain MRI images and tumor detection using morphological techniques. In *2016 international conference on electrical, electronics, communication, computer and optimization techniques (ICEECCOT)* (pp. 6-11). IEEE.
3. Halder, A., Giri, C. and Halder, A., 2014, January. Brain tumor detection using segmentation based Object labeling algorithm. In *International Conference on Electronics, Communication and Instrumentation (ICECI)* (pp. 1-4). IEEE.
4. Ramya, L. and Sasirekha, N., 2015, March. A robust segmentation algorithm using morphological operators for detection of tumor in MRI. In *2015 International Conference on Innovations in Information, Embedded and Communication Systems (ICIIECS)* (pp. 1-4). IEEE.
5. Thakur, P., Pahwa, K. and Gupta, R., 2015. Brain tumor detection segmentation using watershed segmentation and morphological operation. *International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE)*, *4*(6).
6. Oo, S.Z. and Khaing, A.S., 2014. Brain tumor detection and segmentation using watershed segmentation and morphological operation. *International Journal of Research in Engineering and Technology*, *3*(03), pp.367-374.
7. El-Dahshan, E.S.A., Mohsen, H.M., Revett, K. and Salem, A.B.M., 2014. Computer-aided diagnosis of human brain tumor through MRI: A survey and a new algorithm. *Expert systems with Applications*, *41*(11), pp.5526-5545.
8. Dhumal, S.P. and Gaikwad, A.S., 2014. Automated Brain Tumor Segmentation Using Region Growing Algorithm by Extracting Feature. *International Journal of Application or Innovation in Engineering and Management (IJAIEM)*, *3*(12), pp.121-127.
9. Rana, R., Bhdauria, H.S. and Singh, A., 2013, August. Brain tumour extraction from MRI images using bounding-box with level set method. In *2013 Sixth International Conference on Contemporary Computing (IC3)* (pp. 319-324). IEEE.
10. [Roy, S., Chatterjee, K., Maitra, I.K. and Bandyopadhyay, S.K., 2013. Artefact Removal from MRI of Brain Image. *International Refereed Journal of Engineering and Science (IRJES)*, *2*(3), pp.24-30.
11. [Roy, S., Nag, S., Maitra, I.K. and Bandyopadhyay, S.K., 2013. Artefact removal and skull elimination from MRI of brain image. *International Journal of Scientific and Engineering Research*, *4*(6), pp.163-170.
12. Gordillo, N., Montseny, E. and Sobrevilla, P., 2013. State of the art survey on MRI brain tumor segmentation. *Magnetic resonance imaging*, *31*(8), pp.1426-1438.
13. Patil, R.C. and Bhalchandra, A.S., 2012. Brain tumour extraction from MRI images using MATLAB. *International Journal of Electronics, Communication & Soft Computing Science and Engineering*, *2*(1), pp.1-4.
14. Mustaqeem, A., Javed, A. and Fatima, T., 2012. An efficient brain tumor detection algorithm using watershed & thresholding based segmentation. *International Journal of Image, Graphics and Signal Processing*, *4*(10), p.34.
15. Abdullah, N., Ngah, U.K. and Aziz, S.A., 2011, May. Image classification of brain MRI using support vector machine. In *2011 IEEE International Conference on Imaging Systems and Techniques* (pp. 242-247). IEEE.