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Brain Tumour Diagnosis from MRI Images Using Segmentation and Classification Using Artificial Neural Network

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Abstract: Brain tumour detection using image segmentation technique like threshold segmentation and with the help of artificial neural network like k-means clustering algorithm. First we have extracted features which are important for the diagnosis of Brain tumour through median filter. After that we have calculated statistical features for the diagnosis of Brain tumour like area, length and thickness of tumour.

Keywords: Brain tumour, Classification, Magnetic Resonance Imaging (MRI), Segmentation.

I. Introduction

Brain tumour is type of brain diseases which directly affect the brain. It has affected many lives. An abnormal growth of cell in brain is called brain tumour. In earlier days it was very difficult to find the exact position of brain but now with the help of technology it is easy to find it and also very much helpful for doctors. Various methods are present to detect brain tumour automatically with the help of MRI (Magnetic Resonance Image). Generally brain tumour identified in the children is primary brain tumour and in adult it is stated as secondary brain tumour. People who are affected by secondary brain tumour were expected to survive only several weeks after diagnosis.

Types of brain tumour:-

- *Benign:* It is the type of noncancerous cell and least aggressive type in nature. They originate from cells within or surrounding the brain, grow slowly, and typically have clear borders that do not spread into other tissue.
- *Malignant:* It is the type of cancerous cell. It usually do not have clear borders. These types of tumours are life threatening because they grow rapidly and invade surrounding brain tissue. After the diagnosis of this tumour. Patient needs immediate recovery treatment.
- *Primary:* Tumours that start in cells of the brain are called primary brain tumours. Primary brain tumours may spread to other parts of the brain or to the spine, but rarely to other organs.
- *Secondary:* Metastatic or secondary brain tumour begins in another part of the body and then spread to the brain.

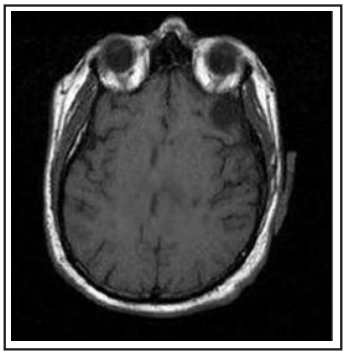

Fig. 1: Normal Brain Image

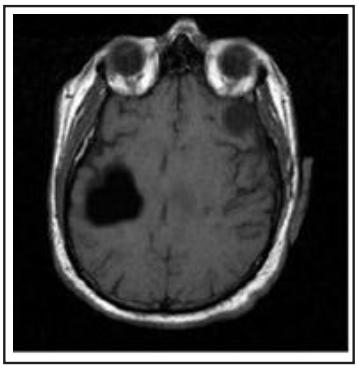

Fig. 2: Abnormal Brain Image

II. Methodology

In this paper we represent brain tumour detection method through morphological approach. Morphology is a broad set of image processing operations that process images based

on shapes. Morphological operation applies a structuring element to an input image, creating an output image of the same size. In this method we take brain MRI image from the dataset and convert the image into gray scale image. Then apply morphological operations dilation and erosion to get the boundary image. On this boundary image we apply threshold segmentation to highlight the tumour, and apply k-means clustering algorithm to get high similarity object in comparison to one another.

III. Work Flow Diagram

Input: MRI image.

Output: Tumour portion of the image.

In this method we used Morphological Approach for Segmentation.

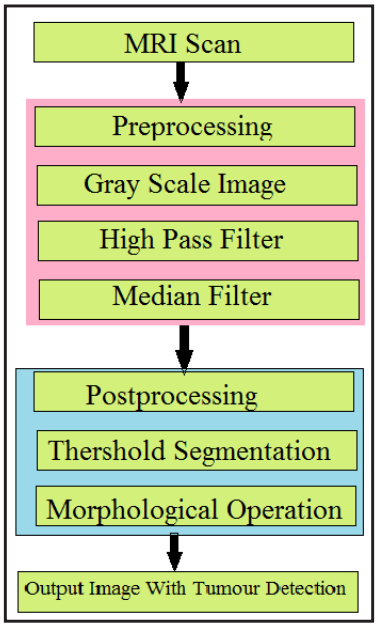

Fig. 3

IV. Explanation of Each Step from Implementation

In this method for the extraction of Brain tumour we use Brain MRI images of size 256*256 and the slice thickness is 1mm. The MRI images are used to produce high quality images of inside the human body [1]. With the help of high pass filter and median filter we get improve image quality and removal of impulse noise. We apply morphological operation i.e. dilation and erosion on 2D image to extract some parameters like boundaries, skeleton and complex hull. With the help of these parameters we calculate area and length of tumour. To solve clustering problem we use k-means clustering unsupervised learning and get the extracted image as a diagnosis of brain tumour.

A. Original Image

We have apply our proposed algorithm on various brain tumour MRI images from website www.cenral.xnat.org. This dataset contains various brain tumour MRI images. Matrix size of images is 256*256 and the slice thickness is 1mm used for analysis. The sample images are shown in the Fig. 4.

Fig. 4: Sampled Original Image from Dataset

B. Apply Median Filter

To improve image quality we apply high pass filter. To remove impulse noise this improved quality image is again pass through median filter. This filter is comparatively less sensitive than outliers [2].

The value of each pixel is obtained by median of the neighbouring pixe [3] i.e.

$F(x,y) = \text{median}\{g(s,t)\}$

The original value of the pixel is included in the computation of the median.

The result is shown in the following Fig. 5.

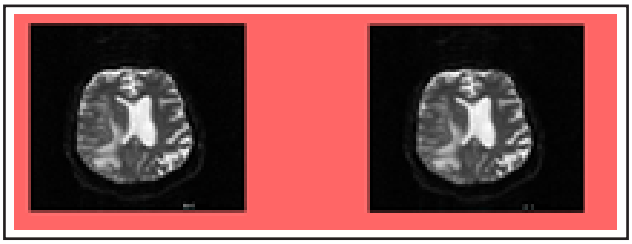

Fig. 5: Output of Median Filter

C. Thersholding of Image

The output of median filter is than convert in to grayscale image i.e. 2D image. In gray color image the pixel intensity 0 represents black color and the pixel intensity 255 represents white color [4] .

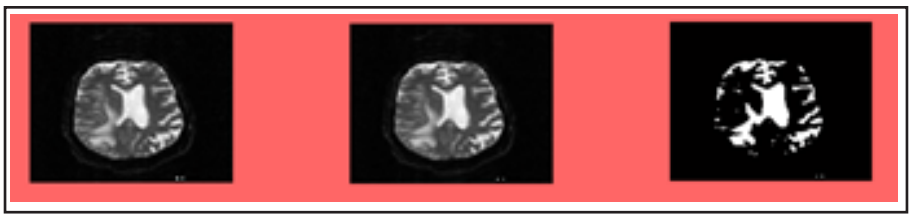

Fig. 6: Black and White Image

D. Morphological Operation

With morphological tool i.e. with the help of dilation and Erosion operator it is easy to each detail component sub band of the binary image. For filling the broken gaps at the edges we use dilation operation and with Erosion operation shrinks binary image [5]. Here we use only the relative ordering of pixel value for the processing of binary images. To get the structuring elements strel function is used. Its basic syntax is:

Se=strel(shape,parameter)

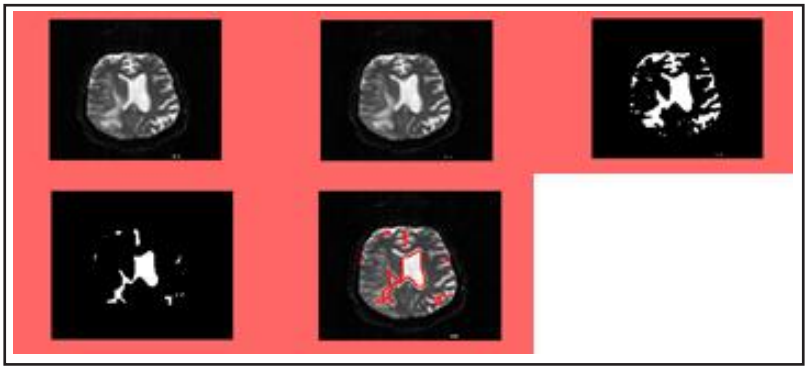

Fig. 7: Image after Morphological Operation and Boundary Detection

E. Classification (K-Means Clustering)

Cluster analysis is method of analysing and discovering useful information from numerous data. In this analysis the data groups into classes or cluster so as to get high similarity object in comparison to one another [6]. The main idea is to define k centroids, one for each cluster. When no point is pending the groupage is done. With k new centroid a new binding has to be done between the same data set points and the nearest new centroid [7]. Clustering can be supervised or unsupervised. In supervised clustering criteria is specified by the user and in unsupervised the criteria are decided by the clustering system itself [8]. In K-mean clustering algorithm standard local deviation is used for the segmentation of image into gray matter, white matter, tumour region, length and breadth of the tumour [9].

The objective function

$$J = \sum_{j=1}^{k} \sum_{i=1}^{k} ||x_i^{(j)} - c_j||^2$$

where, $||x_i^{(j)} - c_j||^2$ is a chosen distance measure between a data point $x_i^{(j)}$ and the cluster centre c_j, is an indicator of the distance of the n data points from their respective cluster centres [6].

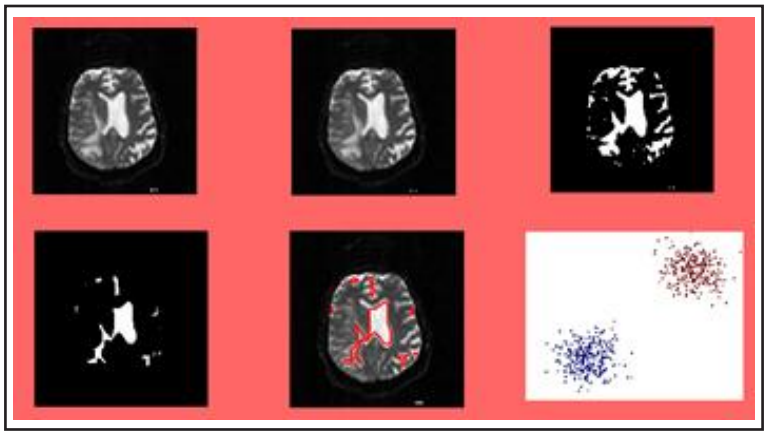

Fig. 8: Result of K-means Clustering Algorithm

F. Calculation of Length, Area and Thickness

With the help of K-means clustering algorithm we can calculate the length, area and thickness.

Table I: Feature Table

Sr. No.	Image Name	Area	Length	Thickness
1	000001	286	4	71.5
2	000002	335.75	3	111.917
3	000003	40	3	13.3333
4	000004	2267.88	9	251.986
5	000005	61	1	61
6	000006	1552.25	19	81.6974
7	000007	105.5	2	52.75
8	000008	94.75	2	47.375
9	000009	5.25	1	5.25
10	000010	3520.5	18	195.583
11	000011	31.125	2	15.5625
12	000012	265.25	1	265.25
13	000013	2219.5	11	201.773
14	000014	867.875	13	66.7596
15	000015	3490.13	9	3490.13
16	000016	26.625	2	26.625
17	000017	0	0	0
18	000018	11.5	2	11.5
19	000019	1174.63	23	51.0707
20	000020	18.875	1	18.875
21	000021	38.375	2	19.1875
22	000022	114.5	2	57.25
23	000023	57.25	2	26.4375
24	000024	11.125	1	11.125
25	000025	1	1	1
26	000026	307.875	2	153.938
27	000027	1076.75	4	269.188
28	000028	0	0	0
29	000029	3	1	3
30	000030	1336.25	15	89.0833
31	000031	89.0833	5	15.15
32	000032	1	1	1
33	000033	982.25	10	98.225
34	000037	3.125	1	3.125
35	000038	837.25	14	59.8036
36	000039	10.25	3	3.41667
37	000040	89.875	3	29.9583
38	000041	1141.5	6	190.25
39	000042	36.875	2	18.4375
40	000043	722.25	14	51.5893

V. Information About Database

For our proposed method, we have collected the various tumour and non-tumour MRI images from the website www.central.xnat.org. This image dataset contains brain MRI images. Matrix size of images is 256*256 and the slice thickness is 1mm used for analysis [10].

VI. Conclusion

This work was done to detect brain tumour using medical imaging techniques. With the help of threshold segmentation and morphological operation (dilation and erosion) we are locating the tumour in brain MRI scanned images. Brain MRI images were taken, converted to gray images using thersholding converted to binary, highlighting the tumour. The proposed method has efficient result. Future work is to extend the proposed method for colour based segmentation and 3D images.

Acknowledgement

For this paper we acknowledge the database provided by www.central.xnat.org. On this database all the images are free for download and have all the detailed information about image which are required for brain tumour detection in MRI images.

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