Performance Comparison of Unsupervised Techniques For MRI Brain Tumor Detection

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Abstract: ***This lump could be a deformity in physical structure cells that, if not detected and treated, will even cause harm of body part. tumour is one such deformity that has been set by pathologists manually from past few years. Magnetic resonance Imaging (MRI), computed tomography (CT), antielectron Emission pictorial representation (PET) and immoderate sound square measure techniques that wont to take pictures of brain cells. however MRI is wide used because it is multiplanar image capturing technique. It is very difficult task for mechanically locating lump and computing its dimensional parameter as a result of boundaries or edges of various tissues in MRI brain pictures square measure unclear. Even intensities of sunshine and dark intensity pixels square measure indivisible in most cases. For tumors detection. therefore during this work, K-Means algorithm and Fuzzy C-Means algorithm techniques are enforced. additionally Histogram technique that is bar chart Thresholding is enforced. Results of these 3 unattended techniques are applied over a group of brain pictures that are gathered from open sources. Results of lump location of those brain pictures square measure compared for 3 techniques and it's found that Fuzzy C-Means agglomeration outperforms different 2 techniques.***

Keyword*:* - FCM, K-Means Clustering, Histogram Thresholding and Mathematical Morphology

1. Introduction

Brain controls memory and learning, senses. it commands different parts of the body, together with muscles, organs, and blood vessels. Brain tumors are diseases within which cancer cells begin to grow within the tissues of the Brain. Brain tumors are unwanted in or on the brain which might result to results of uncontrolled cell growth. Tumors are classified into primary and secondary growth. Primary tumors ar additional like brain cells. Central system tumors embody heterogeneous diseases which will be benign, slow-growing injury to malignancies which can even cause death. Secondary tumors have origin in other places within the body that then unfold in brain. they're cancer cells truly that have unfold into the brain. they'll be diagnosed and should be removed simply by surgery.

Image segmentation is performed to find any desired region which can be any object or some figure within the MRI image, which might be used for recognition, piece of writing or compression etc. In machine learning techniques, wherever computer is employed to phase desired a part of a picture from its background, there will be two kinds of algorithm. These are unsupervised and supervised algorithms. Unsupervised Algorithms are such algorithms wherever no data is antecedently obtainable to come up with membership operate of any category in image. Such unsupervised learning will be enforced by strategies like clump (e.g., k-means, fuzzy c-means clustering and hierarchal clustering) and neural network models. supervised algorithm deducing work from training data.

2. Liteature Review

Ed-Edily et. al. proposed brain tumor detection and localization framework which comprises five steps: image acquisition, pre-processing under a median filter, edge detection by sobel edge detection, modified histogram clustering to color threshold and morphological operations. **Selkar et. al.** presented the detection and segmentation of brain tumor using watershed and thresholding algorithm. **Sivaramakrishnan et. al.** proposed Fuzzy C-means clustering and histogram. The Fuzzy C-means clustering algorithm finds the centroids of the cluster groups. **Dhanalakshmi et. al.** described k-means clustering algorithm for detecting the range and shape of tumor in brain MR Images. **Ali et. al.** preprocessed T2 weighted modality, by bilateral filter to reduce the noise and maintaining edges among the different tissues. Gray level stretching and Sobel edge detection, K-Means Clustering technique based on location and intensity, Fuzzy C-Means Clustering, and An Adapted K-Means
clustering technique and Fuzzy C-Means segmentation technique are applied. **Kowar et. al.** presented detection of tumor in brain using and histogram thresholding. **Selvakumar et. al.** implemented method which allows the segmentation of tumor tissue with accuracy and

reproducibility comparable to manual segmentation. The stage of the tumor is displayed based on the amount of area calculated from the cluster.
On the basis of problems analyzed after literature review, objectives of this research work are being defined here:

i). Implementation of Unsupervised Brain Tumor Segmentation techniques like Histogram Thresholding, K-Means Clustering technique and Fuzzy C-Means clustering Technique.
ii). Applying Morphological Operations to sharpen boundary of segmented tumor portion of image.

In the next section, methodology is being proposed to tackle problem which are analyzed in this section.

3. Methodology

In this section, algorithms of three different unsupervised image segmentation techniques are being proposed to detect brain tumor:

3.1 Histogram thresholding technique

In this technique histograms of 2 halves of brain pictures drawn. Then symmetry between these 2 histograms is ascertained then there would be each likelihood of presence of any deformity or tumour within the brain image.
Step by step process is given below:

i) Preprocessing- RGB color image is 1st transformed into grey color image.
ii).Division the image- grey image is then divided into 2 equal halves on its central axis. The column worth is split by a pair of. Divided image are half of the actual image.

iii).Plotting and correlate bar chart of 2 halves- A bar chart may be a plot between element and its intensity. Histograms of 2 halves brain image compared to estimate the tumour.
iv). choosing a threshold point- Resultant distinction is chosen as threshold point.
v). Segmentation using threshold point - Intensity of image is compared with on top of calculated threshold point. If worth is larger than the brink, then its location is appointed a price 255 otherwise zero.
vi). tumour Selection- the maximum intensity pixel location is chosen as tumour.

3.2 k-means cluster technique

K-Means cluster works on the principle of cluster of every element in keeping with its minimum distance with any cluster

Step by step clarification of technique is given as below:
1.Assign the numbers of clusters as k.
2. select the k cluster centers.
3.Calculate mean or center of the cluster, specifiedclusterwill be pictured by Ca wherever p=(1, 2,3….k)
4. Calculate the maximum distance b/w every element to every cluster center. It will be performed by nearest neighbor classification technique like euclidian Distance Calculation
di,j = || Xi,j-Ca || (1)
5. If the gap is with reference to the middle then move to it cluster. Otherwise move to next cluster.
6. Re-estimate the middle.
7. Repeat the method till centre of mass movement stops.

3.3 Fuzzy c-means cluster technique

The fuzzy cluster formula is associate repetitive cluster technique which may produces associate optimum c partition by minimizing the weighted inside cluster total of square error objective operate J

$$J_m = \sum_{i=1}^{N} \sum_{j=1}^{C} M_{ij}^{m} \left\| x_i - c_j \right\|^2 \qquad (2)$$

if then iteration wherever m > one, Mij is membership degree of xi within the cluster j, xi is any d dimensional knowledge, cj is cluster centre specified ci=, c is that the variety of clusters in x with limit a pair of ≤ c< n, m may be a coefficient exponent on every fuzzy membership. Cluster centre C=[cj] will be computed by

$$c_j = \frac{\sum_{i=1}^{N} x_i}{\sum_{i=1}^{N} M\, M_{ij}^{m}} \qquad (3)$$

And membership matrix M(k) and M(k+1) will be calculated by

where one ≤ k ≤ N and one ≤ i ≤ C
is stopped otherwise set M(k+1) = M(k) and C is once more calculated.

4. RESULTS AND DISCUSSION

Results of each algorithm are shown step by step and then tumor results of these algorithms are compared.

4.1 Histogram thresholdin same amount of brain region in both halves.g technique

1..Dividing Image –Resized image is divided into two half. This will be a vertical partition, with

Gray Scale Image

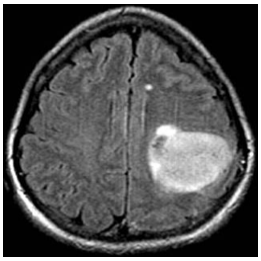

Figure1: Resized Gray Scale Image

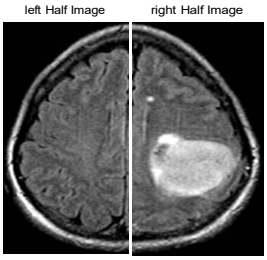

Figure2: Partitioned Image in two halves (a) Left half, (b) Right half

2. Histogram Difference- Now Fig. 3 showing difference between thresholds

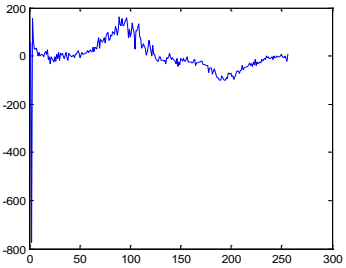

Figure 3: Histogram Difference of Two Halves of Brain Image

3. Threshold Calculation- Now that portion of image is selected as threshold. Figure 4 shows its result

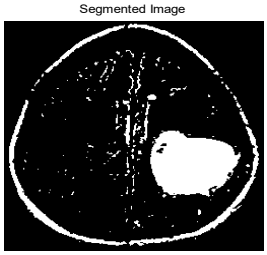

Figure 4: Threshold Image

4. Selecting Tumor- To select tumor region, all other light intensity region should be removed. It can be done by removing all connected components of image which are not part of tumor.Figure5 is selected tumor.

5. Tumor Region in Brain- In last step, intensity of region which is finally selected as tumor, is highest intensity value and hence this region is marked in the sample brain image. Figure 6 is this image

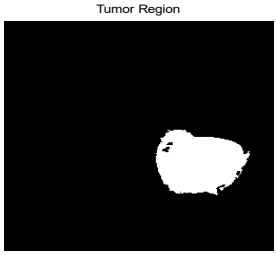

Figure 5: Tumor Region of Brain

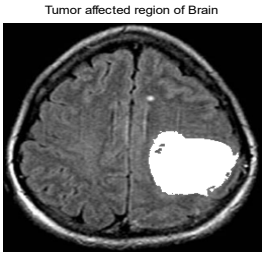

Figure. 6 : Tumor Portion Projected in Brain by Histogram Thresholding

4.2 K-means clustering based mri brain image segmentation

1. K-Means Clustering – Gray scale image is then applied with K-Means clustering. Here K is number of clusters. 4 numbers of cluster we are choosing. K-Means clustering calculates 4 numbers of centroid and all pixels of image are checked for distance (in terms of intensity) with these clusters. Pixel is assigned that particular cluster, with which it is nearest,. Figure 8 to Figure 10 shows 4 numbers of clusters of Figure 7 which is resized gray version of sample image

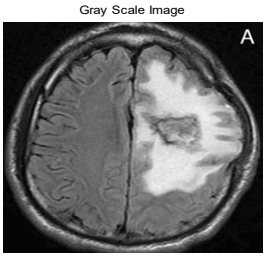

Figure 7: Resized Gray Scale Image

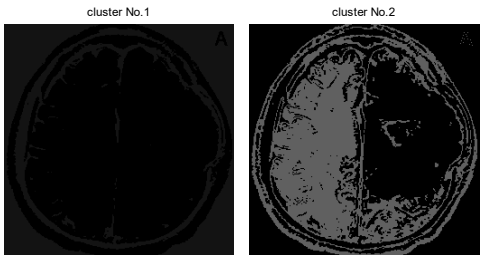

Figure 8: Cluster No. 1 with intensity Value 19.45
Figure 9: Cluster No. 2 with intensity Value 95.67

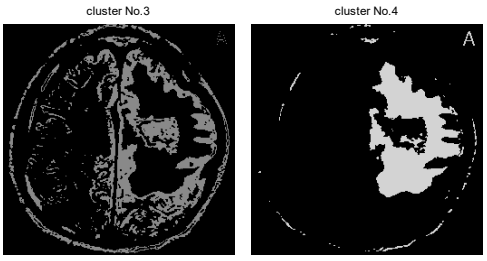

Figure 10: Cluster No. 3 with intensity Value 136.64
Figure 11: Cluster No. 4 with intensity Value 211.43

2. Selecting Segmented Image- In a tumor affected brain, tumor is bright in color as compared to its surrounding. So that particular cluster is selected which is having highest intensity value among all 4. Selected cluster is shown in Figure 11.

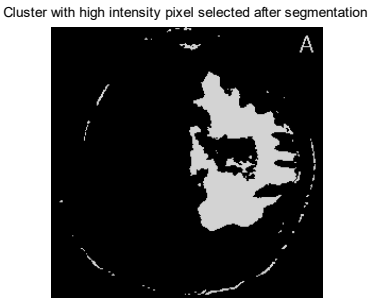

Figure 11: Selected Cluster with Tumor

3. Clearing Border – In the designated cluster image, it's 1st targeted to identified boundary of designated cluster image. Region within boundary are unbroken dark in order that growth within it is highlighted and region outside boundary is unbroken light-weight in order that region is removed in next step. Fig.12 is showing.

4. Filling Holes- In this step any tiny dark region, encircled completed by lighter region, are filled, i.e they're additionally reborn into lighter region. Figure thirteen is clustered image with hole stuffed.

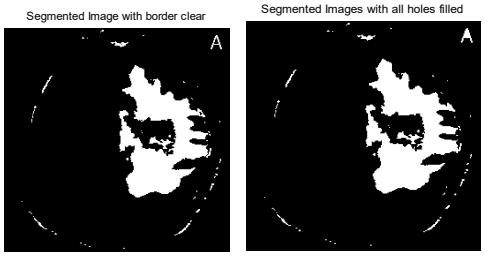

Figure 12: Border Cleared Image
Figure13: Image After Holes Filling

5. Selecting Tumor- To select growth region, all different strength region ought to be removed. thus a intensity is outlined below that these unsought elements ar removed. Fig. fourteen is detected growth.

6. Tumor Region in Brain- In last step, intensity of region that is finally designated as growth, is raised to highest intensity worth. Fig. fifteen is brain image with growth.

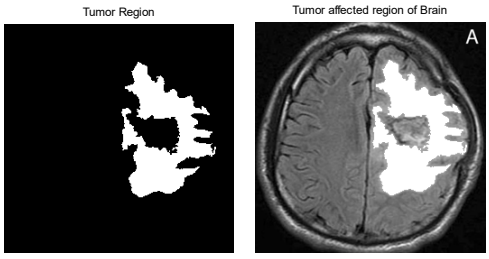

Figure 14: Tumor Region of Brain
Figure 15: Tumor Portion Projected in Brain by KMeans Clustering

4.3 Fuzzy c-means clustering based mri brain image segmentation

Fuzzy C-Means Clustering is a multi valued logic that allows, within the same fuzzy sets

1. Fuzzy C-Means Clustering – Here degree of membership image, intermediate elements i.e., member of 1 fuzzy set to be member of different perform, dimension within which brain image are going to be worked upon and a positive real price larger than one needs to be outlined for membership perform. Fig. seventeen is that the clustered pictures once segmentation.

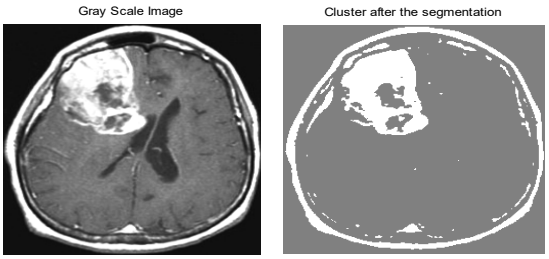

Figure 16: Resized Gray Scale Image
Figure 17: FCM Clustered image after segmentation

2. Clearing Border – In the elect cluster image, region within boundary are going to be unbroken dark so growth within it are often highlighted. Figure 18 is showing this specific image.

3. Filling Holes- In this step any tiny dark region, encircled completed by lighter region, are filled, i.e they're additionally reborn into lighter region. Figure nineteen is showing crammed hole image

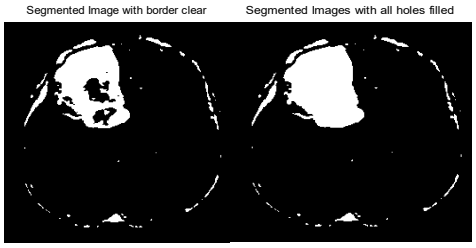

Figure 18: Border Cleared Image
Figure 19: Image After Holes Filling

5. Selecting Tumor- To select growth region, a strength are often outlined below that these unsought elements area unit removed. Fig. twenty is growth region of this brain image

6. Tumor Region in Brain- Intensity of tumor is raised to highest value and hence marked in the sample brain image. Figure 21 is brain image over which tumor is highlighted.

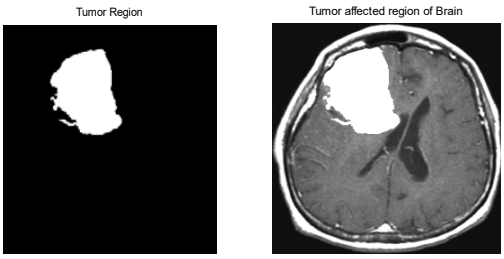

Figure 20: Tumor Region of Brain
Figure 21: Tumor Portion Projected in Brain by Fuzzy C-Means Clustering

4. Conclusion

In this work, Input MRI brain image is RGB color image which is first transformed input gray-scale images and resized to 256 x 256. Then this image is separately applied with Histogram Thresholding, K-Means Clustering and Fuzzy C-Means Clustering Technique. In histogram thresholding, a brain image is partitioned into equal halves vertically and their histogram is compared for intensity of tumor in either of these two halves. In K-means clustering brain image is distributed in 4 clusters on the basis of their intensity. Tumor cluster intensity will be high which helps in selection of this particular cluster. Similarly in Fuzzy C-Means clustering, image is distributed in two clusters and then tumor cluster is selected. Tumor location in input brain image is compared for three unsupervised technique. On comparing these algorithms by applying over various brain images, it is found out that Fuzzy C-Means clustering is giving good results all the time as compared with other two works. In some brain images, Histogram Thresholding and K-Means clustering are even unable to produce any tumor image which is very clearly shown by FCM

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