



BRAIN TUMOUR DETECTION USING SUPER PIXEL BASED SPECTRAL CLUSTERING

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Abstract – A brain tumour or intracranial neoplasm occurs due to abnormal cell growth within the brain. It varies in different shape, size and intensity. Here, superpixel based spectral clustering method is been used for the segmentation of brain tumour from MRI. MRI (Magnetic Resonance Imaging) is used to create high quality clusters. The main problem during spectral clustering is that it suffers from dense similarity matrix construction. In the proposed work, the drawback of dense similarity matrix construction can be overcome in two steps (i.e., identification of region of interest (ROI) and then doing spectral clustering from obtained ROI). FCM and GMM algorithms are used to perform brain tumour segmentation. The dice score values of edema and tumour core regions are calculated from the MRI. From the results, it can be observed that the proposed method gives better result than the existing.

Keywords – brain tumour, MRI, segmentation, spectral clustering, superpixels, ROI.

I. INTRODUCTION

Detection of brain tumour is very important in current scenario of health care society. There are two main types of tumours: malignant and benign tumours. Benign is just a cyst but malignant are the cancer causing cells[1]. Cyst can be removed very easily and do not reproduce one removed. However, malignant are having rapid growth with increasing pressure in head and has to be removed as early as possible. Diagnosing a brain tumour usually begins with magnetic resonance imaging (MRI)[3](fig.1). MRI is advantageous in creating better soft tissue contrast than X-rays which leads to production of high quality images, mainly in brain and spinal cord scans. The automatic brain tumour segmentation[2] method is of two types, supervised method and unsupervised method. A supervised method requires high data sets and it's a time consuming one whereas the unsupervised method does not depend on data sets, reduces complexity and increases the speed of operation without loss of accuracy for segmentation[1].

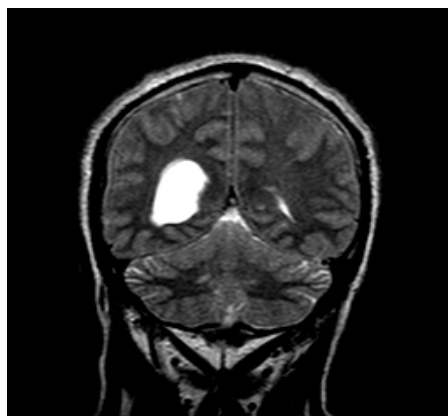


Fig. 1. MRI of a brain with tumour

II. EXISTING WORK

In this paper, the brain tumour detection using superpixel based spectral clustering is performed. After chosen, the image pre-processing method is applied. In pre-processing, the image is smoothed and adjusted. Then the image is portioned into blocks for the selection of superpixel. Then after the selection of tumour superpixel the similar blocks will be identified to select the region of interest and then spectral clustering is performed using k-means algorithm to get the tumour. Fig.2. the flow diagram of existing model is been given.

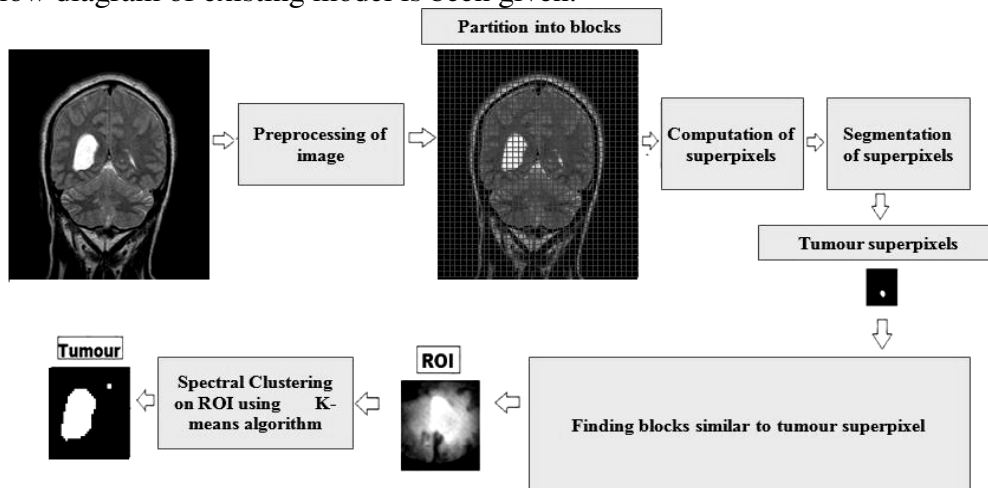


Fig. 2. Flow diagram of existing work

Flow Chart:

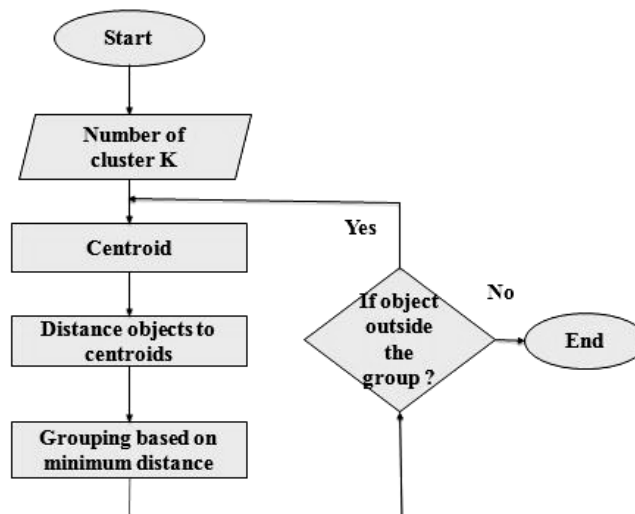


Fig. 3. Flow chart of K-Means algorithm

Algorithm for identification of ROI:

Input: Input an MRI tumour image

Output: ROI

Step 1: Partitioning of image into equal sized n blocks $b_1; b_2 \dots b_n$.

Step 2: Compute superpixel value S of each block using Central Tendency Value,

$$S_i = CTV(i),$$

Where $\rightarrow i = 1, 2 \dots n$.

$\rightarrow n$ is the number of blocks.

$\rightarrow CTV$ is Central Tendency Value of the block

Step 3: Perform spectral clustering on superpixels S_i

Where, $i = 1, 2, \dots$ No of superpixels to get clusters

(c_1 = Tumour superpixels (white colour) and c_2 = Non-Tumour superpixels (black colour)).

Step 4: Find the corresponding block of tumour superpixels (c_1) in the image and label the block as tumour block (T).

Step 5: Find adjacent blocks similar to tumour block (T) using LBP feature extraction to form ROI.

Output:

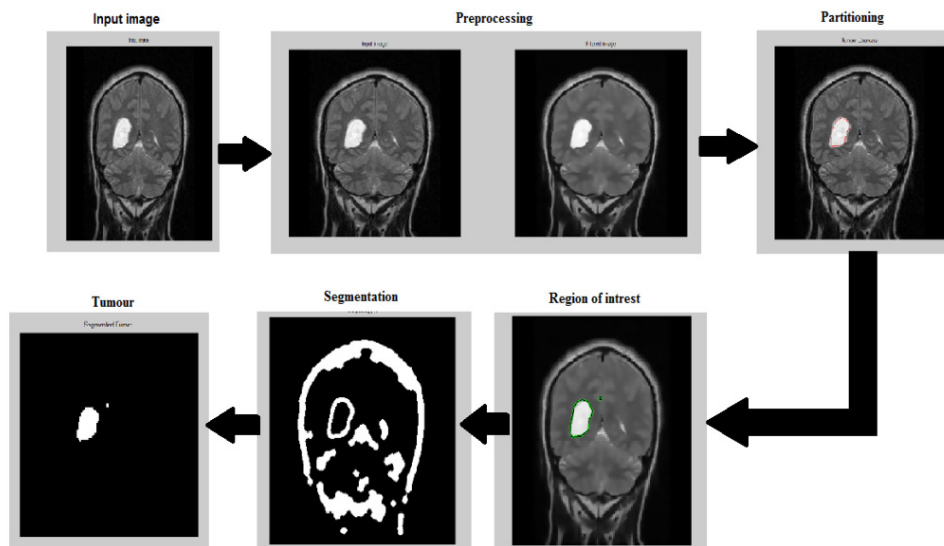


Fig. 4 Output of existing work

III. PROPOSED WORK

To perform brain tumour segmentation using FCM and GMM algorithms to obtain better dice score for critical cases.

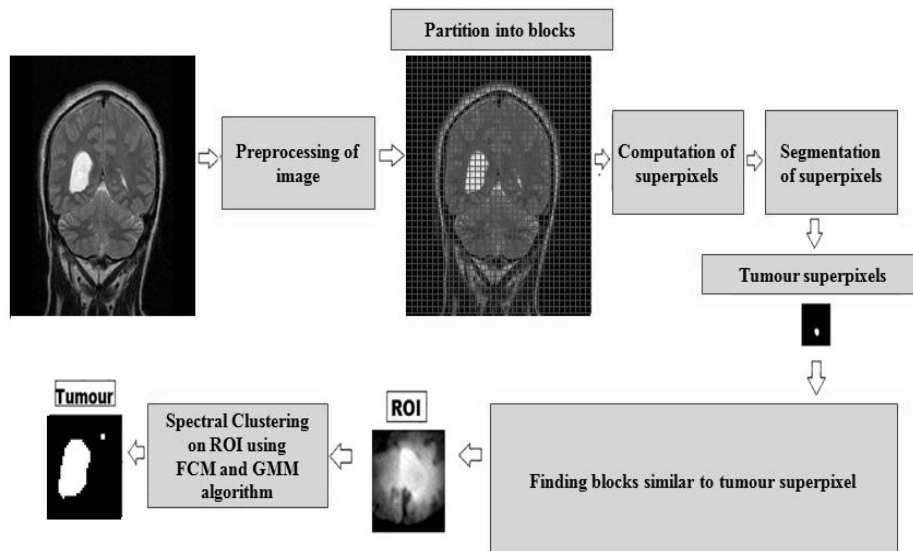


Fig. 5 Flow diagram of proposed work

Flow Chart:

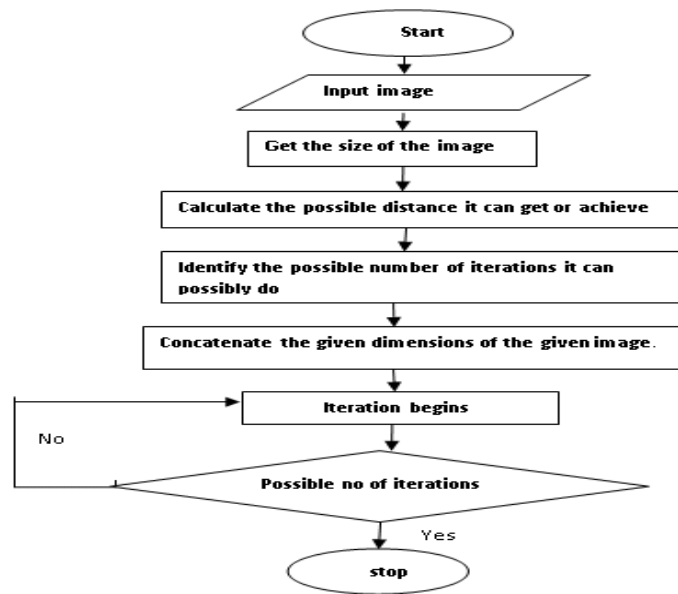


Fig. 6 Flow chart of FCM algorithm

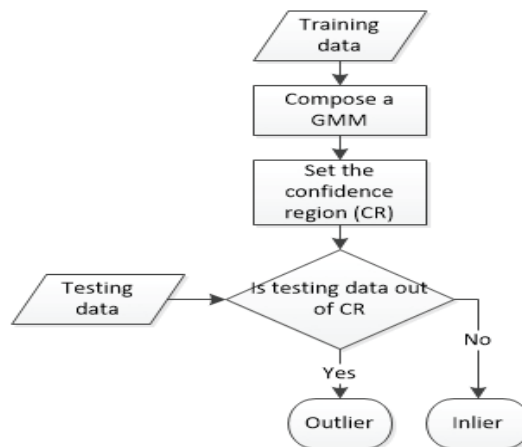


Fig. 7 Flow chart of GMM algorithm

Algorithm of FCM:

- Read the image into the Matlab environment
- Get the size of the image.
- Calculate the distance possible size using repeating structure.
- Concatenate the given dimension for the image size
- Repeat the matrix to generate large data items in carrying out possibly distance calculation.
- Begin Iterations by identifying large component of data vis - a - vis the value of the pixel.
- Stop Iteration when possible identification elapses.
- Generate the time taken to segment.

In FCM each data point can belong to more than one cluster. It involves assigning data points to clusters such that items in the same cluster are as similar as possible. Then the clusters are identified via similarity measures. Different similarity measures may be chosen based on the data or the

application. One of the most widely used fuzzy clustering algorithms is the Fuzzy C-means clustering (FCM) Algorithm.

Algorithm of GMM:

- Step 1: Input data is feeded.
- Step 2: Fit each data into individual identical Gaussian distribution model.
- Step 3: Mixture all models into a whole GMM model.
- Step 4: Set the criteria region for different criterion method and different significance level [(i) 0.10, (ii) 0.05, (iii) 0.01].
- Step 5: Label data as an outlier if the data is out of the criteria region.

In GMM, the mixture model as a way of handle data with multiple outliers. GMM is a parametric probability density function represented as a weighted sum of Gaussian component densities. In mathematics, a one-dimensional Gaussian distribution is a distribution function of the possibility density form:

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} \dots e^{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2}$$

IV. EXPERIMENTAL RESULT

Output Image:

The output of the proposed model is given below through the following figure, fig.8.

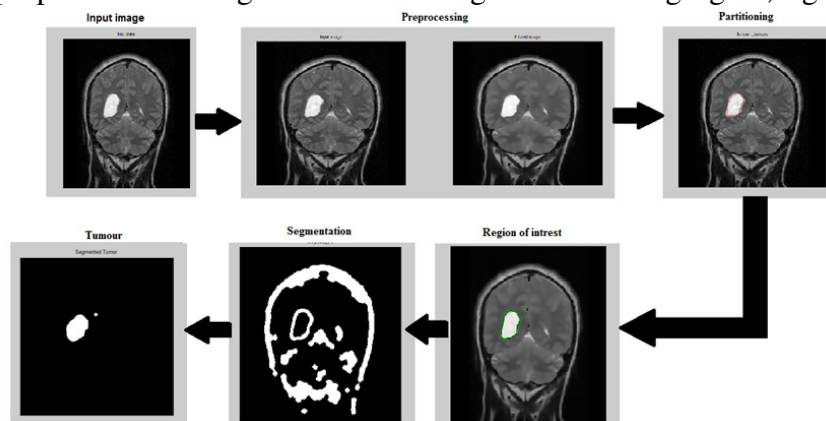


Fig. 8 Output of proposed model

The dice score is used to evaluate the performance of segmentation. The pixel by pixel comparison is made between ground truth and the segmented region.

The equation is given as:

$$Dice\ score = \frac{2(TP)}{FN + 2(TP) + FP}$$

Where;

- **TP** is *True Positive* that counts the number of correctly segmented positive case pixels in the segmented region.
- **FN** is *False Negative* that counts the number of incorrectly segmented negative case pixels in the segmented region.
- **FP** is *False Positive* that counts the number of incorrect segmented positive case pixels in the segmented region.

Tabulation –

Algorithm Used	Dice Score Value	Dice Score Value
	Edema	Tumour Core
FCM & GMM Algorithm	0.63	0.29

V. CONCLUSION

In this paper, the drawback of dense similarity matrix construction is reduced by using FMM and GMM algorithms over K-means algorithm. Here, GMM algorithm runs at an average speed. However, it gives a precise result. Better clusters are obtained because it can quickly model the data with interpolation pattern and complex cluster configurations. No specific cluster centers are required for startup because in the complex patterns less intensity overlap is present. The proposed method produces better dice score value which allows better identification of tumorous tissues and with this better evaluation of the tumorous cells can be done for better treatment purpose. However, in future grade classification can also be added along with segmentation process.

REFERENCES

- I. P. Shanthakumar , P. Ganeshkumar, ” Performance analysis of classifier for brain tumour detection and diagnosis”, *Computers and Electrical Engineering*, 24 June 2015.
- II. B. Devkotaa, A. K. Singhb, A. Elchouemic ,” Image Segmentation for Early Stage Brain Tumor Detection using Mathematical Morphological Reconstruction ”, *6th International Conference on Smart Computing and Communications*, ICSCC 2017, 7-8 December 2017, Kurukshetra, India.
- III. Eman Abdel-Maksoud , Mohammed Elmogy , Rashid Al-Awadi, ” Brain tumor segmentation based on a hybrid clustering technique”, *Egyptian Informatics Journal*, 10 February 2015.
- IV. Rajesh C. Patil, Dr. A. S. Bhalchandra, ” Brain Tumour Extraction from MRI Images Using MATLAB”, *International Journal of Electronics, Communication & Soft Computing Science and Engineering* ISSN: 2277-9477, Volume 2, Issue 1.