International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 09 | Sep 2018 www.irjet.net p-ISSN: 2395-0072

IMPROVED BRAIN TUMOR DETECTION USING FUZZY RULES WITH IMAGE FILTERING FOR TUMOR IDENTFICATION

Anjali Pandey[1], Dr. Rekha Gupta[2], Dr. Rahul Dubey[3]

[1]PG scholar, Electronics& communication Engineering Department, Madhav Institute of Technology & Science, M.P., Gwalior
[2,3]Faculty of Electronics& communication Engineering, Madhav Institute of Technology & Science, M.P., Gwalior

---

Abstract - *The identification and extraction of brain tumor is a complicated task that has yet to be furnished. To ease detection process of brain tumor, different image processing techniques have been used. In this paper, Fuzzy C mean algorithm is used. Fuzzy c mean algorithm is very famous image segmentation. Fuzzy c mean algorithm output also contains some unwanted part. In our proposed work, these unwanted parts can be eliminate by using simple median filter. In our proposed work, DWT with SVM are used to identify the types of tumor, whether it is Benign and Malignant type. Filtered image by median filter also helps in better detection by SVM classifier.*

Key Words: FCM (Fuzzy C Mean), MRI (Magnetic Resonance Imaging), Grayscale image, computerized tomography (CT) scan, image pre-processing, image filtering.

1. INTRODUCTION

There are many parts in our body but brain is the most complicated part. When cells grow abnormally it causes tumor or in general, we know when cells grow older or it get damaged, new cells replaced it but when old cells does not get destroy and new cells build up on them[1]. Then some extra cells remain there and these extra cells form a mass of tissue called as tumor. Tumor can be cancerous or non-cancerous. Brain tumor can itself grow in brain or it can grow in another part of the body and then spread to brain.

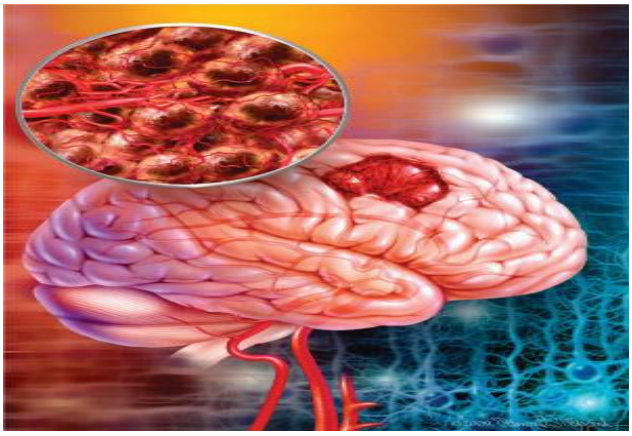


Fig-1: Image of brain detected with cancerous cells

1.1 Tumors type

1.1.1 Primary brain tumors - Primary brain tumor is the tumor which begins in brain. It can be of two types (a) malignant (cancerous) or (b) benign (non-cancerous).

1.1.2 Secondary brain tumors - Secondary brain tumor is more dangerous than primary tumor because it is cancerous. It starts from another part of the body and after some time it spreads to brain. It is also called metastatic brain tumor.

Tumor is classified into grades (more the grade number more aggressive is the tumor growth). Grades of tumor depend upon the abnormality of cells and aggressive growth:

Grade I: The tissue is said to be benign, grows slowly and resembles like the healthy cell.

Grade II: The tissue is said to be malignant, tissues doesn't resemble like the regular cell.

Grade III: These malignant tissues are the cells which are more irregular to look at and rapidly growing.

Grade IV: These malignant tissues are the most abnormal and tend to grow at faster rate.

Early detection of tumor is very essential, to increase the chances of survival of tumor infected patient [2, 3]. Researchers discovered different automated methods for early detection of tumor. Segmentation approach is used to determine the affected tumor part. It divides image to its constituent parts to detect infected area of the brain. For classification of tumor images, support vector machine (SVM) and Neural network are widely used [4].

In our proposed work, FCM algorithm is used for the segmentation purpose of the MRI image of brain. The segmented image is further enhanced by using median filter. Here median filter removes the unwanted segmented part by considering them as a noise.

2. FCM (FUZZY C MEAN) SEGMENTATION

Fuzzy c-means clustering technique is an unsupervised technique of image segmentation [5]. FCM is very popular and very powerful compared to other segmentation techniques. In this technique, number of clusters is chosen than data is clustered into two or more known number of classes [6]. It assigns membership to each data point on the basis of distance between cluster center and data point [10].

FCM is a technique of iterative clustering that creates an optimal c-partitioning by method of minimizing the weight within the group sum of squared error objective function in short JFCM [8].

$$JFCM = \sum_{k=1}^{n}\sum_{i=1}^{c}(u_{ik})^{q}d^{2}(x_k, v_i) \quad (1)$$

Here,

X = array of x that is xi where i=1 to n and it should be less than equals to R,

n = it is a number of data items,

c = it is a number of clusters where $2 \le c < n$,

u_{ik} = it is a degree of membership of x_k in the ith cluster,

q = it is a weighting exponent on each fuzzy membership,

v_i = it is a prototype of the centre of cluster i,

and $d^2(x_k,v_i)$ is a distance measure between object x_k and cluster centre v_i.

Solution of object function (JFCM) can be calculated by a iterative process, which is as follows:

- First set the values for q, c, & e,
- Second, fuzzy partition matrix need to be initialized,
- Third, need to set the loop counter such that b = 0,
- Calculate c cluster centers $\{v_i^{(b)}\}$ with $U^{(b)}$

$$v_i^{(b)} = \frac{\sum_{k=1}^{n}(u_{ik}^{(b)})^{q} x_k}{\sum_{k=1}^{n}(u_{ik}^{(b)})^{q}} \quad (2)$$

- Calculate the membership $U^{(b+1)}$, For k = 1 to n, calculate the following:
  $I_k=\{i|1<=i<=c$
  $d_{ik}=||x_k-v_i||=0\}$,
  $\sim I_k=\{1,2,\ldots\ldots c\}-I_k$, for the k^{th} column of the matrix, compute new membership values, and if $I_k=\emptyset$, then

$$u_{ik}^{(b+1)} = \frac{1}{\sum_{j=1}^{c}\left(\frac{d_{ij}}{d_{jk}}\right)^{\frac{2}{q-1}}} \quad (3)$$

else $u_{ik}^{(b+1)} = 0$ for all $i\epsilon \sim I_k$ and $\Sigma i\epsilon I_k\, u_{ik}^{(b+1)} = 1$, next k [9],

- if $||U^b - U^{(b+1)}|| < \Ɛ$, stop; otherwise set b=b+1 and go to step 4.

3. MEDIAN FILTER

Median filter is very popular image filtering method among other filtering methods. It acts as a low pass filter. It blocks all the high frequency components in the image that may be noise & edges [11]. It has been seen that at high density of corruption, higher window size works better because at higher window size, sufficient number of uncorrupted pixels will available in the window. Therefore the size of the window in simple median filter should be varies with change in noise density. The window size 3×3, 5×5, 7×7, and 9×9 median filter are mainly applicable. Output of the median filter is given by

$$y(i,j)=\text{median}\{x(i-s,j-t),x(i,j)/(s,t)\in W,(s,t)\neq(0,0)\} \quad (4)$$

where {x} is the noisy image and y(i,j) is the recovered image with preserve edges.

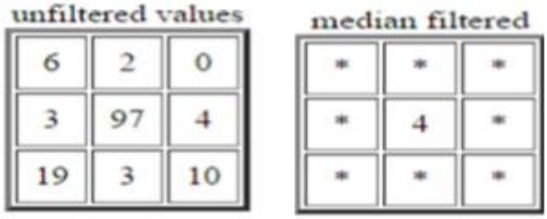


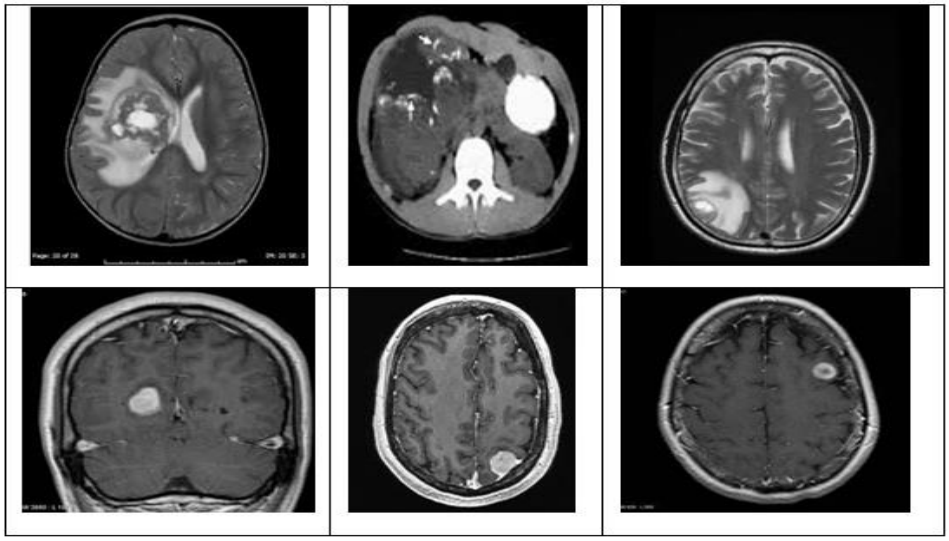
Fig-2: median filter [4]

As shown in fig. 4 above, the unfiltered values are the pixels of corrupted image. Since the median of all the neighbouring pixels is 4 therefore the center pixel is replaced by this median value.

4. PROPOSED ALGORITHM

The flowchart of proposed algorithm is shown in fig-3. The process starts with reading the image into MATLAB. After that FCM algorithm is applied for segmentation of the image. The FCM segmentation output still contains some unwanted parts. Therefore median filter is applied to remove those parts.

Table-1: Data set of MRI images with brain tumour



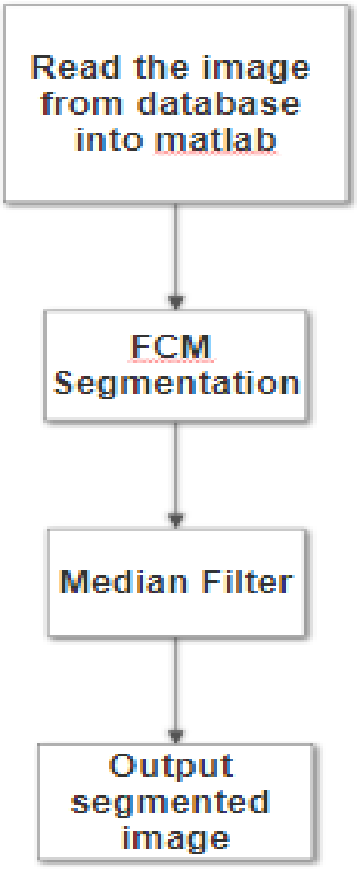


Fig- 3: Flowchart of Proposed Algorithm

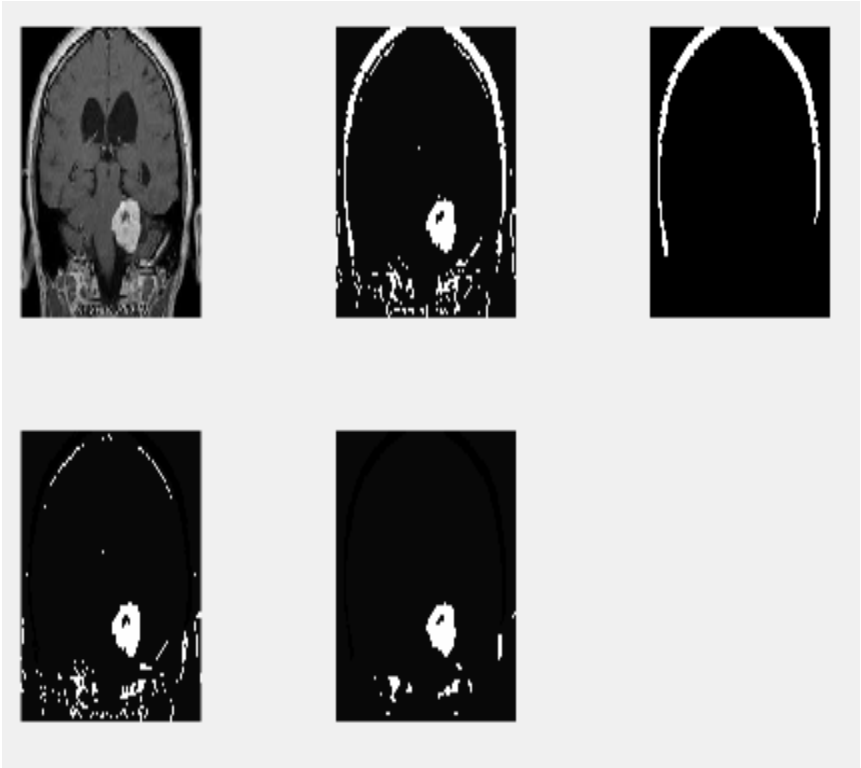
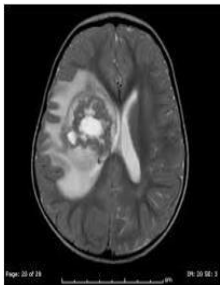
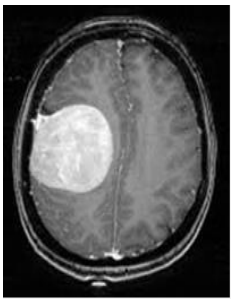
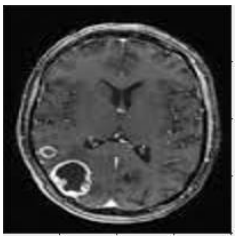
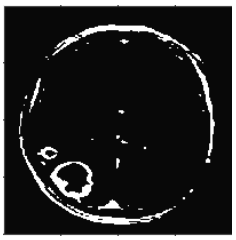
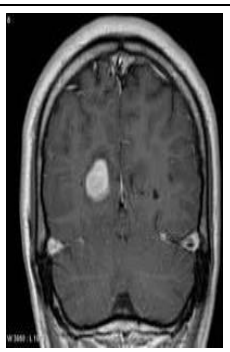
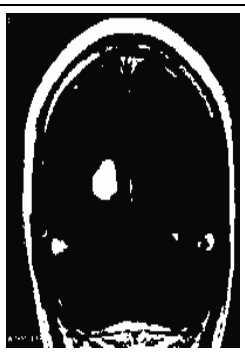
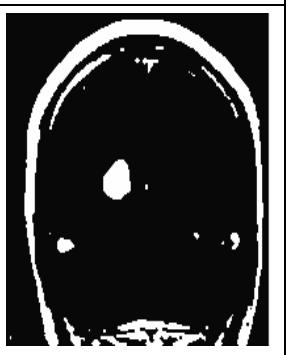
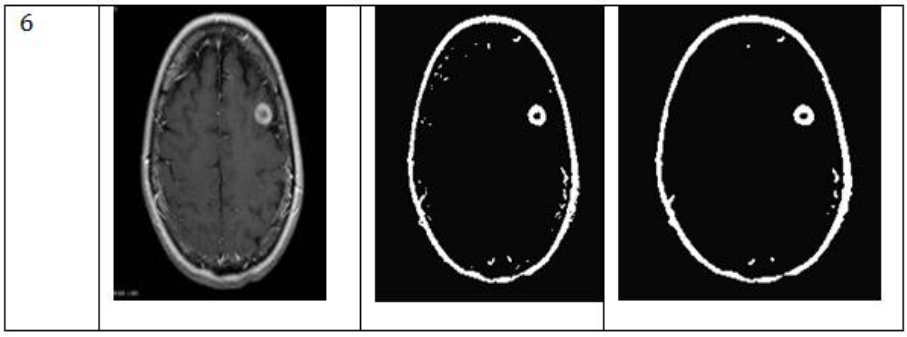


Fig- 4: Stage wise outputs (a) Original image (b) FCM output (c) Open area elimination (d) Difference image (e) Final output

5. SIMULATION RESULTS

Table -2: Simulation results of FCM segmentation and proposed work

S.No.	Original image	FCM segmentation	Proposed work
1			
3			
2			
4			
5			



6. CONCLUSIONS

Brain tumor can be detected and classified by using different image processing algorithms but FCM is very famous and effective algorithm for segmentation of brain tumor images. Output of FCM contains unwanted parts. To remove unwanted parts pf FCM segmented image median filter is introduced in our work to filter out these parts. The segmentation output of FCM segmentation with filter is better than FCM Segmentation as shown in results. Proposed algorithm is better in terms of quality of image also it will help in providing better classification accuracy.

REFERENCES

[1] Pooja B Minajagi, R. H. Goudar, "Segmentation of Brain MRI Images using Fuzzy C-Means and DWT", IJSTE - International Journal of Science Technology & Engineering, Volume 2, Issue 12, June 2016.

[2] N. Varuna Shree, T. N. R. Kumar, "Identification and classification of brain tumor MRI images with feature extraction using DWT and probabilistic neural network", Springer, Brain Informatics, Jan 2018.

[3] Heba Mohsen, El-Sayed A.L.Dashan, M.L.horbaty, abdel-badheeh M.Salem, "classification using deep learning neural networks for brain tumor", future computing and informatics journal, Dec 2017.

[4] Manisha, Radhakrishnan.B, Dr. L.Padma Suresh, "Tumor Region Extraction using Edge Detection Method in Brain MRI Images", [ICCPCT] International Conference on Circuit, Power And Computing Technologies, 2017.

[5] Baljinder Singh, Pankaj Aggarwal, "Detection of brain tumor using modified mean-shift based fuzzy c-mean segmentation from MRI Images", 8th IEEE Annual Information Technology, Electronics and Mobile Communication Conference (IEMCON), Nov 2017.

[6] Hind Rustum Mohammed, Husein Hadi Alnoamani, Ali AbdulZahraa Jalil, "Improved Fuzzy C-Mean Algorithm for Image Segmentation", (IJARAI) International Journal of Advanced Research in Artificial Intelligence, Vol. 5, No.6, 2016.

[7] Emre Dandıl, Murat Çakıroğlu, and Ziya Ekşi, "Computer-Aided Diagnosis of Malign and Benign Brain Tumors on MR Images", Springer International Publishing Switzerland, Jan 2015.

[8] S.Jayalakshmi, M.Sundaresan, "A Study of Iris Segmentation Methods using Fuzzy CMeans and K-Means Clustering Algorithm", International Journal of Computer Applications, Volume 85, Issue 11, Jan 2014.

[9] A. Meena, K. Raja, "Spatial Fuzzy C-Means PET Image Segmentation of Neurodegenerative Disorder", Indian Journal of Computer Science and Engineering (IJCSE), Volume 4, Issue 1, Feb-Mar 2013.

[10] R.Suganya, R.Shanthi, "Fuzzy C- Means Algorithm- A Review", International Journal of Scientific and Research Publications, Volume 2, Issue 11, Nov 2012.

[11] Youlian Zhu, Cheng Huang, "An Improved Median Filtering Algorithm for Image Noise Reduction", Physics Procedia, Elsevier, Volume 25, 2012.