ISSN: 0975-766X
CODEN: IJPTFI
*Available Online through* *Research Article*
**www.ijptonline.com**

# MRI BRAIN IMAGE SEGMENTATION USING MODIFIED FCM AND CLASSIFICATION BASED ON BPNN, AND SVM

**S.Gayathri[1], T.Abimala[2], R.Vishnupriya[3]**
1,2 PG students, CIE department, St. Joseph's college of Engineering
3 Assistant Professor, CIE department, St. Joseph's college of Engineering
*Email: saigayathri.90@gmail.com*

*Received on 20-12-2015* *Accepted on 18-01-2016*

**Abstract**

Brain tissue segmentation in MRI images is widely useful in the clinical applications and research field. Modified FCM (Fuzzy C- Means) is used to segment the tumours in the MRI brain images, since FCM takes lot of time for computation. After removing the noise, the image is segmented using MFCM. The segmented images are then classified using three different methods BPNN (Back Propagation Neural Network), SVM (Support Vector Machine).Features are extracted from all the methods. And finally the results are compared to find the accuracy of these three methods.

**Keywords:** MFCM, BPNN, SVM, Anisotropic Diffusion.

## I. Introduction

There are number of medical imaging techniques like X-ray, CT (Computed Tomography), MRI (Magnetic Resonance imaging), and PET (Positron Emission Tomography).Magnetic resonance imaging (MRI) has lot of advantages over other diagnostic imaging modalities such as high spatial resolution and inherent 3D nature, so it has gained wide range of clinical applications. Image segmentation is used to fragment each pixel into a number of non-overlapping and constituent regions into one group which are alike. Almost all research on tumour in brain is done using MRI images only. Therefore, in clinical diagnosis and pathology analysis MR image segmentation plays a vital role.

Some of the existing segmentation techniques are I) Histogram based Segmentation II) Clustering based Segmentation III) Region growing based segmentation IV) Active Contour based Segmentation V) Watershed based segmentation and VI) Morphology based segmentation. Among all the above methodologies, clustering based segmentation gives better results. Clustering techniques are unsupervised methods which groups the most similar

data. The potential of clustering algorithms is to reveal the underlying structures in data which can be utilized for a wide variety of applications, like classification, image processing, face recognition, and abnormality identification. However, the clustering algorithm has its own drawbacks. Clustering based segmentation will take a very long time for execution. To overcome the above drawback, Modified Fuzzy C-Means has been proposed in this paper. Segmentation of imaging data involves partitioning the image pixels into different cluster regions with similar intensity image values. There are several Modified FCM clustering applications in the MRI segmentation. The Modified Fuzzy C-means (FCM) is the fuzzified version of the k-means algorithm. It is a method of clustering which allows a piece of data that can own two or more clusters. This clustering algorithm will have number of iterations.

The proposed algorithm involves the following steps: Pre-Processing the MRI image followed by Segmentation and Classification. Proposed segmentation methodology is discussed in section II. Results and discussion is explained in Section III and conclusion is given in section IV.

**II. Proposed Work**

The proposed methodology involves the following steps

1) Pre-Processing
2) Anisotropic Diffusion
3) Clustering
4) Classifier

**Pre-Processing**

Pre-processing is used to remove the noise. Noise is nothing but the unwanted signals present in the image. It also enhances the quality of the image. This makes the segmentation more successful. The aim of pre-processing is to improve the image content that suppresses the unwanted signal distortions.

**Anisotropic Diffusion**

In this paper, anisotropic diffusion is used for processing the image before segmenting it. This is used to remove the two important noises namely, salt and pepper and Gaussian noise. Anisotropic diffusion was introduced by Persona and Malik in 1987. This noise removal method contains Partial Differential Equation (PDE) in its algorithm. The resultant image is a combination of the original image and the filtered image. Salt and pepper noise is also known as spike noise. The images will have dark pixels in bright region and bright pixels in dark regions. This caused due to some error occurred during the conversion of analog to digital. Gaussian noise is due to high temperature.

**Clustering**

Clustering groups objects that has high degree of similarity. It reduces the large number of input into less number of clusters. In image analysis, it groups the pixel based on some characteristics like intensity of the image. Two types of clustering are: i) Hard clustering and ii) Soft clustering. Hard clustering groups the data element into only one cluster. Example: K-means. Soft clustering groups the data in more than one cluster with different membership value. Example: Fuzzy C- Means.

**Modified Fuzzy C-Means**

MFCM is one of the soft clustering techniques. It is similar to the hard k-means. That is the data will belong to more than one cluster. FCM is good segmenting tool. But it is a time consuming process.

**Classifier**

Classification is one of the important steps in image segmentation. It is used to identify and depict the features of the image. With this we can identify the categories of the image. The aim of classifier is to categorize all the pixels in the image into number of classes. There are two main methods in classification. They are supervised and unsupervised classification or parametric and non-parametric method. The supervised classifier needs to be trained. After training, the images given are compared with the trained images, and the result will be produced indicating the quality of the image.

**Support Vector Machine**

SVM was proposed by Vladimir Vapnik. It is one of the best classifier techniques. It is an unsupervised technique. It can be used for classification and degeneracy. SVM is used to find the hyper plane, that separates the two different classes. The idea of SVM is to maximize the distance between the hyper plane and the closest sample point. That is good separation can be achieved, when the hyper plane has longest distance.

A diagrammatic representation of SVM is given below.

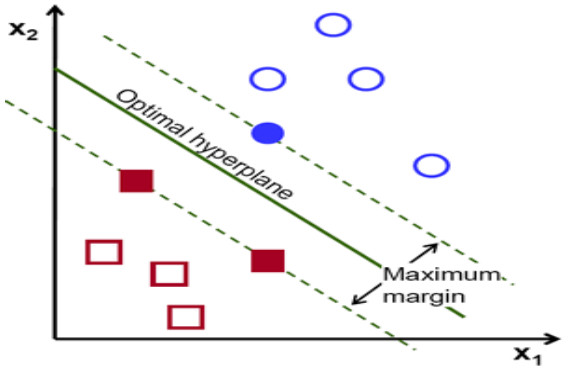



**Figure 1: Support Vector Machine.**

**Back Propagation Neural Network (BPNN)**

BPNN is a type of supervised learning technique which requires training. It can be trained in the following way. An input pattern is given to the input layer. The input layer then gives the activations to the hidden layer, which is next to the input layer. The output of the hidden layer is given to the next layer which is the output layer. This output layer processes the inputs given to it using bias and threshold function. The output pattern is compared with the input pattern and the error is calculated. In order to reduce the error, the error function between the hidden layer and the output layer is calculated and weight is updated between the input and the hidden layer. This process is repeated for number of cycles to reduce the error. This number of cycles is known as an Epochs. This is done till the BP network has learned the process. Thus it helps in identifying whether the image is normal or tumour affected.

The flow chart of the proposed segmentation methodology is shown below.

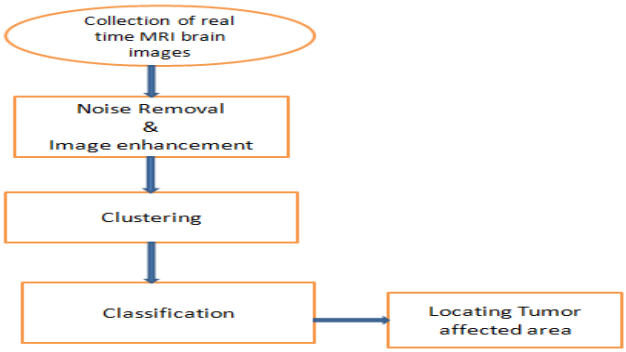
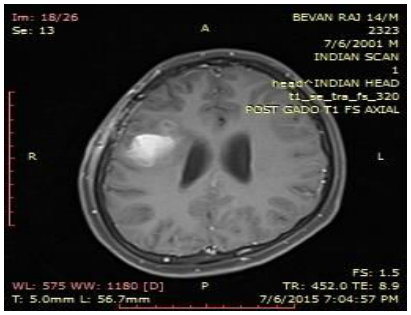


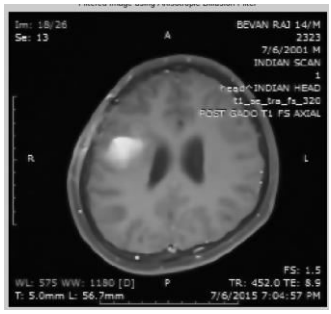

**Figure 2: Flowchart of the proposed methodology.**

**III. Results and Discussion**

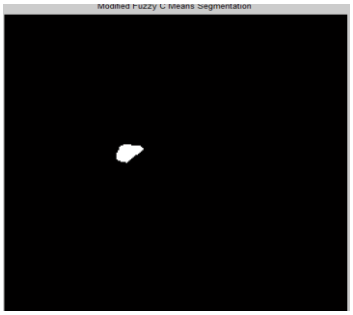
The above algorithm is implemented in MRI brain database to detect the presence of tumour. It helps us to locate the tumour affected area in the input image. Initially noise is removed using anisotropic diffusion. Then it is segmented using MFCM. The segmented image undergoes classification using SVM and BPNN. Finally the classifier give the output whether the image is normal or abnormal (Tumour affected). The images for this paper are collected form Indian Scan centre.



**a) Input Image**



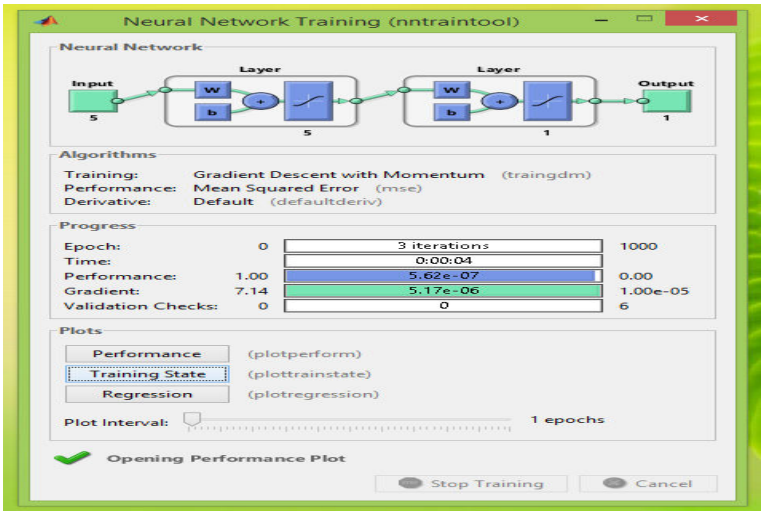
**b) Image after Noise Removal**



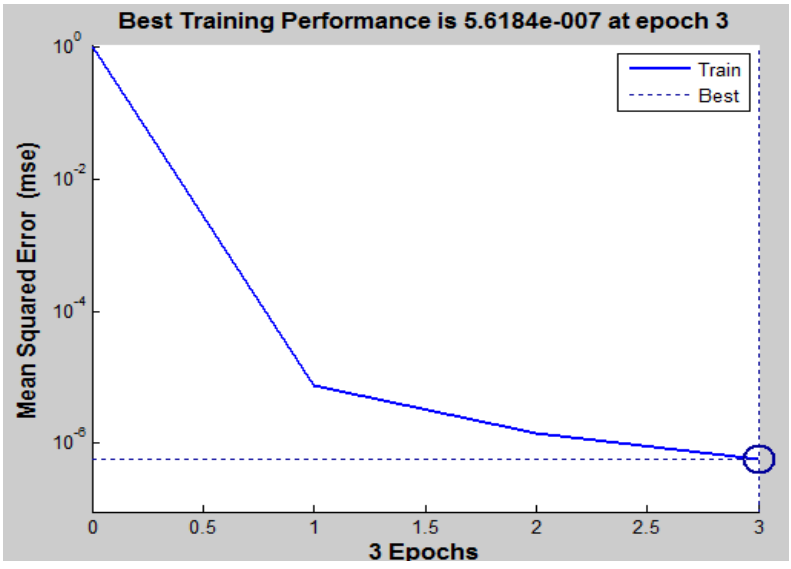
**c) Segmented Image**

The image is initially filtered using anisotropic diffusion is shown in the image b. Then it is segmented using Modified Fuzzy C-Means. The image 'c' shows the tumour affected area. The BPNN training is done using neural network toolbox. The performance of BPNN is identified by mapping the graph between Mean Squared Error (MSE) and Epochs.

| | |
|---|---|
| Peak Signal to Noise Ratio | 30.10 |
| Mean Squared Error | 63.4181 |



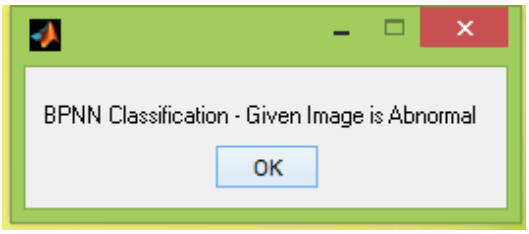

**d) BPNN Training**



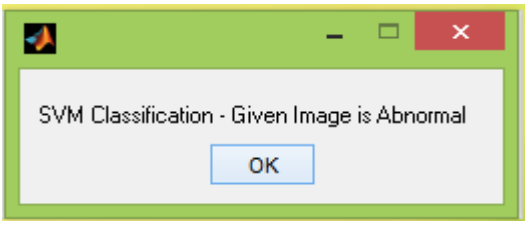

**e) Performance Analysis Graph for BPNN**

Performance analysis of the proposed methodology

BPNN is trained using this training tool. From the graph it is evident that the error is almost zero. The error value in the graph is 10^-6. The output of SVM and BPNN shows whether the given image is normal or tumour affected.




**f) Output of Bpnn for a Tumour Cell**




**g) Output of Svm for a Tumour Cell**

This is the output of the SVM and BPNN which indicates the input data is affected by tumour.

## IV. Conclusion

In this paper, Modified Fuzzy C-Means Clustering based segmentation is done for MRI brain images to detect the presence of the tumour. The image is also classified using Back Propagation Neural Network (BPNN) and Support Vector Machine (SVM) classified the image and identifies whether the image is normal or tumour affected. This work can be extended by extracting the features and comparing the performance of the above algorithm with different classifiers.

## References

1. Heena Hooda, Om Prakash verma, Tripti Singhal, "Brain Tumor Segmentation: A Performance Analysis using K-Means, Fuzzy C-Means and Region Growing Algorithms", 2014 IEEE International Conference on Advanced Communication Control and Computing Technologies (ICACCCT).
2. Pooja Kamavisdar, Sonam Saluja, Sonu Agarwal, "A Survey on Image Classification Approaches and Techniques", International Journal of Advanced Research in Computer and Communication Engineering Vol. 2, Issue 1, January 2013.
3. Abolfazl Kouhi, Hadi Seyedarabi and Ali Aghagolzadeh, "A Modified FCM Algorithm for MRI Brain Image Segmentation", IEEE 2011.
4. Min Li, Tinglei Huang and Gangqiang Zhu, "Improved Fast Fuzzy C-Means Algorithm for Medical MR Images Segmentation", IEEE 2008.
5. Parveen and Amritpal Singh, "Detection of Brain Tumor in MRI Images, using Combination of Fuzzy C-Means and SVM", 2nd International Conference on Signal Processing and Integrated Networks (SPIN) 2015.
6. M. Shasidhar, V. Sudheer Raja and B. Vijayakumar, "MRI Brain Image Segmentation Using Modified Fuzzy C-Means Clustering Algorithm", International Conference on Communication Systems and Network Technologies 2011.

7. A. Sathya, S. Senthil and Anudevi Samue , " Segmentation of Breast MRI using Effective MRI based on Support Vector Machine", IEEE 2012.

8. S.N. Deepa and Aruna Devi, "Neural Networks and SMO based Classification for Brain Tumor", IEEE 2011.

9. Maheshkumar S.Badmera, Ajinkya P.Nilawar and Dr. Anil R. Karwankar, "Modified FCM approach for MR brain image Segmentation", 2013 International Conference on Circuits, Power and Computing Technologies [ICCPCT-2013]

10. Jeenal I. Patel and Minkal B. Patel, "MRI Brain Image Segmentation Using Modified Fuzzy C-Means Clustering Algorithm", IJIRT, Volume 2 Issue 2, ISSN: 2349-6002 July 2015.

11. G.B. Deshmukh and P.D. Lambhate, "Mri Brain Image Segmentatin And Classification By Modified FCM & SVM Algorithm", IJERT Dec 2013, Volume: 02 Issue: 12

12. Ebrahim. Aghajari and Dr.Mrs. Gharpure Damayanti, "Incorporating FCM and Back Propagation Neural Network for Image Segmentation", International Journal of Computer & communication Technology Volume-2 Issue-VIII, 2011

13. P.Vasuda and S.Satheesh, "Improved Fuzzy C-Means Algorithm for MR Brain Image Segmentation", International Journal on Computer Science and Engineering, Vol. 02, No. 05, 2010

14. Walaa Hussein Ibrahim, Ahmed AbdelRhman Ahmed Osman and Yusra Ibrahim Mohamed, "MRI Brain Image Classification Using Neural Networks",

International Conference on Computing, Electrical and Electronics Engineering (ICCEEE) 2013

15. Selvathi.D & Arulmurgan. A, Thamarai Selvi.S and Alagappan. S, "MRI Image Segmentation Using Unsupervised Clustering Techniques", IEEE 2005.

**Corresponding Author:**

**S. Gayathri,**

**Email:** *saigayathri.90@gmail.com*