Analysis and Detection of Multi Tumor from MRI of Brain using Advance Adaptive Feature Fuzzy C-means (AAFFCM) Algorithm

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Abstract

Objectives: The objective of the study focused on the detection of the multi-tumor must involves evaluation of the computer-aided diagnosis systems which use image processing as the main tool for detection, therefore, the performance parameters that agree with the inter observers must be used. Methods: Segmentation is a significant feature of medical image dispensation, where Clustering move toward is extensively used in biomedical application mainly for brain multi tumor detection in irregular Magnetic Resonance Images (MRI). The present approach derives an innovative method for brain tumor analysis and detection based on the support vector machine (SVM) and fuzzy c-means algorithms. No such study is available to detect the multi-tumor. The present approach is to solve that problem and used to detect multi-tumors. Findings: The proposed AAFFCM approach is a hybrid approach which is a combination of fuzzy c-means and SVM algorithms for detecting multi-tumors in brain. A color base segmentation technique so as to uses the k-means clustering system is to path the multi tumor objects in the Magnetic Resonance (MR) brain images. Improvement: In the proposed approach, the MRI is improved by improvement techniques such as difference development, and Mean stretch. The skull striping operation is performed by using Morphology and double-thresh holding technique. By using Matrix, the specific information is removed from the brain image which is called Grey Level Advance Length Matrix (GLALM). After removing the specific information from the brain, SVM algorithm is used to categorize the brain MRI images, which give precise and more effectual importance for categorization of brain MRI.

Keywords: AAF^2CM, Fuzzy C Means, Grey Level Advance length Matrix, Magnetic Resonance Imaging, Segmentation, SVM

1. Introduction

The brain is an extremely dedicated organ. It serves as the organize central for determination of the body Brain tumors are one of the popular brain diseases, so discovery and segmentation of brain tumors in Magnetic Resonance Imaging (MRI) are significant in medical image analysis and find the behavior of the disease. MRI provides full in order concerning brain tumor structure, cellular arrangement and vascular provide, creation it a significant instrument for the effectual analysis, action and monitor of the ailment. Segmentation is an significant tool in medical image dispensation and it has be helpful in many application, such as discovery of tumors, discovery of the coronary edge, surgical preparation, measure tumor volume and its volumetric reply to treatment, categorization of blood cells MRI is the best medical imaging technology which permits cross sectional perspective of the body with unparalleled tissue distinction. In brain tumor analysis, doctors put together their medical information and brain magnetic resonance imaging (MRI) scans to get the life and pathological individuality of brain tumors and to make a decision on treatment options3.

This paper is deal with MRI fuzzy segmentation of medical image which is more multifaceted due to inherent nature of descriptions for detect multi tumor, edema present is a require of segmentation and MRI is an significant imaging method for detect abnormal change in tissues and being imagery have good difference declaration for unlike.
Segmentation methods because of it generates unique image compared to hard methods have more popularity among the available approaches and combination methods. The fuzzy based segmentation approaches are fuzzy, edge, histogram based approaches available in the world. The different types of data are done. Feature elimination data to get the information segmentation prove acceptable for fuzzy algorithms for medical image extra strong segmentation. The present studies results show the attendance of a tumor as abnormal brain while the lack of growth as a normal brain. In the dissimilar clusters obtain.

A Cluster weight index for fuzzy grouping, proposed a segmentation method to extra cell form an accretion of lesion called a tumor. The Brain tumors are asymmetrical and abandoned spreads of cells. The segmentation strategy utilized in biomedical representation liberality and go around the method supportive for improved segmentation. Serious assessments of the position of self-loader and programmed techniques are made for the segmentation of anatomical medical images underlines the advantages and disadvantages.

Statistical pattern recognition paper proposed a technique used the FCM concept and is compare with K-Means segmentation followed by the tumor detection which will show the attendance of a tumor as Abnormal brain while the lack of growth as a normal brain. In the dissimilar clusters obtain.

MRI segmentation techniques are done using the pattern recognition technique to segment the brain tumor uncovering. This advantage of this technique is segmentation is done only if it is necessary. This procedure is a difficult task since of the high variety in the look of tumor tissues in the middle of dissimilar patients and in many cases resemblance with the customary tissues. Physical segmentation of checkup image by the radiologist is a monotonous and protracted procedure. MRI is an extremely developed medical imaging technique as long as rich in order concerning the person soft-tissue structure.

Medical Images are one of the main concerns of Image processing where the competence and correctness both are necessary at extremely high level. Lot of work is previously complete in this district connected to medical image segmentation, irregularity uncovering etc. Even then since of obligation of high correctness it is the open investigate area. The proposed employment is too in the same direction. The character of images is not enhanced using enhancement method in existing methodology. The supplementary the edges are weakened. At the same time, the edges not symmetrical are enhanced. There is no proposer research in multi tumor analysis using FCM. To overcome the disadvantages of the existing approaches, the present paper develops an approach for Finding and Analysis of Multi Tumor on MRI in efficient and effective manner. The present approach uses both fuzzy c-means and SVM for tumor detection and analysis.

The rest of the paper is planned as follows. The proposed method is described in section 2 and results and derived user defined algorithm are discussed in section 3. Finally, conclusions are given in section 4.
2. Problem Identification

The proposed work is for the discovery of brain multi tumors in brain on MRI. The schematic diagram of the proposed approach is shown in Figure 1. The obtainable work covers the next objectives: Analysis and Study of existing Brain multi-Tumor Analysis Approaches researcher first contribution A² SIET - Automatic Detection of Multiple Tumors through Magnetic Resonance Image using MAT Lab. This paper research work fully belongs to Analysis and Detection of Multi Tumor from MRI of Brain using Advance Adaptive Feature Fuzzy C-means (AAF²CM) Algorithm\textsuperscript{17,18}. In this research describe a clustering move toward to carry out high level segmentation for multi tumor detection. Classify the network fuzzy based algorithm to achieve low level segmentation and to optimize the result. The proposed approach consists of five stages. Taking the MRI as input image and determines information about the image in the first stage. The preprocessing is applied on input image for removing the noise in 2nd step. Extract the features from the preprocessed image in step 3. Segmentation technique is in the step 4 for segment the MRI image based on feature extraction. Finally SVM is applied for tumor detection.

![Figure 1. Block diagram of the proposed algorithm.](image)

**A. Source of Input MRI Data:** The input information at this time necessity is in the form of brain images. Collect this data from the resulting source. It resources the images used in existing research. This data will be composed also from the internet or submit the request to the researchers. Main data can be together from the medical or hospitals. The images required with a 512*512 matrix and quantized with 16 bits. They were transfer into the Digital Imaging and Communications in Medicine (DICOM) format\textsuperscript{5,19}.

**B. Image Pre-Processing:** Normally capture image is of reduced superiority so image pre-processing is necessary for noise filtering in the image and also for reshaping the image. It include highly developed real time middle filter for noise removal. This is pace is helpful previous to going for the segmentation of the image\textsuperscript{12}.

**C. Feature Extraction, Segmentation, using Adaptive Feature Fuzzy C-means:** The feature removal is pulling out the cluster which demonstrates the collection of the irregular tissues. The removed cluster is specified to the threshold procedure it apply double mask over the whole image which give the fabrication as dim pixel become black and light pixel becomes white. In threshold procedure, every change coefficient is compare with a unique value. The extract attribute be supposed to give the individuality of the contribution type to the classifier by allowing for the account of applicable property of the image into a characteristic space. The present study extracts three textural features i.e. Local contrast; Valuable correlation and Missed entropy are extracted from Grey-Level Co-occurrence Matrix (GLCM). The objective of the segmentation is to make easier to change the shape of an image into another form and it is more significant and make easy to examine\textsuperscript{17,20}.

**D. Advance Adaptive Feature Fuzzy C-Means:** In the present study, fcm() is used for performin the FCM clustering which is available in the Fuzzy Logic Toolbox\textsuperscript{\\circledast}. A first presumption is complete for cluster centers, which are future to spot the denote position of each cluster\textsuperscript{21-23}. Mostly, the first guess for these cluster center is probable wrong. After that initial guess, fcm assign every data tip an association grade for each cluster\textsuperscript{5}. FCM is mostly used method based on concept of the Centroid\textsuperscript{24-26}. The present approach input data set is portioned into fuzzy clusters and selects the data points in the fuzzy clusters in step 1. The distance is calculated for each data from the cluster point in step 2. Step 2 repeated until all data points are moved from one cluster to another\textsuperscript{27-29}. In advance Fuzzy a value is given to the each pixel in image this value range from 0 to 1\textsuperscript{30}. The proposed algorithm is
representing in Algorithm1 and graphical representation of the proposed algorithm is shown in Figure 2.

**Algorithm 1: Advance Adaptive Feature Fuzzy C-means (AAF2CM) Proposed Algorithm Step Flow Mechanism/**

**/*input source image to taken to indentify brain multi tumor****/

**Step 1**: Load the medical image from image retrieval process and perform image normalization on it. Image normalization is done by using scaling.

**Step 2**: If the source image is in RGB arrangement then exchange it into a Grayscale image else not.

**Step 3**: Following getting grayscale image, execute the improvement on image by adjusting its brightness, contrast.

**Step 4**: Advanced Evaluate Image processing technique under Rapid Intensity Distance.

**Step 5**: Achieve Gray Threshold over selected Image to extract the Image Advanced Fuzzy features.

**Step 6**: Apply Fuzzy C Means to split the picture in Clusters.

**Step 7**: Divide the Image in Small Size Segments of N x N real time matrix format.

**Step 8**: Setup FCM Parameters under Min to Max Multi tumor cells normal and abnormal Weighted Approach.

**Step 9**: Apply Fuzzy C Network to train the image blocks.

**Step 10**: Identify the Adaptive Thresholding from FCM Analysis Response.

**Step 11**: Apply Threshold to Extract Tumor Area over Image.

**Step 12**: Measure Tumor Area.

**Step 13**: If Tumor Area>Threshold then display “Critical Multi-Tumor Identified” else “Tumor Identified”

**Step 14**: This step includes all experimental results and parameters which are taken for analysis. This parameter includes mean, standard deviation, pixel count, volume.

This fusion technique mainly involves image enhancement, skull striping, segmentation, feature extraction and creating training data set and apply SVM to classify the MRI images with GLCM features and stores the results for analysis. For classifying the MRI brain images, the above mentioned steps are necessary.

Fuzzy Clustering is a learning task, wherever one requirements to recognize a limited set of category known as clusters to classify pixels. Clustering is above all used when module are known in development. A similar principle is follow to differentiate between pixels and then similar pixels are grouped together to form clusters. A good excellence clustering technique creates high quality clusters with high intra-class relationship – similar to one another within the same cluster low inter-class similarity and difference to the entities in additional clusters. It is successfully used in pattern recognition and fuzzy modeling. There are a variety of comparison actions used to recognize course depended on the data and the request. Comparison events for example detachment, connectivity, and concentration are used. Its request is in data analysis, pattern recognition and image segment.

\[
Y_n = \sum_{p=1}^{X} \sum_{q=1}^{C} X_{pq}^m ||K_p - C_j||
\]

Where, \(n\) - Real number which is > 1, \(X_{pq}^m\) - degree of membership of K in the cluster j, \(K_p\) - data measured in
d-dimensional, the fuzzy membership function

\[ X_{pq}^{m} \]

### 3. Simulation Results

The evolution results of the proposed technique can be calculated by using MatLab, which is transformed into normalize arrangement by using scale to get filtered image, then changed into negative image, and then high level segmentation is performed, then low level segmentation to take out the correct impure area from the whole medical image\(^{34}\). The MatLab implementation of the proposed method is shown below.

The projected come within reach of tested on the database of images out of which multi-tumor images input is discussed. The record entity was as follows: the image name, Area of tumor, implementation time and the finding decision. Some of the table entries are given below in Table 1 and 2. The present approach uses median filter for removing salt and pepper noise in Grey level image\(^{35}\).

**Programming Implementation:**

1. Read the input image by using `imread()` and stores it in `img`.
2. Extract the size, weight and corner features of the input image using `size()`, `weight()`, and `corner()` functions and stores in `X`, `Y` and `Z` respectively.
3. Segment the image using FCM for each layer of segmentation from 1 to K, where K is cluster value.
4. Intilize the `M` variable with 2
5. Generate the Max matrix by using pixel() function
6. Find some Fuzzy cluster base Mapping vector using expression:

\[ MM(p,q,r) = MM(p,q,z) + Th*(MM(wp,wq,z) - mw(p,q, z)) \]

7. Calculate the abstraction: \( S = \text{sum (var (MM))/M} \)
8. If \( S > \text{MM}(p,q) \) then \( T(p,p) = \text{MM}(i,j) \)
9. Calculate the Cluster center: \( CC=\text{hcluster(T)} \)
10. \[ [r,c] = \text{size}(C) ; \]
11. Calculate the fuzzy c means segmentation using `clustfcm()` function
12. /* expand the som mapping*/
13. \( M = M+2 ; \)
14. \( p=p+1 ; \)
15. end;

The consequences occurred in the fuzzy segmentation are listed below. The significant parameter for analyze medical images is execution time. The number of Multi-tumor grey values detected by a method with the carrying out time is presented in Table. By using these values, the approach is planned to the number of pixels abnormal by the multi-tumor cells and the consequences are comparing with the existing results. Our proposed FCM based segmentation technique provides improved values. For the multiplication purpose, the present study used three the input features i.e. size, weight and corner\(^{35}\). Figure 3 which show the input dataset image for Multi tumor analysis. The researcher ultimate is to analysis the more than one abnormal cell in MRI using FCM mechanism.

![Multi tumor detection using AFCM](image)

**Figure 3.** Database Input Image.

Table 1 show the assessment of proposed and existing algorithm according to volume values of database images. It is experiential that amount values of proposed algorithm (AAF\(^{2}\)CM) are less than the existing algorithm (A\(^{2}\)SIET). Lesser the value of volume, additional strongly identifies the brain multi tumor and so gives better result. More the value of MEAN gives better result. The Figure 4 image which shows the FCM in Gradient magnitude Different Clusters gives the different values of the MRI such as white pixels, gray pixels, edema and Cerebro Spinal Fluid (CSF) and tumor if present, etc. In Gradient base feature extraction, the multi tumor abnormal collection of tissues is extract from segmentation input image which is given to the SVM (Support Vector Machine) process as input\(^{11}\). The binary mask is applied over the entire image. It makes the white become brighter and dark pixel become darker.

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The multi tumor analysis is take place in Advance Adaptive Feature Fuzzy C-means so researcher ultimate aim is to dive the cluster groups into two different scenarios from the input image. The proposed FCM algorithm is based on the data density where the size of the input is extremely focused. The data density has two sub steps: aggregation and quantization. The classification graph of the proposed method is shown in Figure 5.

Figure 5. Classification graph of the input image using Fuzzy concept.

Figure 6 shows the result obtained from the SVM classifier in FCM based methodology in different training mechanism is involved to train the MRI input image. The SVM is a supervised learning technique and good tool for data analysis and classification. The SVM classifier is also faster for large data sets and used for two or more class classification problems at a time.

Figure 6. Resultant image of input image when applies FCM based Support vector Machine.

SVM is based on the starting of conclusion planes. A choice plane is one that separate flanked by a set of substance have dissimilar class relationships. The classification and uncovering of brain tumor is done by using the SVM approach. Arrangement is done to identify the multi-tumor class in presence in the MRI. The SVM involves two basic datasets i.e. training and testing in FCM reconstruction mechanism. The resultant reconstructed image is shown in Figure 7.

Figure 7. FCM with SVM Reconstruction mechanism.
FCM threshold it is a multi tumor segmentation method. The FCM implementation converts the grey level image into binary by using the following procedure. For each pixel in grey level image do the following procedure.

If the pixel value is lies between 25 and 225 then treated as 1 (white) and remaining values are treated as 0 (black). Non brain tissues pixels are rejected in MRI image. The figure 8 shows the analysis of the multi tumor of the input image.

For each Cluster do the following steps:
1. Increase both, contribution start and its productivity delta to get the incline of the density.
2. Following that, take away a ratio (percentage) of the gradient from the Density. This ratio (percentage) affects the momentum and class of learning; it is called the learning rate. The greater the learning rate, the lower the learning rate, the more accurate the training is. Repeat steps 1 and 2 continuously until the performance of the detection multi tumor. The resultant image of the input image when cluster density is applied is shown in Figure 9.

This segment obviously shows that the area of AFCM method is more accurate and near to ground truth area than K-means tumor area. However, the time required by FCM is leaser than K-means as it considers more iteration. So use of Advance Adaptive Feature Fuzzy C-means algorithm detection of multi tumor is obtained successfully fast in manner. The result image of the input image when the proposed algorithm is applied on input image is shown in Figure 10.

The Figure 11 shows that cluster is divided into two different groups this separation for Graphical user analysis method in mat lab simulation tool. The color which implies the red for abnormal cells and blue for normal cells. The Figure 12 shows the FCM based Graphical result of the input image.
3.1 Comparison of Existing Method with and Proposed Scheme

Researcher existing work which implies A²SIET Automatic Detection of Multiple Tumors based segmentation and threshold mechanism is compare with this research work (A²F²CM) show in the table given below.

### 4. Conclusion and Future Work

The proposed method detects the multi tumors in MRI brain images in efficient and effective manner. The present paper utilized Adaptive SVM and fuzzy c-means clustering for classification gives precise result for recognize the brain multi tumor. The input images in the database are trained by the implement FCM network classifier. The medical image segmentation has difficulty in segmenting multi-layered arrangement with uneven shape, size, and properties. In such state it is improved to use unsupported method such as fuzzy-c-means algorithm. Also achieve the assessment of these existing and proposed algorithms are done on the basis of time, tumor area and reproducibility, PSNR, RI, and VOI. The results obtained conclude that the efficiency of FCM is comparatively better than existing algorithm for overlap datasets. In future, this system can be implementing with some other algorithm which will give more accuracy and save more time.

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