ANALYSIS OF BRAIN TUMOR CLASSIFICATION BY USING MULTIPLE CLUSTERING ALGORITHMS

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Abstract - *Medical imaging has becoming as a transpire discipline in diversified medical diagnosis. It plays a vital role in automatic detection, which bestows information about abnormalities for further treatment. The traditional approach of detecting the MRI and PET images based on manual inspection, which has become inappropriate for vast volume of data. Computerized tumor detection has been advance significance that conserves the time of radiologist. In this system, brain tumor is detected from MRI and PET images by the various classification techniques based on the Gustafson-Kessel (G-K) algorithm, density based spectral clustering algorithm(DBSCAN), k-means clustering algorithm and fuzzy c-means clustering algorithms. The Performance of different algorithms are Compared. Here the features extraction from MRI and PET images is done by Gray Level Co-occurrence Matrix (GLCM). The GLCM is a technique for dividing the second order measurable texture features. The texture features are attained from the statistical appropriation of examined blend of intensities at correct positions regarding each other. Based on the intensity pixels in all combinations, these measurements can be differentiated into first, second-and higher-request imminent. Finally, in this paper, the various algorithm for brain tumor detection are analyzed based on the performances and found that Gustafson Kessel algorithm are efficient.*

Keywords:* *Fuzzy c-means, Gustafson Kessel algorithm, k-means, DBSCAN and GLCM.

1. INTRODUCTION

The Digital Image processing deals with developing a digital system that performs operation on an digital image. Various algorithms are proposed and implemented to detect the brain tumor and its type.

Image segmentation is the fundamental step in medical image analysis. Segmentation is a procedure to separate features like shape, size, color, etc.

Each human being body is made up of cells. Each cell has a special function and will grow and divide in order to keep the body healthy. When cells lose the ability to control their growth mechanism, cell division starts without any order. The extra cells form as a tissue called as tumor. Tumors are of two types benign and malignant. Benign tumors grow slowly, whereas malignant tumors grow quickly and spread to nearby tissues and organs, which are life threatening. Tumors that instigate within brain tissue are known as primary brain tumors. Brain tumor is dangerous because of its character in intracranial cavity (space formed inside the skull). Brain tumors are differentiated by grade I to grade IV. Cells from higher grade tumors grow faster than grade I tumors. The amount of drug to be pumped into the human body to cure the tumor cells depends on the size of the tumor and this can be obtained accurately by Magnetic Resonance imaging (MRI) scan or a CT scan (Computed Tomography). However, in this paper, MRI scan images are used for the analysis. MRI is a very powerful tool to diagnose brain tumors. After MRI scan, the image is visually examined by a physician for finding &analysis of brain tumor. Computer aided methods for tumor segmentation help the doctors inaccurately determining the size, shape and stage of the tumor. Image segmentation and clustering are used to estimate the area of the tumor. In this segmentation process based on the different algorithms are Fuzzy C-Means, K-Means, Gustafson Kessel algorithm and Density based spectral clustering algorithm are used to obtain the true area of the tumor [13]. In this paper, the performance of different algorithms used for brain tumor detections are analyzed.

2. RELATED WORK

Brain tumor segmentation aims to separate the different tumor tissues such as active cells, necrotic core, and edema from normal brain tissues of White Matter (WM), Gray Matter (GM), and Cerebrospinal Fluid (CSF). MRI based brain tumor segmentation studies are attracting more and more attention in recent years due to non-invasive imaging and good soft tissue contrast of Magnetic Resonance Imaging (MRI) images. With the development of almost two decades, the innovative approaches applying computer-aided techniques for segmenting brain tumor are becoming more and more mature and coming closer to routine clinical applications. Firstly, a brief introduction to brain tumors and imaging modalities of brain tumors is given. Then, the preprocessing operations and the state of the art methods of MRI-based brain tumor segmentation are introduced. Moreover, the evaluation and validation of the results of MRI-based brain tumor segmentation are discussed. Finally, an objective assessment is presented and future developments and trends are addressed for MRI-based brain tumor segmentation methods [1].

A tumor is said to be the growth in the abnormal tissue of the brain which causes damage to the functioning cells. Brain tumor detection is very difficult as there are many techniques available for it. Magnetic Resonance Imaging (MRI) is the active resource for detecting brain tumor. It is necessary to use technique which can give the accurate location and size of the tumor. There are various algorithms proposed for brain tumor detection, this paper presents a survey on the various brain tumor detection algorithms. It gives the existing techniques and what are the advantages and disadvantages of these techniques [2].

Detection of brain tumor from MRI images involves various Phases such as Preprocessing, Feature extraction, Segmentation and classification. Figures shows different stages in brain tumor detection. Image Preprocessing techniques are applied to improve the quality of image. MR Image segmentation is based on set of measurable features which are extracted. In this process of brain tumor detection, pixel intensity based features are extracted. Image Segmentation group pixels into regions and hence defines the object regions. Segmentation uses the features extracted from an image. Classification is the last step in the process of brain tumor detection used to classify the image into normal or abnormal and classify the abnormality type whether it is benign or malignant. This study evaluates various techniques which are used in tumor detection from brain MRI [3].

Medical imaging has becoming as a transpire discipline in diversified medical diagnosis. It plays a vital role in automatic detection, which bestows information about abnormalities for further treatment. The traditional approach of detecting MRI is based on manual inspection, which has become inappropriate for vast volume of data. Automated tumor detection has gaining importance that conserves the time of radiologist. In this paper, brain tumor is detected from MRI images by utilizing classification technique based on Gustafson-Kessel (G-K) fuzzy clustering algorithm. Here feature extraction from MRI Images is done by Gray Level Co-occurrence Matrix (GLCM). Finally, results prove that the proposed intelligent system improves accuracy rate and trim down the error rate [4].

The FCM (fuzzy c-mean) algorithm has been extended and modified in many ways in order to solve the image segmentation problem. However, almost all the extensions require the adjustment of at least one parameter that depends on the image itself. To overcome this problem and provide a robust fuzzy clustering algorithm hat is fully free of the empirical parameters and noise type independent, we propose a new factor that includes the local spatial and the gray level information. Actually, this work provides three extensions of the FCM algorithm that proved their efficiency on synthetic and real images [18].

3. PROPOSED SYSTEM

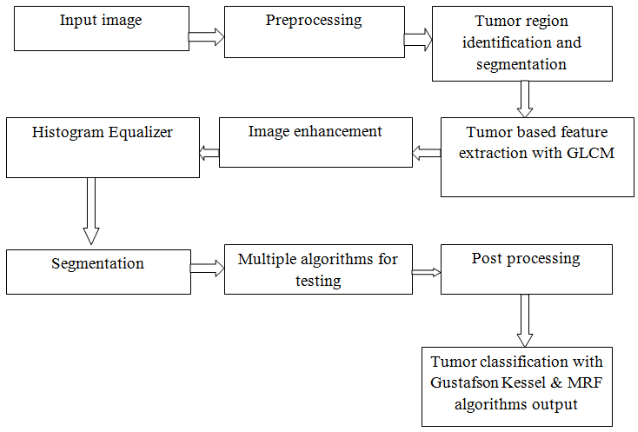

Fig-1: Block Diagram of the Proposed System.

4. METHODOLOGY

4.1 Input Image

The different patients brain tumor images are available in the MICCAI BRATS 2017 data sets. The PET and MRI brain tumor images are taken as the input images for brain tumor classification from this data sets.

4.2 Pre-processing

It is used for color conversion of RGB image to Gray level image and also to remove the noise from the input image

4.3 Morphological operation

Morphology is a process of broad set of the image processing operations that process images based on shapes. The number of pixels added or removed from the objects in an image depends on the size and shape of the structuring element used to process the image.

4.4 Segmentation

The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image. Each of the pixels in a region is similar with respect to some characteristic or computed property, such as color, intensity, or texture. Adjacent regions are significantly different with respect to the same characteristic. When applied to a stack of images, typical in medical imaging, the resulting contours after image segmentation can be used to create 3D reconstructions with the help of interpolation algorithms like marching cubes.

4.5 Image Enhancement

It removes the noise and sharpens or brightens an image, making it easier to identify key features and exactly find the tumor. This help to increase the contrast value of image.

4.6 Multiple Algorithm for Testing

In this system, comparing the performance of different algorithms used to analysis the brain tumor detection and to find the efficient algorithm to provide the information about the brain tumors and the types of brain tumor. The multiple algorithms consider for comparison are K-means algorithm, Fuzzy c- means, Gustafson Kessel algorithm and DBSCAN algorithm.

4.7 Steps for Analysis

1. MRI and PET image are used as input images.

2. Preprocessing of the image processing is applied in the color input images.

3. Segmentation used to segment the images

4. The multiple algorithms used to find the type of brain tumor and the spreading area of brain tumors are calculated using different classification algorithm.

4.8 Region Based Segmentation

Region-based segmentation methods examine pixels in an image and form disjoint regions by merging neighborhood pixels with homogeneity properties based on a predefined similarity criterion [4]. The region growing and the watershed segmentation methods are part of the region-based methods and are generally used in the process of brain tumor segmentation.

The region growing is the simplest and most commonly region-based segmentation method and is used to extract a connected region of similar pixels from an image [5]. Region growing starts with at least one seed that belongs to the structure of interest. Neighbors of the seed are checked and those satisfying the similarity criteria are added to the region. The similarity criteria are determined by a range of pixel intensity values or other features in the image. Seeds can be chosen manually or provided by an automatic seed-finding procedure [2]. The procedure iterates until no more pixels can be added to the region. The advantage of region growing is that it is capable of correctly segmenting regions that have similar properties and generating connected region [2]. Some researchers have proved that the region growing is an effective approach and less computation intensive than other non-region-based methods for segmenting MRI images of brain tumors, especially for the homogeneous tissues and region [3, 4]. The primary disadvantage of region growing method is the partial volume effect [5] which limits the accuracy of MR brain image segmentation.

Partial volume effect blurs the intensity distinction between different tissue classes at the border of the two tissues types, because the voxel may represent more than one kind of tissue types [6]. Some segmentation methods incorporate the region growing process as a refinement step [14]. A fuzzy information fusion framework was proposed for the automatic segmentation of brain tumor using MRI [1]. The registration of multispectral images was the first step for the creation of this framework including a priori knowledge, fuzzy feature fusion, and an adjustment by fuzzy region growing.

4.9 Result of the Proposed Method

From the result table we recognize that the Gustafson Kessel algorithm provides the efficient result of brain tumor. The algorithm gives clear report of the tumor and easy to detect the location and the stages of tumor.

The accurate values are calculated by the different clustering for the input images.

The resolution defines the smallest discriminable color change in the input images.

RESOLUTION	GK	FCM	K-Mean	DBSCAN
480x320	97%	88%	83%	85%
240x320	97%	88%	83%	85%

Table-1: Accuracy of the Different Algorithm.

5. MULTIPLE ALGORITHM

5.1 Fuzzy C-means Clustering

Fuzzy clustering method is basically used for pattern recognition, classification and image segmentation. In the fuzzy algorithm the fuzzy set can be a shared set which means a member from one fuzzy set can belong to another set also. Each pixel of the image is given a partial membership value [17].

Powerful unsupervised method for the analysis of data and construction of models

Not efficient Time consuming

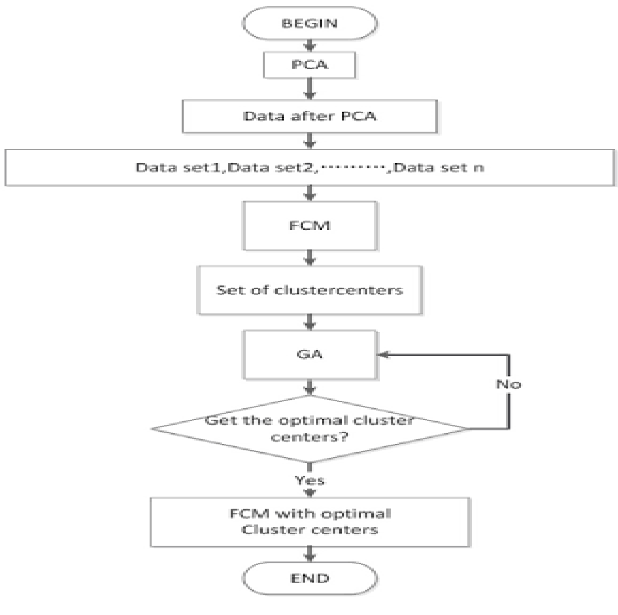

Fig-2: Flow Chart of FUZZY C-Means Algorithm[14].

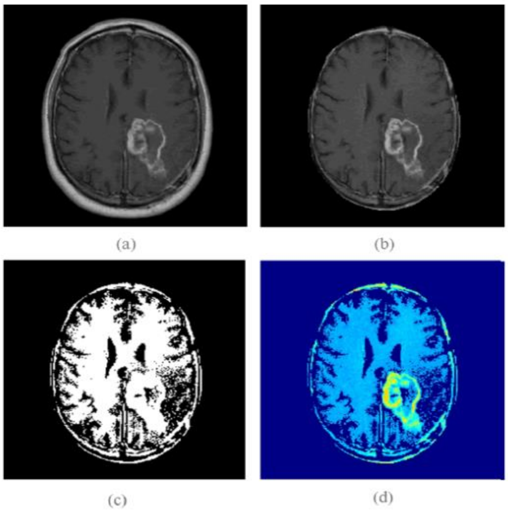

Fig-3: FCM algorithm input and output images after clustering [14].

5.2 K-Means Clustering

K-means clustering is one the partitioning algorithms which is widely used in the data mining. The k-means clustering, partitions n documents in the context of text data into k clusters. Representative around which the clusters are built. The basic form of k-means algorithm is: Finding an optimal solution for k-means clustering is computationally difficult (NP-hard), however, there are efficient heuristics such that are employed in order to converge rapidly to a local optimum. The main disadvantage of k-means clustering is that it is indeed very sensitive to the initial choice of the number of k. Thus, there are some techniques used to determine the initial k, e.g. using another lightweight clustering algorithm such as agglomerative clustering algorithm[14].

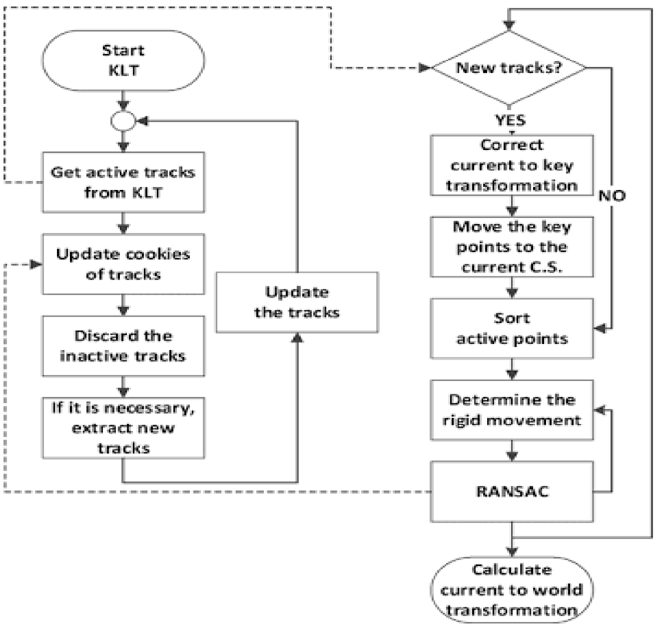

Fig-4: Flow Chart of K-Means Algorithm [14].

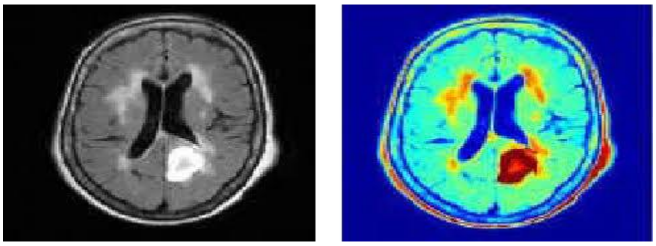

Fig-5: K-Means algorithm input and output images after clustering [15].

5.3 Gustafson Kessel Algorithm

The fuzzy covariance matrix in the Gustafson Kessel (GK) clustering algorithm. The first one overcomes troubles that occur in the standard GK clustering when the number of data samples is small or when the statistics within a cluster are linearly correlated. The improvement is achieved by fixing the share between the maximal and minimal Eigen value of the covariance matrix. The second technique is useful when the GK algorithm is employed in the extraction of Takagi–Sugeno fuzzy model from data. It reduces the risk of over fitting when the numeral of training samples is low in comparison to the number of clusters. This is achieved by adding a scaled unity medium to the calculated covariance matrix[6].

The GK clustering algorithm to construct Tagaki-Sugeno fuzzy models, a certain degree of over right will be knowledgeable for larger numbers of clusters. In such a case, the routine can be improved by further limiting the maximal ratio between the Eigen values of the covariance matrix or by adding a scaled identity matrix to the covariance matrix. While these latter modifications can improve the performance for small data sets, with a sufficient number of guidance samples, this restriction in the freedom of the algorithm may have an adverse effect and on the performance. Some testing with the weighting parameter γ may thus be needed.

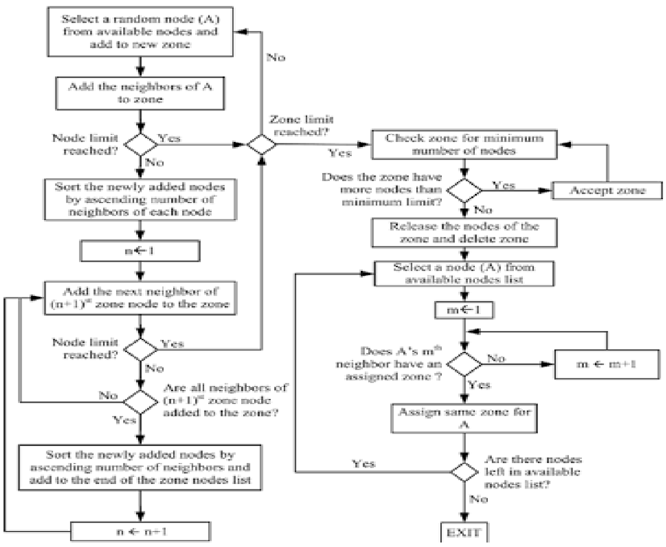

Fig-6: Flow Chart of Gustafson Kessel Algorithm [15].

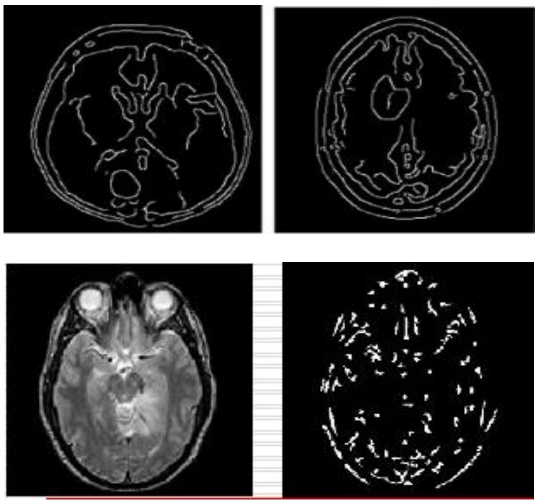

Fig-7: Gustafson Kessel algorithm input and output images after clustering [15].

5.4 DBSCAN Algorithm

Density based clustering algorithm has played a vital role in finding nonlinear shapes structure based on the density. Density-Based Spatial Clustering of Applications with Noise (DBSCAN) is most widely used density based algorithm. It uses the concept of density reach ability and density connectivity [10].

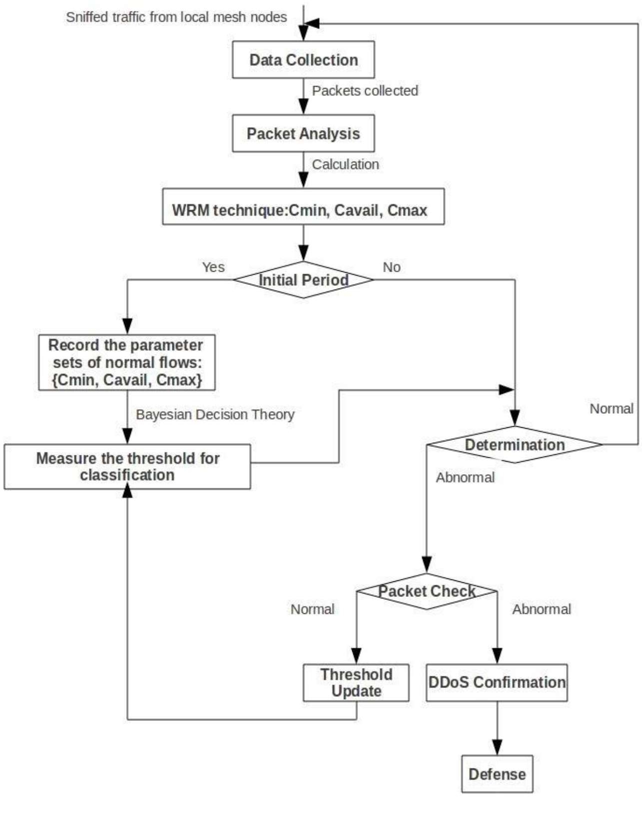

Fig-8: Flow Chart of Density Based Spectral Clustering Algorithm (DBSCAN) [17].

5.4.1 Advantages

1) Does not require a-priori specification of number of clusters.
2) Able to identify noise data while clustering.
3) DBSCAN algorithm is able to find arbitrarily size and arbitrarily shaped clusters [5].

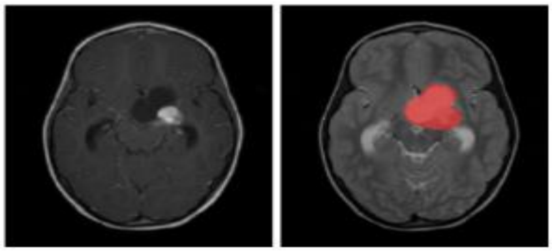

Fig-9: DBSCAN algorithm input output images after clustering.

5.4.2 Disadvantages

1) DBSCAN algorithm fails in case of varying density clusters.

2) Fails in case of neck type of dataset.

3) Does not work well in case of high dimensional data.

6.RESULTS AND DISCUSSION

Fuzzy techniques have been used for handling vague boundaries of arbitrarily oriented clusters. However, traditional clustering algorithms tend to break down in high dimensional spaces due to inherent sparsity of data. We propose a modification in the objective function of Gustafson-Kessel clustering algorithm for projected clustering and prove the convergence of the resulting algorithm. We present the results of applying the proposed projected Gustafson-Kessel clustering algorithm to synthetic and UCI data sets, and also suggest a way of extending it to a rough set based algorithm [6].

ALGORITHM	Accuracy of the locating part of Tumor % Value		Accuracy on the Spreading area of Tumor cell % Value	
INPUT IMAGES	MRI	PET	MRI	PET
Fuzzy C-means	77	79	52	51
K-means	79	81.2	57	55
Gustafson Kessel	87	89.6	81	87
Density Based Spectral Clustering (DBSCAN)	83	85	62	73

Table-2: Comparison of Different Algorithm

7. CONCLUSION

The traditional approach of detecting MRI and PET is based on manual inspection, which has become inappropriate for vast volume of data. Computerized tumor detection has in advance significance that conserves the time of radiologist. In this system, brain tumor is detected from MRI and PET images by utilizing classification techniques based on Gustafson-Kessel (G-K) algorithm, density based spectral clustering algorithm, k-means and fuzzy c means algorithms. Here the feature extraction from MRI and PET Images is done by Gray Level Co-occurrence Matrix (GLCM). Finally, results prove that the proposed intelligent system improves accuracy rate and trim down the error rate. In the proposed method, the texture features are attained from the statistical appropriation of examined blend of intensities at correct positions regarding each other. Based on the intensity pixels in all combinations, these measurements can be differentiated into first, second-and higher-request imminent. The GLCM is a technique for dividing the second order measurable texture features. In this paper, the various algorithm for brain tumor detection are analyzed based on the performances and found that Gustafson kessel algorithm are efficient.

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