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# Detection and Segmentation of Brain Tumor from MRI/PET Brain Images using K Means Clustering Algorithms

**Abhshek M, Amutha S**

Final Year M. Tech Student, Dept. of CSE, DSCE, Bangalore, India

Professor, Dept. of CSE, DSCE, Bangalore, India

**ABSTRACT***:* The Human Brain Detection and Segmentation has Improved a lot using the clustering Algorithms, Brain tumor detection and segmentation has created an interest in several medical research areas. The process of identifying and segmenting brain tumor is a very important and time consuming task, since human physique has anatomical structure naturally. Magnetic Resonance Image (MRI) scan analysis and Positron Emission Tomography (PET) analysis is a powerful tool that makes effective detection of the abnormal tissues from the brain. Among different techniques, Magnetic Resonance Image (MRI) is a liable one which contains several modalities in scanning the images captured from interior structure of human brain. The novel hybrid energy-efficient method is efficiently proposed for automatic Brain tumor detection and segmentation. The proposed system follows K-means clustering, integrated with Fuzzy C-Means (KMFCM) and active contour by level set for tumor segmentation. An effective segmentation, edge detection and intensity enhancement can detect brain tumor easily. For that, active contour with level set method has been utilized

Image segmentation is one of the most important tasks in medical image analysis and is often the first and the most critical step in many clinical applications. In brain MRI analysis, image segmentation is commonly used for measuring and visualizing the brain's anatomical structures, for analyzing brain changes, for delineating pathological regions, and for surgical planning and image-guided interventions. In the last few decades, various segmentation techniques of different accuracy and degree of complexity have been developed and reported in the literature. In this paper we review the most popular methods commonly used for brain MRI segmentation. We highlight differences between them and discuss their capabilities, advantages, and limitations. To address the complexity and challenges of the brain MRI segmentation problem, we first introduce the basic concepts of image segmentation

**KEYWORDS:** MRI, KMFCM, Pathological regions, MRI Segmentation.

## I. INTRODUCTION

Brain tissue classification is used for detection, segmentation and diagnosis of normal and pathological tissues in brain tumor such as MS tissue abnormalities and tumors. These abnormalities could be identified by tracking of changes in volume, shape and regional distribution of brain tissue during follow-up of patients. Also, some of the neurological and psychiatric disorders such as Alzheimer's, Parkinson's and Huntington's disease, depression, autism, can be diagnosed with detection of changes in the morphology of sub cortical nuclei and the cerebellum

Furthermore, brain image segmentation plays an important role in clinical diagnostic tools and treatment procedures such as diagnosis and follow-up and also 3D brain visualization for measuring the volume of different tissues in brain such as Gray and White Matter, Thalamus, Amygdale, Hippocampus etc

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There are various image segmentation techniques based on clustering. Examples of the clustering algorithm are K-means (KM) clustering, Moving K-means (MKM) clustering and Fuzzy C-means (FCM) clustering. Clustering is the process of separating data into a group of similarity . It is also known as a procedure of organizing objects into groups whose members are similar in a certain way, where the goal is to identify structures or clusters existing in a group of unlabelled data. Clustering algorithms are normally used in computer, engineering and mathematics field . In the past few decades, the uses of clustering algorithm have been broadening to medical fields, due to the development and advancement of medical imaging fields. Examples of medical images are the image of the brain, bone, and also chest. The clustering algorithm is suitable in the biomedical field because it will make the analysis easier. Segmentation via clustering can also be used to detect the three regions on the brain image. The Magnetic Resonance Image (MRI) of brain is one of the medical imaging tools used to detect abnormality in the brain. From the MRI brain images, the radiologist is normally interested to look for three significant regions.

## II. METHODOLOGY

In the medical field, the Medical Resonance Image (MRI) is one of the methods used to detect abnormalities in the human body. The clustering algorithm for the image segmentation was introduced to the MRI images in order to segment the image. In this paper, a new method of the clustering algorithm based on known segmentation technique is recommended to be used on MRI images. It is employed to analyze exquisite soft tissue contrast between the normal tissue and pathologic tissue. The proposed method for this paper is then compared with the conventional method known as Fuzzy C-means (FCM). In this section algorithms FCM and AFKM are briefly discussed in II(A) and II(B).

### *A. Fuzzy C-means (FCM) clustering Algorithm*

Bedeck is the person who introduced the Fuzzy C-means (FCM) algorithm. The FCM is one of the most commonly used clustering algorithms. The FCM clustering is constructed based on the same idea of the definition cluster centers by iteratively regulating their locations and minimizing an objective function as the K-Means (KM) algorithm . The advantage of FCM is that it allows more flexibility when dealing with multiple clusters by introducing multiple fuzzy membership grades.

### *B. Adaptive Fuzzy K-Means (AFKM) clustering Algorithm*

In this paper, the AFKM method is recommended to be used to process MRI images. It is the latest type of clustering algorithm proposed by. The AFKM is a combination of fundamental theories of the conventional K-means and MKM clustering algorithm (i.e., assigning each data to its closest centre or cluster) and the conventional Fuzzy C-means (FCM) clustering algorithm (i.e., allows the data to belong to two or more clusters or centres). The objective function of the AFKM is calculated using the equation:
where m M kt is the fuzzy membership function and m is the fuzziness exponent. The degree of being in a certain cluster is related to the inverse of the distance to the cluster. The new position for each centroid is calculated using the equation: M kt is the new membership and is defined and k e is error of belongingness. Then, the value of k e is calculated by The AFKM algorithm improved the clustering with the introduction of the belongingness concept where it measures the degree of the relationship between the centre and its members. The degree of belongingness, Bk is calculated using; The objective is to minimize the objective function from equation. The process is repeated iteratively until the center is no longer moved and all data have been considered. Images of the brain MRI are obtained from the Internet database. The images are processed with the AFKM and FCM clustering algorithm and a comparison is made between the two clustering algorithms. The flow chart for the whole process is depicted in
The flow chart describes the complete process of the

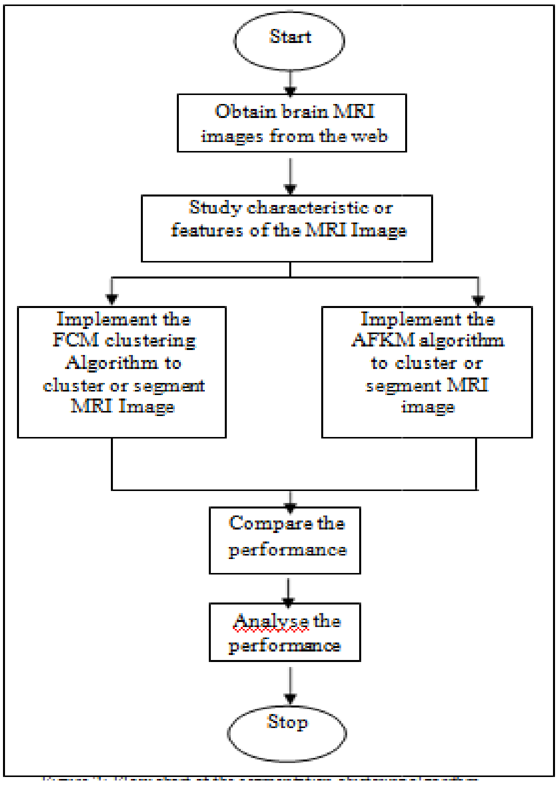


**Figure 1: Flow chart of the segmentation clustering**

### III. DATA ACQUISITION AND ANALYS

The method, the Adaptive Fuzzy K-me clustering algorithm is introduced to segment image but usually the MRI brain image is com detect any irregularities that have taken place. In of the MRI brain images obtained from Interne chosen to be tested with the AFKM algorithm. To implement the performance analysis, q quantitative measures are considered. The evaluation functions used in the quantitative an from Liu and Yang: Equations F'(I) and Q(I) are proposed by Bors the Q(I) is the improved version of F(I). The given as follows; ( )
Start Obtain brain MRI images from the web Study characteristic or features of the MRI Image Implement the FCM clustering Algorithm to cluster or segment MRI Image Implementation AFKM to segmentation i Compare the performance Analyze the performance Stop algorithm SIS earns (AFKM) a MRI brain computer-aided to n this paper, six et databases are m, as shown in qualitative and three analysis sotti where e equations are For the evaluation of the fundamental benchmark is the mean could be described

### IV. RESULT AND DISCUSSION

From these images, the qualifying performance analyses are implement analysis depends on the human via interpret the images based on the cap algorithm of the conventional e implement the M algorithm cluster MRI image (2) (3) cluster quality, the most squared error (MSE quantitative entered. The qualitative . Human visual capability and segmentation like the FCM and the

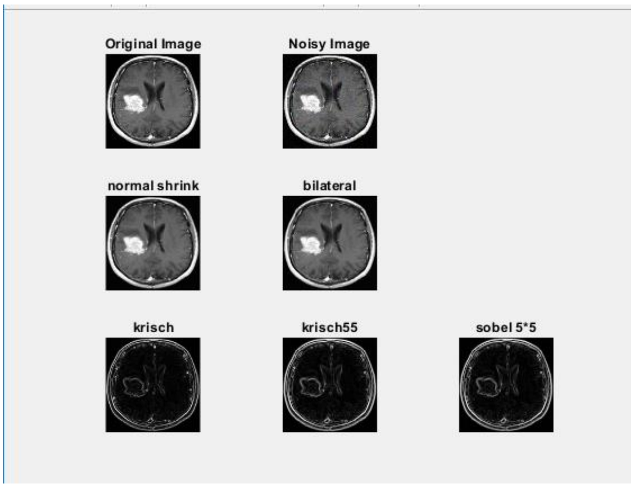


**Figure2: edge preservation of brain tumor**

on Industrial Electronics and Applications (ISIEA), ] Kota Kinabalu new method proposed which is the AFKM. It can detect the region of interests like GM, WM and CSF. For the quantitative analysis, it refers to the performance of the segmentation of the image. It is produced by the proposed algorithm. The conventional algorithm will be compared with the new proposed algorithm. The result of the quantitative analysis is taken based on three evaluation functions.

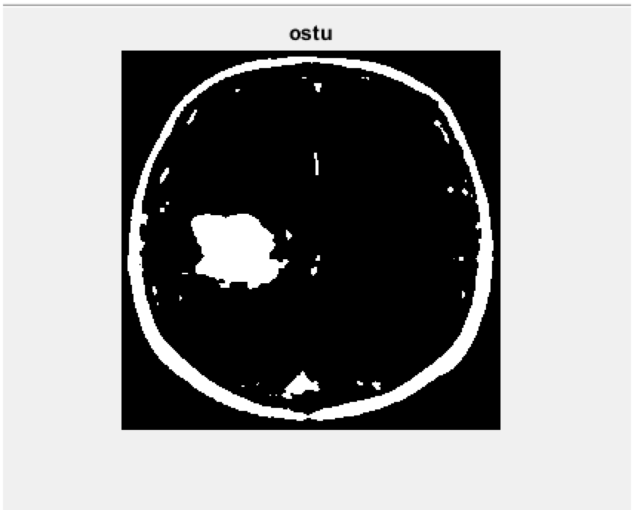


**Figure3: Threshold based Segmentation**

The three functions of the quantitative analysis are F(I), F'(I) and Q(I). The image size can be calculated from N x M. For the evaluation of the cluster, the mean squared error (MSE) is the most fundamental benchmark. Also, these functions are related more to the visual judgment. For the better result of segmentation, the AFKM values of F(I), F'(I) and Q(I) are smaller than the FCM values. Both qualitative and quantitative results will be presented in sections (A) and (B).

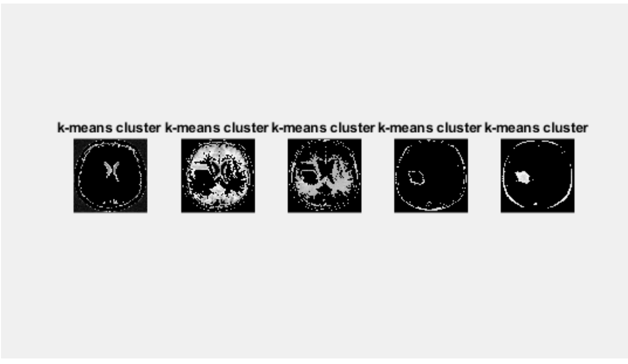


**Figure 4 : Iteration process of brain Tumor**

### *A. Qualitative Analysis*

For the result in the qualitative analysis, six images are used. Qualitative analysis usually seeks to examine whether or not the resultant image is good. The performance is examined visually in the qualitative analysis. The segmentation performances are compared with the conventional methods of the FCM and the new method proposed. The clustering algorithm used in this paper is to segment the MRI brain image into three regions i.e. the GM, WM and CSF, therefore the clustering algorithm is chosen to have three clusters. The result is then compared with the FCM algorithm. From the result shown in Figures 4 to 5, it can be observed that the


**Figure5: Iteration process of brain Tumor**

quality of the image is not perfect compared to the AFKM method. The weakness of the FCM method is that it over segments the image which leads to the image becoming too bright. Nonetheless using the AFKM, it can segment the image clearly and the region of interest can become sharper. (a) (b) (c) Figure 4: Image 1 of the segmentation image with three clusters: (a) Original image. (b) FCM. (c) AFKM (a) (b) (c) Figure 5: Image 2

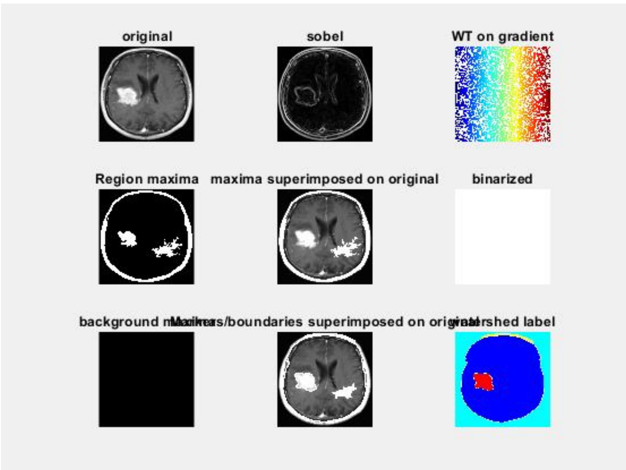


**Figure6 : Finding the gradient Magnitude**

of the segmentation image with three clusters: (a)Original image. (b) FCM. (c) AFKM (a) (b) (c) Figure 3: Image 3 of the segmentation image with three clusters: (a) Original image. (b) FCM. (c) AFKM (a) (b) (c) Figure 4: Image 4 of the segmentation image with three clusters: (a) Original image. (b) FCM. (c) AFKM (a) (b) (c) Figure 5: Image 5 of the segmentation image with three clusters

and the Figures shows the clear segmentation of brain tumor from the MRI images and the threshold that is depicted from the brain tumor used for the clinical purpose when the patient is kept in MRI scanning machine The acquisition will be reduced due to fallowing the k- means clustering algorithms and doing iterations on brain tumor Original image. (b) FCM. (c) AFKM After implementing the AFKM algorithm, the image looks clear in the visual compared to the conventional method of the FCM. The resultant images are shown in Figures 6 and 7. By the FCM, the MRI brain image is brighter compared to the AFKM. It happens because the FCM has over-segmented the image. It can give effect on the segmentation and three regions cannot be detected clearly. The images of the AFKM become sharper and clearer. (a) (b) (c) Figure 9: Image 6 of the segmentation image with three clusters: (a) Original image. (b) FCM. (c) AFKM 2014 IEEE Symposium on Industrial Electronics and Applications (ISIEA). It is because the image becomes bright and it does not meet the criteria of segmentation. However, when the AFKM method is applied, the images become sharp and the segments of WM, GM and CSF are corrected. The resultant images are shown in Figures 2 and 3, respectively. From the resultant images shown in Figures 3 to 6, the proposed method of the AFKM can give better performance of the segmentation technique

### *B. Quantitative Analysis*

The quantitative analysis is evaluated based on the three benchmark functions. It is also mentioned in section III. The analysis is also evaluated by a fundamental benchmark which is the mean squared error (MSE).The quantitative analysis is to support the qualitative finding in section III(A). The result of the quantitative analysis is shown in Tables 1 to 4. These tables summarize the segmentation of the quantitative estimation. All the results were obtained from a comparison between the FCM and AFKM clustering methods. From the comparison, a new method of the AFKM produces a better result compared to the conventional method of the FCM. The new method proposed which is the AFKM produces smaller values of all MSEs, F(I), F'(I) and Q(I) analyses. It can be concluded that the AFKM method has proven to be a successful segmentation. It is because the AFKM can detect the three regions in the MRI brain. In addition, the proposed AFKM manages to segment the image successfully with less noisy pixels. Generally, these interpretations specify that the AFKM might be a better methodology in terms of the image segmentation application and the images from the image segmentation are used by k-means and cluster means

## V. PERFORMANCE ANALYSIS

The trained dataset images for which the features extracted were trained using Convolution neural network (CNN) classifier for the classification purpose, whereas the test dataset was not trained using CNN classifier, only the statistical and textural features were extracted. The accuracy of trained and tested image was compared based on the Classification of normal and abnormal lesions tissues. Figure 4 shows the accuracy results in classification of normal and abnormal lesions tissues. Accuracy or correct rate of classification is the efficiency of appropriate classification to the total number of classification tests.

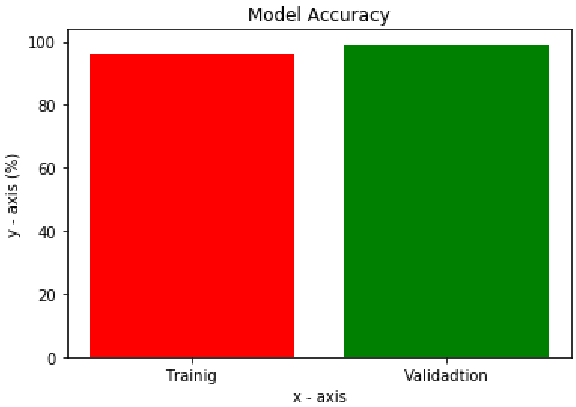


**Figure 8 : Model Accuracy**

## VI. CONCLUSION

This In this paper, the k means Clustering method of the AFKM clustering algorithm is present. The AFKM clustering is a combination between the MKM, KM and FCM. The result can prove that using the AFKM can get sharper and clearer segmentation in the MRI brain image. This process is a good method for segmentation. The technique is used to segment the three regions in the MRI brain image using the clustering algorithm. The results were obtained from the qualitative and quantitative analyses of the MRI brain image. In the future, the AFKM method can be applied in the engineering, agriculture and also nutrition fields.

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