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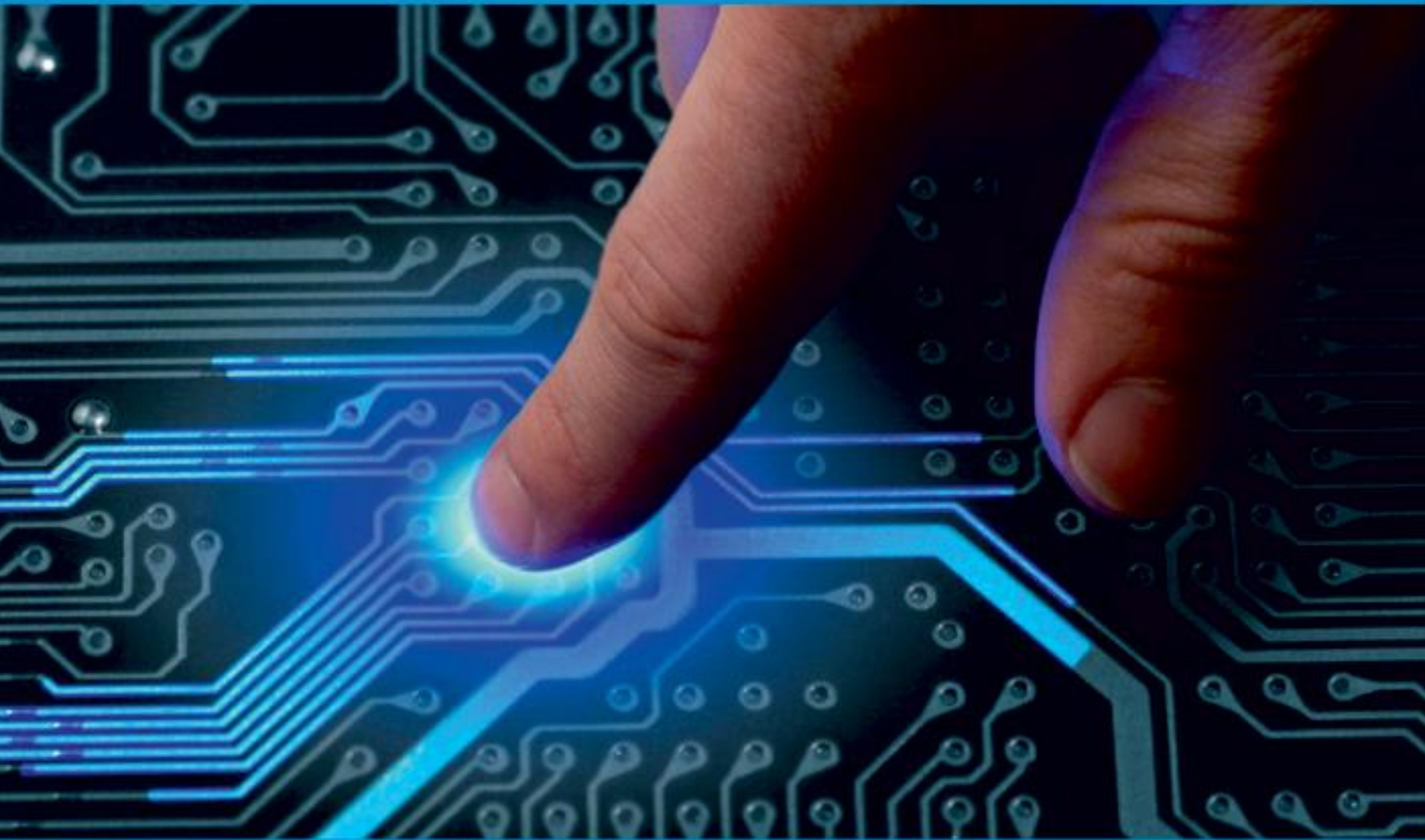

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Adaptive K-Means Segmentation Technique to Extract Tumor from MRI Images

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ABSTRACT: Segmentation plays an important role in biomedical image processing. It is often the starting point for other processes like analysis, visualization and quantization. Several popular techniques are available for segmentation. Among them K-Means is one of the hard segmentation techniques applicable for quicker diagnosis of Magnetic resonance imaging (MRI) scans.

MRI machine produces more modality of images that are varied by tissue characteristics. Hence, several works focused all types of modality images, but they are more expensive. This paper propose a simple method with minimize the expense and computational time called Adaptive K-Means (AKM). Regarding that, this work employs morphological operators to improve the performance of K-Means segmentation.

This proposed (AKM) consists of three stages, morphological transformation is employed to improve the image quality, K-Means method is used to cluster the image pixels and the tumor region is identified by its mean value and the characteristics of largest connected component. The extracted tumor is also compared with the K-Means clustered image which ensures that the proposed work outperform the K-Means.

I. INTRODUCTION

Medical images are normally used by the physicians to detect abnormalities in human body. It is also used for the treatment planning and diagnosis. Various medical imaging techniques are used to sense the irregularities in human bodies such as Magnetic resonance imaging (MRI), Computerized tomography (CT), and Ultrasound (US) imaging. In such a case, the radiographer used a tool to make the decision of medical image analysis easier. It also helps to the radiographer to make accurate decision about the corresponding image. The radiologist use medical images to identify the abnormality tissues and its pathology to summarize the patient report. After that, doctors make use of it to make decision about the treatment. But medical images are having much more difficulties in capturing procedure. The images are also frequently affected by non-linear characteristics and sometimes corrupted with noise. These problems make difficulties in pathology detection as well as difficulties to study the anatomical abnormal growth of glands. It may lead inconveniences in making decision [1].

Medical images made the doctors to see the interior portions of the body for easy diagnosis. It also helped doctors to make keyhole surgeries for reaching the interior parts without really opening too much of the body. CT scanner, Ultrasound and Magnetic resonance imaging took over x-ray imaging by making the doctors to look at the body's elusive third dimension. With the CT scanner, body's interior can be bared with ease and the diseased areas can be identified without causing either discomfort or pain to the patient. Even though MRI images take place in brain tumor diagnosis process. It picks up signals from the body's Hydrogen particles. It is spinning the machine's magnetic tune. The signals are captured by the powerful computer. It converts scanner data into pictures of internal organs.

Uncontrolled growth of cells is called tumors where, the real Magnetic Resonance (MR) images are classified into normal, non cancerous (benign) brain tumor and cancerous (malignant) brain tumor. 70% tumors are growing from glial cells in brain and called Glioma [2]. The tumor's size takes part in surgical planning and diagnosis. Hence, the tumor segmentation and tissue classification is emerging in the medical image processing.

Image segmentation refers to the process of partitioning a digital image into N number of parts. The images are segmented on the basis of set of pixels or pixels in a region that are similar on the basis of some homogeneity criteria such as color, intensity or texture, which helps to locate and identify objects or boundaries in an image.

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Some segmentation techniques such as region based, edge based, thresholding and clustering techniques have been developed for tumor segmentation. Among them, unsupervised clustering techniques such as K-means and Fuzzy C-means have been widely used for tissue clustering.

1.1. Brain Analysis Methods

A comprehensive review of several existing methods related to the research work is presented here, Antonios et al. investigated the two most important and commonly used imaging modalities such as MRI and CT scans. They enlisted the role of CT and MRI in the diagnosis of brain tumors[3].Nameirakpam et al. proposed a subtractive clustering method which is used for data clustering. It generates the centroid based on the potential value of the data points. So subtractive cluster was used to generate the initial centers and these centers were used in k-means algorithm for the segmentation of image. Then finally median filter was employed on the segmented image to remove any unwanted region from the image. The final segmented result was compared with k-means clustering algorithm and they have concluded that their proposed clustering algorithm yields a better segmentation[4]. Suman et al. analyzed two unsupervised learning algorithms namely K-means and Expected maximization(EM) and compare it with a graph based algorithm and Normalized Cut algorithm. Finally they have implemented the EM and K-means clustering algorithm for intensity based segmentation. For smaller values of K, the algorithms give good results[5]. Alan et al.compared k-means clustering and the fuzzy c-means algorithms in which the brain tumor is detected and its exact location is identified. They concluded that the performance of fuzzy c-means plays a major role in exact tumor location detection and K- means algorithm is enough to extract tumor from the other brain cells[6]. Vijayalakshmi et al. proposed an adaptiveK-means clustering algorithm for tissue segmentation from three dimensional and multi valued images [7].Kiri et al. proposed a profitably modified K-means clustering algorithm. The experiments with artificial constraints on six data sets. They observed the improvements in clustering accuracy[8].Andrew et al.proposed a new technique for clustering large, high dimensional datasets. They introduced Canopies which can be applied to many domains used with a variety of clustering approaches, including Greedy agglomerative clustering, K-means and expectation maximization[9].Sudipta et al. proposed a fully automatic algorithm to detect brain tumors by using symmetry analysis and compared against interactive method. The interactive segmentation method segments the tumors quickly and efficiently from MRI images.Soumi et al. proposed two important clustering algorithms namely centroid based k-means and representative object based Fuzzy c means clustering algorithms. FCM produces close results to K-means clustering but it still requires more computation time than K-means clustering. Finally, they concluded that K-Means algorithm seems to be superior to Fuzzy C-Means algorithm[10].Recently, intelligent or model-based quantitative image analysis approaches have been explored for computer-aided diagnosis to improve the sensitivity of radiological tests involving medical images.

1.2. Image Clustering

The image is segmented based on the intensity of the images. Clustering is the process of grouping feature vectors into classes in the self organizing mode. Let {**x**(q): q = 1,…,Q} be a set of Q feature vectors. Each feature vector **x** (q)= (x1(q), …, x N (q)) has N components. The process of clustering is to assign the Q feature vectors into K clusters {**c** (k): k = 1, …, K},usually by the minimum distance assignment principle. Choosing the representation of cluster centers (or prototypes) is crucial to the clustering. Feature vectors that are farther away from the cluster center should not have as much weight to those are close. These more distant feature vectors are outliers usually caused by errors in one or more measurements or a deviation in the processes that formed the object. The simplest weighting method is arithmetic averaging; it adds all feature vectors in a cluster and takes the average as prototype. Because of its simplicity, it is still widely used in the clustering initialization.

Clustering is one of the widely used segmentation techniques which classify patterns in such a way that samples of the same group are more similar to one another than samples belonging to different groups. Clustering is a process of partitioning or grouping a given sector unlabeled pattern into number of clusters such that similar patterns are assigned to a group, which is considered as a cluster.

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II. PROPOSED METHOD

The proposed method AKM is comprised into 3 stages as given in the flow chart Fig.1. Stage 1 is pixel normalization which uses morphological operators such as erosion and dilation. Stage 2 is using K-means to segment the image into fourregions. Stage 3 is tumor extraction in which it extracts the tumor region based on statistical and structural quantities.

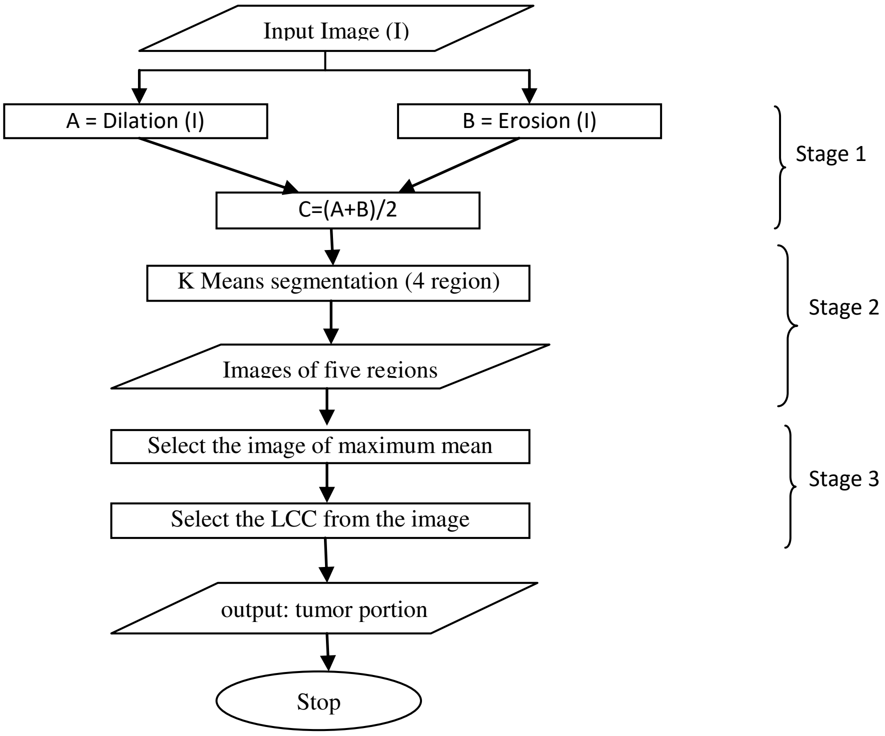

Figure 1: Flow Chart of proposed work AKM

2.1. Pixel Normalization

According to the visual inspection, the Flair image shows the tumor in hyper intense but some normal pixels also like abnormal as tumor pixels.Hence, pixel normalization is done on images by employing morphological operators. The language of mathematical morphology is set theory. As such, morphology offers a unified and powerful approach to numerous image processing problems.

Morphological techniques probe with **structuring element**(S).The structuring element is positioned at all possible locations in the image and it is compared with the corresponding neighborhood of pixels. Some operations test whether the element "fits" within the neighborhood, while others test whether it "hits" or intersects the neighborhood.

a. Dilation

Dilation is a transformation that produces an image that is the same shape as the original, but is a different size. It increases the valleys and enlarges the width of maximum regions, so it can remove negative impulsive noises. Dilation of image *f by* structuring element *S* is given by $f \oplus S$. The structuring element S is positioned with its origin at *(x, y)* and the new pixel value is determined using the rule

$$A = \begin{cases} 1 & if Shits f \\ 0 & otherwise \end{cases} \quad (1)$$

where fit means all on pixelin the structuring element covers atlease one pixelin the image.
The set of all points z^2 such that f translated by z^2 is contained in A.

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b. Erosion

It is used to reduce objects in the image (f) and known that erosion reduces the peaks and enlarges the widths of minimum regions, so it can remove positive noises but affect negative impulsive noise title.Erosion of image f by structuring element S is given by f $\ominus$S. The structuring element S is positioned with its origin at (x, y) and the new pixel value is determined using the rule

$$B = \begin{cases} 0 & if S hits f \\ 1 & otherwise \end{cases} \quad (2)$$

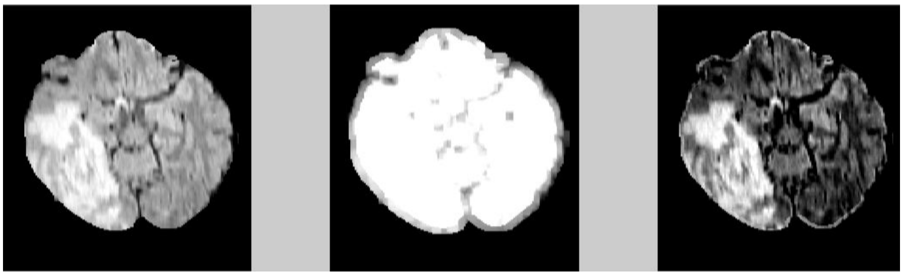
the set of all points z^2 such that f translated by z^2 is contained in A.

The proposed method implies a strategic method to normalize the pixels by taking average of the both result further reduces its intensity by log(256). The formula is defined as follows,

$$I = \frac{A+B}{2} \quad (3)$$

$$I = \frac{I}{\log(255)} \quad (4)$$

In the eqn.(4) 255 is fixed based on the maximum intensity of 8 bit gray scale image. The proposed strategic process improves the brightness of the tumor pixels as well as decreases the intensity of other normal pixels as given in Fig. 2.



(a) (b) (c)

Figure 2. Intermediate results. (a) shows the original image, (b) shows the average of A and B and (c) shows the normalized image3.1.2 K-Means clustering

2.2. K-Means Clustering

K-Means Clustering

K-means is an extensively used clustering algorithm to partition data into certain number of clusters. It is one of the simplest unsupervised segmentation algorithms developed to solve the clustering problems. The procedure follows a simple and easy way to classify a given data set through a certain number of clusters, fixed a priori. The process involves of grouping data points which closest to centroids and far from the centroids are grouped.

The algorithm consists of the following steps with a data set x_i , i=1,2, .. n

This algorithm aims at minimizing an objective function, in this case a squared c_j error function. The objective function is given by

$$J = \sum_{j=1}^{k} \sum_{i=1}^{n} \| x_i(j) - Cj \| 2 \quad (5)$$

where $\|x_i^{(j)} - c_j\|^2$ is a measure of intensity distance between a data point x_i and the cluster center. For simplicity the Euclidean distance is used as the dissimilarity measure.

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Algorithm K-means

1. Initialize the Centroids C_j , j=1,2, .. k

2. Assign each data point to the group that has the closest centroid.

3. When all points have been assigned, calculate the positions of the centroids.

4. Repeat steps 2 and 3 until the centroids no longer move. This produces a separation of the data points into groups from which the metric to be minimized can be calculated.

This method applies K-Means algorithm in the normalized image. Then the image is clustered into four regions. In this figure, region1 displays the background of the brain image, region 2 shows the outer side boundary of the image, region 3 shows the white matter, region 4 shows the gray matter and region 5 shows the tumor. Many non tumor pixels are also clustered along with the tumor. Hence, post processing step also require to segment tumor.

2.3. Tumor Extraction

Tumor is clustered along with some brain tissues. According to the tumor appearance in Flair image, the tumor cluster vote for hyper intense pixels. Hence, mean value for each cluster is taken for the analysis. If a cluster contains maximum mean value then it will consider as tumor cluster. Then the exact tumor extraction is also essential at this stage. Hence, labelling process has carried on finding the largest connected component (LCC). According to LCC, exact tumor region is extracted from it.

III. RESULTS AND DISCUSSION

The above stated method is coded using Malab13 and the experiments carried over some clinical images. The results were analyzed by using quantitative and qualitative parameters. Dice coefficient is very popular method for quantitative evaluation.

3.1. Dice coefficient

Both qualitative and quantitative validations were used for the performance evaluation. The qualitative evaluation is simply done by the visual inspection of the results. The quantitative evaluation is done by some similarity measures between the segmented result and human expert's annotated result.
Dice is a best similarity measure to indicate the performance of the proposed work. The Dice coefficient is a measure of the similarity ranging between 0 and 1, where "0" indicates the sets are disjoint and "1" indicates the sets are identical. The equations is defined as follows,

$$\text{Dice} = 2 * \frac{|A \cap B|}{|A|+|B|} \qquad (6)$$

where A and B are the ground truth and the segmented image respectively. In these images, $|A \cap B|$ represents the number of required pixels, $|A|$ is the number of expected pixels in the ground truth image and $|B|$ is the number of segmented pixels in the output of segmented image.

3.2. Result Analysis

The proposed work AKM attempts to improve the quality of the image. Mostly, Flair images are used for complete tumor segmentation, but some of the regions are same as tumor tissues. The regions are also lack in brain anatomy description. That is no better delineation between the white matter, gray matter and border of all the regions. Hence, the proposed work applies normalization technique to enhance the images initially. It also improves the appearance of all regions.

Some complex images are taken to segment the tumor by using K-Means algorithm. The ground truth and segmented by AKM and K-Means images are projectedfrom column 2 to column 4 respectively. In Fig.3, three complex images are given to analyze the visual perfection. In all images, the complete tumor pixels have some inhomegeity, where as the K-Means method missed some pixels and leads under segmentation. In row 2 and 3 images, K-Means method extracts extra pixels surrounded by the tumor and direct over segmentation. Hence, the AKM method strategically implements the normalization and gives better result than the K-Means method.

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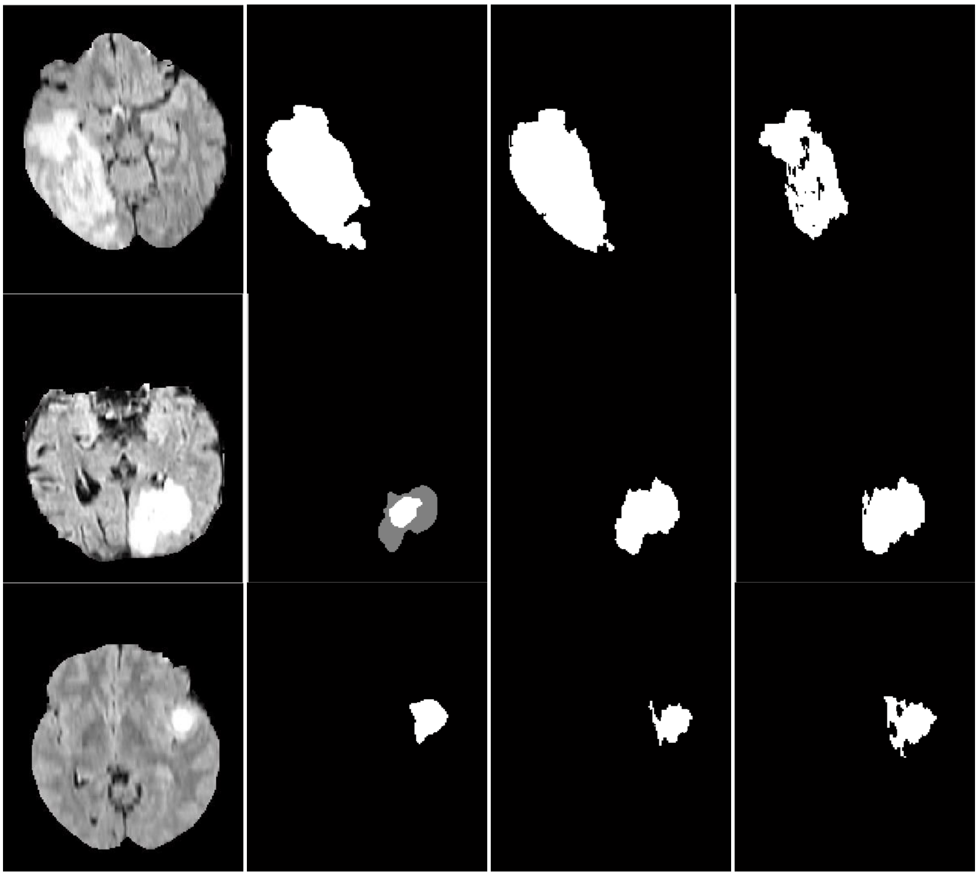

Figure 3. Output of the AKM and K-Means methods. Column1 shows the original image, column 2 shows the ground truth image and column 3 and 4 show the output of the AKM and K-Means segmentation methods.

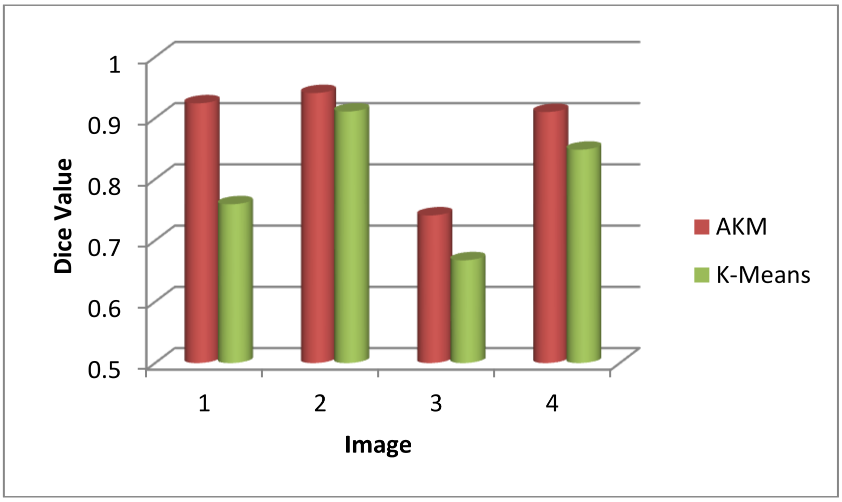

Figure 4. Dice Measures of AKM and K-Means methods.

The quantitative results such as Dice value for the AKM and the K-Means methods are given in bar chart in Fig. 4.It shows the images 1 and 2 are example for best cases whereasthe AKM method gives above 0.9 Dice value and produces higher differences between both methods.The worst case image (image 3) is also taken for the experiment, whereas the AKM method produces good Dice value than the K-Means and yielded high difference. The both results ensured that the adoption of normalization in AKM is very essential before applying K-Means in intensity inhomogeneous images.

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IV. CONCLUSION

The work proposes a method to extract brain tumor by employingstrategic method for normalization and K-Means clustering technique. Initially, MRI brain images are normalized using morphological operators. The strategic technique increases the performance of K-Means clustering algorithm. This work AKM provides an effective result that helps to extract tumor in inhomogeneous brain MR images. The principal advantage of this proposed method is that, it is very easy and less cost. This method is purely based on intensity features and is applicable to Flair images only.

REFERENCES

[1] Cha.s "Update on Brain Tumor Imaging:From Anatomy to physiology", AJNR AM J Neuroradiol , pp.475-487, 27,March 2006

[2] S.Karthigai Selvi, Computer Aided Wavelet Based Methods For Brain Tumor Segmentation From Magnetic Resonance Images, Ph.D. Thesis, The Gandhigram Rural Institute – Deemed to be University, India.

[3] Antonios Drevelegas and Nickolas papanikolaou "Imaging Modalities in brain tumors" A.Drevelegas(ed) imaging of brain tumors with Histological correlations,pp.13-33,2011

[4] Nameirakpam Dhanachandra, Khumanthem Manglem and Yambem Jina Chanu "Image segmentation using k-means clustering Algorithm and subtractive clustering algorithm", Eleventh International Multi conference on information processing (IMCIP-2015) volume 54, pp.764-771,2015

[5] Suman Tatiraju and AVI mehta "Image segmentation using k-means clustering, EM and Normalized cuts" EECs university of california - Irvinc, CA 92612, pp.1-7

[6] Alan Jose, S.Ravi, M.Sambath "Brain tumor segmentation using k-means clustering and Fuzzy c-means algorithm and Its area calculation" International Journal of Innovative Research in computer and communication Engineering, vol.2,pp.3496-3501, March 2014

[7] P.Vijaylakshmi, K.Selvamani, M.Geetha, "Segmentation of brain MRI using k-means clustering algorithm" International Journal of Engineering Trends and Technology, pp.113-115, May to June 2011

[8] Kiri Wagstaff Claire Cardie and Seth Rogers Stefan Schroedl "Constrained k-means clustering with Background Knowledge" Proceedings of the Eighteenth International conference on machine Learning,PP.577-584,2001

[9] Andrew Mccallum, Kamal Nigam, Lyle H. Unger "Efficient clustering of high Dimensional data sets with application to Reference Matching" KDD, PP.169-178, 2000

[10] Soumi Ghosh and Sanjay Kumar Dubey "Comparative Analysis of k-means and Fuzzy C Means Algorithms " International Journal of Advanced computer science and applications,vol.4,N0.4, PP.35-39, 2013

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