Critical Survey of Different Clustering Algorithm for Effective Tumor Detection

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***Abstract*—** this paper provides a critical survey of different clustering algorithm for effective tumor detection. There are many tumor detection techniques. Today the brain tumor segmentation is one of the challenging tasks. This paper compare the technique on the basis of accuracy, precision, recall, algorithm complexity and time. The main focus is on techniques- K-Mean, Fuzzy C-Mean, KIFCM, and EM methods.

Keywords-*Brain Tumor; MRI; CT scan; Segmentation; Tumor Detection; K-mean; Fuzzy C-Mean;*

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I. INTRODUCTION

The tumor in the Brain is one of the common diseases found in human being; which is devastating many lives. According to study of International Agency for Research on Cancer (IARC), it is estimated that more than 126,000 people are diagnosed for brain tumor per year around the world. The mortality rate is around 97,000 per year [1]. Normally the anatomy of the Brain can be viewed by the MRI scan or CT scan. The brain tumor detection is a very important vision application in the medical field. "A brain tumor is an abnormal growth of cells within the brain, which can be cancerous or non-cancerous (benign)". Brain tumor has become one of the leading causes of death from cancer. There are two main types of brain cancer. They include primary brain cancer, in which the brain cancer originates in the brain itself. Primary brain cancer is the rare type of brain cancer. Brain tumors can develop at any age, but are most common in children between the ages of 3-12, and in adults aged 55- 65.

A. Brain Tumor Imaging Technique:

The anatomy of the brain can be scanned by Magnetic Resonance Imaging (MRI) scan or computed tomography (CT) scan. The MRI scan is more comfortable than CT scan for diagnosis. It does not affect the human body because it does not use any radiation. It is based on the magnetic field and radio waves.

i) MRI (Magnetic Resonance Imaging): Magnetic resonance imaging (MRI) is a medical imaging technique/a noninvasive medical test used in radiology to image the anatomy and the physiological processes of the body in both health and disease. MRI scanners use strong magnetic fields, radio waves, and field gradients to form images of the body [2].

ii) CT Scan (Computed Tomography): A CT Scan, also called X-ray computed tomography (X-ray CT) or computerized axial tomography scan (CAT scan) makes use of computer-processed combinations of many X-ray images taken from different angles to produce cross-sectional (tomographic) images of specific areas of a scanned object, allowing the user to see inside the object without cutting.

B. Brian Tumar Detection Techniques:

There are four main brain tumour detection techniques as given follows:

i) Thresholding: Thresholding is one of simple image segmentation technique. It is process of separating pixels in different classes depending on their pixels gray levels. A thresholding method determines an intensity value, called the threshold, which separate the desired classes. The segmentation is achieved by taking threshold value. Based on threshold value, pixels are grouped with intensity greater than the threshold into one class and remain pixels grouped into another class. The mains disadvantage are that, in the simplest form only two classes are generated and it cannot be applied to multichannel images. In thresholding technique, image having only two values either black or white. MR image contains '0' to '255' grey values. So, thresholding of MRI images ignores the tumour cells. This is a serious limitation in the technique [3].

ii) Based on Growing: Based on Region Growing: Region growing is a simple region-based image segmentation method. It is too classified as a pixel-based image segmentation method as it involves the collection of original seed points. This approach to segmentation examines closest pixels of initial "seed points" and determines whether the pixel neighbours should be supplementary to the area. The method is iterated on, in the similar way as common data clustering algorithms.

iii) Image segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as super pixels). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Several automated technique have been developed for MRI segmentation. The segmentation of brain tumour from magnetic resonance (MR) images is a vital process for treatment planning, monitoring of therapy, examining efficacy of radiation and drug treatments, and studying the differences of healthy subjects and subjects with tumour. There are many segmentation techniques which

are useful in finding segregated area in an image. Following are the techniques available for segmentation process: Threshold, Region based, Edge based, and clustering method [4].

iv) Tumor Detection using Active Contour: The techniques based on active contours evolving in time according to intrinsic geometric measures of the image. The developing contours naturally crack and combine, allowing the concurrent discovery of some objects and both interior and exterior limits. This approach is based on the relation between active contours and the computation of geodesics or minimal distance curves. This geodesic approach for object segmentation allows connecting classical "snakes" based on energy minimization and geometric active contours based on the theory of curve evolution. Experimental results of applying the method to actual images together with objects with holes and medical data imagery reveal its influence. The results may be extended to 3D object segmentation as well [5].

II. LITERATURE SURVEY

Eman Abdel-Maksoud, Mohammed Elmogy, Rashid Al-Awadi (2015) **"Brain tumor segmentation based on a hybrid clustering technique"** Egyptian Informatics Journal (2015) 16, 71–81. In this research work author Eman Abdel-Maksoud, Mohammed Elmogy, Rashid Al-Awadi have been proposed an efficient image segmentation approach using K-means clustering technique integrated with Fuzzy C-means algorithm. It is followed by thresholding and level set segmentation stages to provide accurate brain tumor detection. The proposed technique can get benefits of the K-means clustering for image segmentation in the aspects of minimal computation time. In addition, it can get advantages of the Fuzzy C-means in the aspects of accuracy. The performance of the proposed image segmentation approach was evaluated by comparing it with some state of the art segmentation algorithms in case of accuracy, processing time, and performance. The accuracy was evaluated by comparing the results with the ground truth of each processed image. The experimental results clarify the effectiveness of our proposed approach to deal with a higher number of segmentation problems via improving the segmentation quality and accuracy in minimal execution time [6].

Dataset	Parameters	KM	EM	FCM	KIFCM
DS1	Time (sec)	7.52	34.47	59.52	12.87
	Accuracy	85.7	66.6	85.7	90.5
	Precision	100	100	100	100
	Recall	85.7	66.6	85.7	90.5

Table 1: Performance Parameters and its Value for KM, EM, FCM, KIFCM, MKM Algorithms

Above table shows the comparative analysis of different methods. Here we have taken tumor images from digital imaging and communications (DICOM) standard datasets which are DS 1. There are different methods which are K-Means (KM), Expectation Maximization (EM), Fuzzy C-Means (FCM) and K-Means Integrated with Fuzzy C-Means (KIFCM). We compared our datasets on the basis of different parameters. These parameters are iteration, time, accuracy, precision and recall.

Devarshi Naik et.al, **"A Review on Image Segmentation Clustering Algorithms"**(2014). In this research work author K. Padmavathi and C. Megala proposed a technique of image processing filtering and segmentation. It approaches the improvements in filtering and segmentation performance that can be achieved by combining methods from distinct regions of the tumour image. A new image filtering and segmentation technique combining, region growing & detection of edges. The combination of this two method helps to avoid characteristic segmentation errors and noise removal of an image which occurs when using region growing or edge detection separately. In this work, the brain image tumour testing process has been done. Pre-processing an image gives the result of an input image of tumour area. Segmentation and filtering process removes the noise over an image and regain the smoothed clear image of a tumor using the image processing techniques in this research work filter an affected region over a tumor image [7].

Roopali R. Laddha et.al."**A Review on Brain Tumor Detection Using Segmentation and Threshold Operations** " (2014). In this research work author Roopali R.Laddha and S.A.Ladhake proposed an efficient wavelet based algorithm for tumor detection which utilizes the complementary and redundant information from the Computed Tomography (CT) image and Magnetic Resonance Imaging (MRI) images. Hence this algorithm effectively uses the information provided by the CT image and MRI images there by providing a resultant fused image which increases the efficiency of tumor detection. This research was conducted to detect brain tumor using medical imaging techniques. The main technique used was segmentation, which is done using a method based on threshold segmentation, watershed segmentation and morphological operators. The proposed segmentation method was experimented with MRI scanned images of human brains [8].

Siva Sankari. S, et.al,**"Feature Extraction of Brain Tumor Using MRI**" (2014). In this research work the author Siva Sankari. S, Sindhu. M, Sangeetha. R, Shenbaga Rajan. A proposed the concept for brain tumour segmentation and feature extraction. Normally the anatomy of the Brain can be viewed by the MRI scan or CT scan. The MRI scanned image is taken for the entire process. The MRI scan is more comfortable than CT scan for diagnosis. It is not affect the human body because it doesn't use any radiation. But they may have some drawback in segmentation. In this research work, k-means algorithm is used for segmentation. So it gives the accurate result for tumor segmentation. The main aim of this research work is to extract optimal features provide efficient result in feature extraction [9].

Jay Patel and Kaushal Doshi,"**A Study of Segmentation Methods for Detection of Tumor in Brain MRI**" (2014). In this research work author Jay Patel and Kaushal Doshi proposed various existing segmentation methods for brain MR image have been discussed. In this research work various clustering methods also have been used for segmentation for brain tumor detection in magnetic resonance imaging (MRI).MRI because of its provide accurate visualize of anatomical structure of tissues. In this research work a brief study of the various segmentation techniques for the MR image segmentation are reviewed and discuss advantage and disadvantage about particular methods [10].

J.Selva kumar et. al. **"Brain Tumor Segmentation and Its Area Calculation in Brain MR Images are using K-Mean Clustering and Fuzzy C-Mean Algorithm"** This research work deals with the implementation of Simple Algorithm for detection of range and shape of tumor in brain MR images. Tumor is an uncontrolled growth of tissues in any part of the body. Tumors are of different types and they have different Characteristics and different treatment. As it is known, brain tumor is inherently serious and life-threatening because of its character in the limited space of the intracranial cavity (space formed inside the skull). Most Research in developed countries show that the number of people who have brain tumor were died due to the fact of inaccurate detection. Generally, CT scan or MRI that is directed into intracranial cavity produces a complete image of brain. This image is visually examined by the physician for detection & diagnosis of brain tumor. However this method of detection resists the accurate determination of stage & size of tumor. To avoid that, this project uses computer aided method for segmentation (detection) of brain tumor based on the combination of two algorithms. This method allows the segmentation of tumor tissue with accuracy and reproducibility comparable to manual segmentation. In addition, it also reduces the time for analysis. At the end of the process the tumor is extracted from the MR image and its exact position and the shape also determined. The stage of the tumor is displayed based on the amount of area calculated from the cluster [11].

A. Problem identification

Brain is that the anterior most a part of the central nervous system. Tumor is caused because of formation of additional cells in brain as a result of new cells build up whereas existences of older or broken cells for an unknown reason. Today's recent medical imaging analysis faces the challenge of detective work tumor through magnetic resonance pictures (MRI). Broadly, to provide pictures of sentimental tissue of body, MRI pictures are used by specialists. For tumor detection, image segmentation is needed. Physical segmentation of medical image by the radiotherapist may be a monotonous and prolonged method. Imaging may be an extremely developed medical imaging methodology providing made info concerning the person soft-tissue structure. There are varied tumor recognition and section strategies to find and segment a tumor from imaging pictures. A range of algorithms were developed for segmentation of magnetic resonance imaging images by exploitation completely different tools and methods.

B. Proposed Method

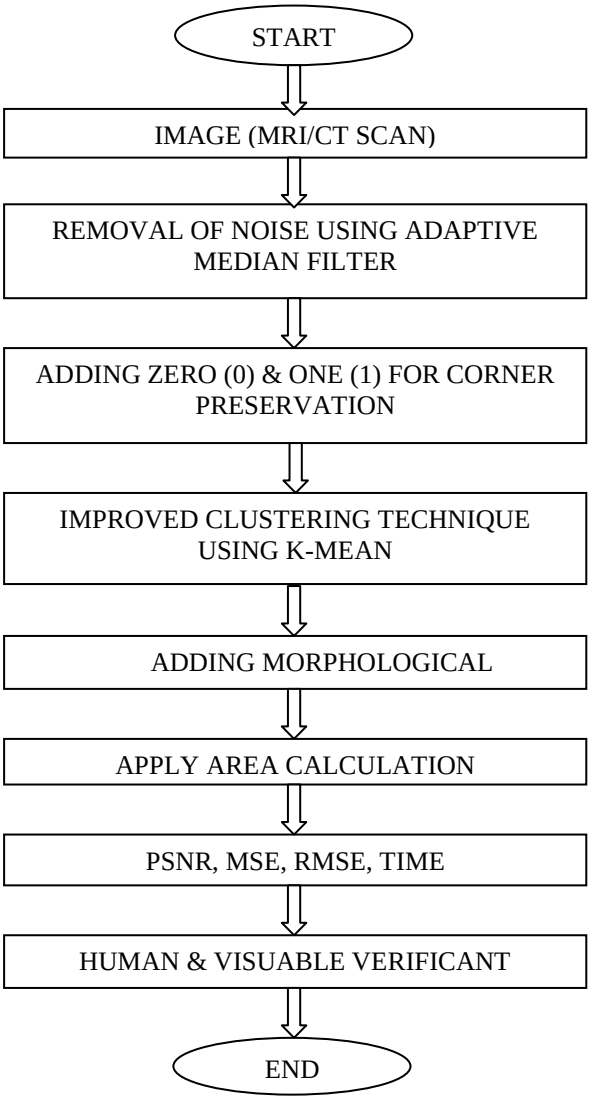
Modified K-mean with morphology (MKM) shows the better result by comparing with other four methods like KM, EM, FCM and KIFCM. The proposed method shows accurate result of area calculation of tumor due to morphological based area calculation method. Accurate area calculation is the major part of the proposed work. In this proposed method try to remove the drawback of previous method. Previous methods are not calculating the accurate area of the tumor.

C. Research Methodology

Rashid Al-Awadi has been proposed an efficient image segmentation approach using K-means clustering technique integrated with Fuzzy C-means algorithm. It is followed by thresholding and level set segmentation stages to provide accurate brain tumor detection. The proposed technique can get benefits of the K-means clustering for image segmentation in the aspects of minimal computation time. In addition, it can get advantages of the Fuzzy C-means in the aspects of accuracy. The performance of the proposed image segmentation approach was evaluated by comparing it with some state of the art segmentation algorithms in case of accuracy, processing time, and performance.

III. MODIFIED K-MEAN WITH MORPHOLOGICAL OPERATIONS

In modified k-mean optimize number of clusters are used. Generally morphological operation is used for object extraction and noise removal [12]. Here it is used to enhance the object boundary and to remove the noise from the images. The addition of morphological operation added more accuracy in results. Here the affected areas have been calculated. To analyze the result scholar has calculated the following parameters: Peak signal-to-noise ratio (PSNR), Mean squared error (MSE), Root-mean-square error (RMSE) and minimal execution time



In above proposed technique-shows the step wise process of brain tumor detection in which de-noising is use for remove the noise from the brain tumor image, clustering is used for feature compression, area calculation is used to find out the part of the brain were tumor is detected.

Researcher has taken images (MRI or CT scan) from the standard Digital Imaging and Communications in Medicine (DICOM) data set [13] after that adaptive median filter has been used to remove the noise. Adaptive median filter is used to remove corrupted pixels from the images [14]. Addition of extra 0 & 1 is done to preserve the corner points of image. This addition do not adds any extra result. Modified K-mean is used for the clustering techniques. Clustering technique is nothing but dividing whole images in small number of groups and putting the corresponding pixels to a particular group. To apply k-mean number of cluster in image should be known.

Time taken to simulate each algorithm was recorded and it was found that k-means clustering algorithm was fastest followed by all other segmentation methods. Also, the results show that all the other segmentation method segmented only tumor cell while the clustering algorithm suffered with false detection problem. The false detection problem can be removed by the modified k-means with adding morphology operations.

IV. CONLUSION AND FUTURE WORK

In this survey paper compares and reviewed the different segmentation techniques. In this survey compare the KIFCM, K-Mean, Fuzzy C-Mean and other techniques. Finally analyze that KIFCM is better rather than other techniques in terms of complexity and accuracy. K-Mean algorithm shows good result in timing. K-Mean consume less time in compare to KIFCM, EM, Fuzzy C-Mean.

In future try to improve the results of previous method with the help of our proposal i.e. the modified K-mean with morphological segmentation. Try to improve the accuracy and algorithm complexity in tumor detection.

REFERENCES

[1] Ferlay J, Shin HR, Bray F, Forman D, Mathers C and Parkin DM,GLOBOCAN 2008 v2.0, "Cancer Incidence and Mortality Worldwide", International Agency for Research on Cancer, Lyon, France, 2010.

[2] Sonali javare, Nitin Patil, Sanjay Patil, "Brain tumor segmentation and area calculation of tumor by use of unsupervised clustering algorithm", International Journal of Advanced Research in Computer Science and Software Engineering, ISSN: 2277 128X, Volume 4, Issue 11(2014), pp. 322-325.

[3] Manoj K Kowear and Sourabh Yadev, "Brain Tumor Detection and Segmentation using Histogram Thresholding", International Journal of Engineering and Advanced Technology, April 2012.

[4] V. Janani, P. Meena, "Image Segmentation for Tumor Detection using Fuzzy Inference System", International Journal of Computer Science and Mobile Computing (IJCSMC), Vol. 2, Issue.5, ISSN 2320–088X, pg.244 – 248, 2013.

[5] Harneet Kaur, Sukhwinder Kaur, "Improved Brain Tumor Detection Using Object Based Segmentation", International journal of Engineering Trends and Technology (IJETT), ISSN: 2231-5381, Volume 13 Number 1 (2014).

[6] Eman Abdel-Maksoud, Mohammed Elmogy, Rashid Al-Awadi, "Brain tumor segmentation based on a hybrid clustering technique", Cairo University, Egyptian Informatics Journal (2015) 16, 71–81.

[7] Devarshi Naik, Pinal Shah, "A Review on Image Segmentation Clustering Algorithms", International Journal of Computer Science and Information Technologies (IJCSIT), Vol. 5(3), 2014, 3289 –3293.

[8] Roopali R. Laddha, S.A. Ladhake, "A Review on Brain Tumor Detection Using Segmentation and Threshold Operations", (IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 5 (1), 2014, 607-611.

[9] Siva Sankari. S, Sindhu. M, Sangeetha. R, Shenbaga Rajan. A, "Feature Extraction of Brain Tumor Using MRI", International Journal of Innovative Research in Science, Engineering and Technology, ISSN: 2319-8753, Vol. 3, Issue 3, March 2014.

[10] Jay Patel and Kaushal Doshi "A Study of Segmentation Methods for Detection of Tumor in Brain MRI", Advance in Electronic and Electric Engineering. ISSN 2231-1297, Volume 4, Number 3 (2014), pp. 279-284.

[11] J.Selva kumar, A.Lakshmi, T.Arivoli, "Brain Tumor Segmentation and Its Area Calculation in Brain MR Images using K-Mean Clustering and Fuzzy C-Mean Algorithm", IEEE-International Conference On Advances In Engineering, Science And Management (ICAESM), ISBN: 978-81-909042-2-3, March 2012.

[12] Meenakshi S R, Arpitha B Mahajanakatti, Shivakumara Bheemanaik, "Morphological Image Processing Approach Using K-Means Clustering for Detection of Tumor in Brain", International Journal of Science and Research (IJSR) Volume 3, Issue 8,ISSN (Online): 2319-7064 Impact Factor : 3.358, 2014.

[13] DICOM Samples Image Dataset. <http://www.osirix-viewer.com/datasets/>; [accessed 29.12.13].

[14] Rachna Mehta, Navneet Kumar Aggarwal, "Comparative Analysis of Median Filter and adaptive Filter for Impulse Noise – A Review", International Journal of Computer Applications (IJCA), ISSN 0975 – 8887, 2014J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68–73.