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Brain Tumor Detection Using BCFCM Algorithm

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Abstract- **Cell is the smallest unit of tissue, whose abnormal growth causes tumor in brain. Bias field correction fuzzy c-means (BCFCM) and support vector machine (SVM) based tumor detection is presented in this paper. The brain magnetic resonance image (MRI) has an embedded bias field. This field need to be corrected to obtain the actual MR image for classification. The bias field estimation algorithm is the most interesting technique to correct the intensity in-homogeneity. To make this system adaptive we are using support vector machine, support vector machine is used in unsupervised manner which will use to create and maintain the pattern for future use.**

Index Terms- **Segmentation, MRI image, tumor detection, SVM, BCFCM.**

I. INTRODUCTION

The fundamental structural unit of all living organisms is the cell. Human body contains about 100 trillion cells and each of them has its own functions. These cells have to divide and should form new cells in a controllable way, then only the body can function correctly. But there are cases in which the cells divide and grow without any control so that a huge amount of unwanted tissue will be formed. It is known as tumor. Tumors can occur in any parts of the body. Brain tumor can be considered as one of the serious and life threatening tumors. It is actually created either by the abnormal and uncontrolled cell division within the brain or from cancers primarily present in other parts of the body. Tumor can affect healthy cells directly and indirectly. It may cause brain swelling and also increases the pressure inside the skull. Generally, tumors are classified based on the location of their origin and its malignancy. There exists several imaging techniques. Magnetic Resonance Imaging (MRI), Computed Tomography (CT) are two imaging techniques for the diagnosis of brain tumor. MRI has the following advantages. It does not uses ionizing radiation while CT scans do. This radiation is harmful if there is repeated exposure. Diagnosis of tumor with the help of tools can improve the chance of survival from tumor in brain. In medical field doctors don't have a standard method that can be used for brain tumor detection which leads to varying Conclusions between one doctor to another. There are several research works going on in order to segment medical images. It will lead to development of more computational tools. It can helps to improve the accuracy, exactness, and speed of Computation of segmentation approaches, as well as minimizing the manual effort. Automated interpretation of segmentation is still very difficult even though the studies are done during last two decades. So several researchers are doing in this field to help doctors in diagnosing and treatment planning.
Medical images build essential parts for identifying and work dissimilar body structures and therefore the diseases offensive them . Many form of images area unit generated like ultrasound images, resonance images (MRI), X-rays which may be once more classified in radiographs, X-raying usually termed as CT scan, radiology, diagnostic technique [2]. Arrival of the technology has revolutionized the medical imaging space and has altered the task of research of a range of ailments for drugs practitioner. To produce images of human body for medical purposes it can be very perceptive for the medical process which is trying to analyse the disease Medical imagining is the name given to the field which constitutes of techniques and processes [3].
Intensity inhomogeneity possess a challenge in MR image segmentation. It appears as a slowly varying nonlinear field, known as bias field, in MR images that changes the tissue statistics. The presence of bias field affects the intensity thereby resulting in misclassification of tissue class. The conventional segmentation methods fail to classify such tissue classes which are affected by intensity inhomogeneity. However the bias field changes from frame to frame for a particular patient and from patient to patient in the same MR system. To handle

such problems, there is a need to design algorithms fast enough to estimate the bias field for each frame and accurately classify different tissues.

II. LITRATURE SURVAY

R. Muthukrishnan, et.al [6] Proposed brain tumor detection in which Segmentation separates an image into its component regions or objects. Image segmentation it needs to segment the object from the background to read the image

properly and classify the content of the image carefully. In this framework, edge detection was an important tool for image segmentation. In this paper their effort was made to study the performance of most commonly used edge detection techniques for image segmentation and also the comparison of these techniques was carried out with an experiment.

M. Saritha et.al, [7] Proposed approach by integrating wavelet entropy based spider web plots and probabilistic neural network for the classification of Brain MRI. The proposed technique uses two steps for classification i.e. Wavelet entropy based spider web plot for feature withdrawal and probabilistic neural network for classification. The obtained brain MRI, the feature extraction was done by wavelet transform and its entropy value was calculated and spider web plot area calculation was done. With the help of entropy value classification using probabilistic neural network was calculated. Probabilistic neural network provides a general solution for pattern classification problem and its classification accuracy is about 100%.

P.Nanda Gopal et.al, [8] in their paper they presented a combination of wavelet statistical features (WST) and wavelet texture feature (WCT) obtained from two level distinct wavelet transform was used for the organization of abnormal brain matters in to benign and malignant. The planned system was consists of four stages: segmentation of region of interest, discrete wavelet disintegration, feature abstraction, feature selection, organization and evaluation. The support vector machine was employed for brain tumor segmentation. A grouping of WST and WCT was used for feature extraction of tumor region extracted from two level discrete wavelet transform. Genetic algorithm was used to select the optimal texture features from the set of mined features. The probabilistic neural network was used to classify abnormal brain tissue in to benign and malignant and the performance evaluation was done by comparing the classification result of PNN with other neural network classifier. The classification accuracy of the proposed system is 97.5%.

A. Laxami et.al, [9] proposed the work on information (region of interest) in the medical image and thereby vastly improve upon the computational speed for tumor segmentation results. Significant feature points based approach for primary brain tumor segmentation was proposed. Axial slices of T1- weighted Brain MR Images with contrast enhancement have been analyzed. In order to extract significant feature points in the image, applied a feature point extraction algorithm based on a fusion of edge maps using morphological and wavelet methods. Evaluation of feature points thus obtained has been done for geometric transformations and image scaling. A region growing algorithm was then employed to isolate the tumor region. Preliminary results show that our approach has achieved good segmentation results. Also this approach was

reduces a large amount of calculation. Future work will involve an investigation of the method in automatic 3D tumor segmentation, segmentation of ROI's in other medical images, as well as the importance of implemented technique in medical image retrieval applications.

III. METHODOLOGY

For the segmentation of a medical image there are numerous algorithms which are utilized by many researchers. Among the segmentation algorithms, fuzzy c-means algorithm is a commonly used method for segmentation of MRI images by many researchers. The segmented output is then subjected to feature extraction. The features for the classification were extracted using bias field correction fuzzy c-means algorithm. Then the extracted features are used for classification. In the recent years, the brain tumor is the one of the leading cause of death irrespective of the age. With the advancement of imaging and image processing techniques it is expected to provide more information to the physicians to take the accurate decision for better healthcare. The brain tumors can be detected using any one of the imaging modality and further processed by using image processing tools for accurate classification of tumors. Many researchers have reported various preprocessing algorithms, feature extraction techniques and classification algorithms. The main purpose of this paper is to identify the region of tumor and to do the detailed diagnosis of that tumor which will used in treating the cancer patient Threshold is a specific intensity value which contents a predefined intensity value; it is used to separate object or Region of Interest (ROI) from the image background, chosen in the range of 0 to 255 [13]. But it is detected that clustering methods followed by threshold cannot notice tumor correctly from MRI image, because the image consist of several non-brain tumor tissue. For this reason we express the proposed method using C-Means algorithm followed by support vector machine is used for tumor detection purpose [14].

A. Preprocessing

In the image processing the gray scale image is processed by using different techniques like brightness, threshold and Filtering, Brightness makes the image by which white objects are distinguished from gray and light items from dark objects. Hence by changing the brightness of the image the tumor detection in the MRI image is easier. Thresholding isolates objects, keeping those that interest us and removing those that do not. Also thresholding converts the image from a grayscale image, with pixel values ranging from 0 to 255, to a binary image, with pixel values of 0 or l. The processing window in vision assistant displays a preview of the threshold operation using the current set of parameters. The pixels showed in red have strengths that fall inside the threshold range. The threshold operator sets their values to 1. The pixels depicted in gray have values outside the threshold range. The threshold operator sets their values to 0.

Skull Striping

Detection of skull is used to control the boundaries of the object. The edge information helps to find out the region of interest (ROI) i.e. the portion of the image covering the tumor. This work is done with the help of the calculating the centroid in the image . Extraction of brain tissue from non-brain tissues in MR images which is referred to as skull stripping is an important step in many neuron imaging studies.

Thirdly, a mathematical morphology operation such as: filling holes and dilation is carried out on selected largest binarised image. Finally, we found skull stripped brain image.

B. Segmentation

Image Segmentation is the procedure of partition a digital image into numerous regions or sets of pixels. Essentially, in image partitions are different objects which have the same texture or color. The image segmentation results are a set of regions that cover the whole image together and a set of contours extracted from the image [11]. All of the pixels in a region are similar with respect to some characteristics such as color, intensity, or texture. Neighboring regions are considerably different with respect to the same individuality. The different approaches are

1. By finding limits between regions based on discontinuities in intensity levels
2. Thresholds based on the distribution of pixel properties, such as intensity values
3. Based on finding the regions directly.

Thus the choice of image segmentation technique is depends on the problem being considered. Region based methods are based on continuity. These techniques split the entire image into sub regions depending on some rules like all the pixels in one region must have the same gray level. Region-based techniques rely on common patterns in intensity values within a cluster of neighboring pixels. The cluster is referred to as the region in addition to group the regions according to their anatomical or functional roles are the goal of the image segmentation [6].

C.means based segmentation

Fuzzy C-Mean clustering algorithm introduced by Bezdek is an improvement of earlier clustering methods. The FCM algorithm is an improvement of earlier clustering methods. The FCM algorithm attempts to partition a finite collection of pixels into a collection of "C" fuzzy clusters with respect to some given criterion. Depending on the data and the application, different types of similarity measures may be used to identify classes. The goal of a Fuzzy C-Mean clustering analysis is to divide a given set of data or objects into a cluster, which represents subsets or a group. The partition should have two properties one of them is the homogeneity inside clusters data, which belongs to one cluster, should be as similar as possible and another one is heterogeneity between the clusters data,

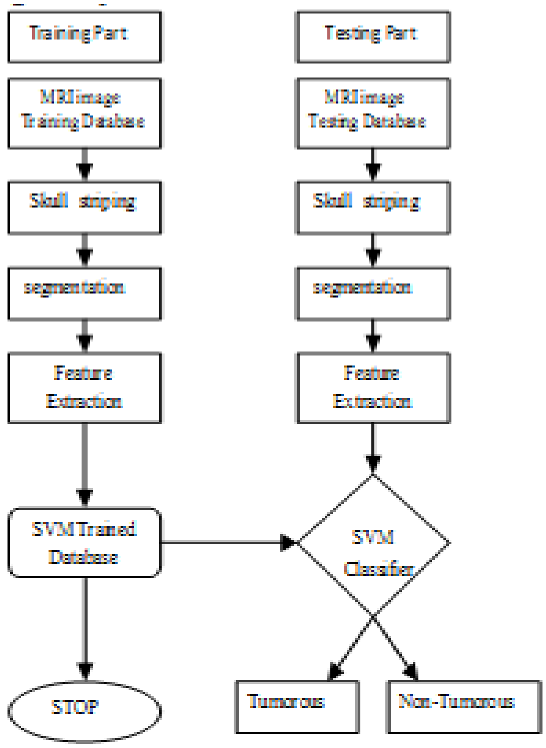

Figure 1: Flow Diagram of system

which belongs to different clusters, should be as different as possible. The membership functions do not replicate the actual data distribution in the input and the output. They may not be suitable for fuzzy pattern recognition. To build membership functions from the data available, a clustering technique may be used to partition the data, and then produce membership functions from the resulting clustering. The FCM algorithm iteratively optimizes with the continuous update of fuzzy membership and set of cluster centroid. The drawback of FCM for image segmentation is the objective function of FCM does not take into consideration any spatial dependence among.

Bias Field Correction Fuzzy C-mean Algorithm

Intensity inhomogeneity poses a challenge in MR image segmentation. It appears as a slowly varying nonlinear field, known as bias field, in MR images that changes the tissue statistics. The presence of bias field affects the intensity thereby resulting in misclassification of tissue class. The conventional segmentation methods fail to classify such tissue classes which are affected by intensity inhomogeneity. However the bias field changes from frame to frame for a particular patient and from patient to patient in the same MR system. To handle such problems, there is a need to design algorithms fast enough to estimate the bias field for each frame and accurately classify different tissues.

Algorithm for BCFCM

1: Set the parameters clusters C, A weighting exponent parameter on each fuzzy membership value p, the total number of pixels in the MRI image Nr and Neighbours effect α.
2: Choose the stop criteria: Error
3: Initialize the centroids vector V and estimated bias field β.
4: repeat
5: Update the membership value U.
6: Update the cluster center vector V.
7: Update the bias field estimated matrix β
8: until Vnew -Vold < Error .

C. SVM

The SVM is a supervised learning method. It is a good tool for data analysis and classification. SVM classifier has a fast learning speed even in large data. SVM is used for two or more class classification problems. Support Vector Machine is based on the conception of decision planes. A decision plane is one that separates between a set of items having dissimilar class memberships. The Classification and detection of brain tumor was done by using the Support Vector Machine technique. Classification is done to identify the tumor class present in the image. The use of SVM involves two basic steps of training and testing.

Linear SVM:

The training patterns are linearly divisible. That is, there exists a linear function of the form $f(x) = w^T x + b$ (1) such that for each training example xi, the function yields $(f(x)) \geq 0$ if x for =+1, y and $f(x_i) < 0$ for yi=-1. In other words, training examples from the two different classes are separated by the hyper plane $F(x) = w^T x + b = 0$, where w is the unit vector and b is a invariable. For a given training set, while there may exist many hyper planes that maximize the separating margin between the two classes, the SVM classifier is based on the hyper plane that maximizes the separating margin between the two classes In other words, SVM finds the hyper plane that causes the largest separation between the decision function values for the “borderline” examples from the two classes. SVM classification with a hyper plane that minimizes the separating margin between the two classes. Support vectors are elements of the training set that lie on the boundary hyper planes of the two classes.

Non-Linear SVM

In the above discussed cases of SVM classifier also shown in figure 7. Straight line or hyper plane is used to distinguish between two classes. But datasets or data points are always not separated by drawing a straight line between two classes. For example the data points in the below figure 2. It can’t be separable by using above SVMs discussed. So, Kernel functions are used with SVM classifier. Kernel function provides the bridge between from nonlinear to linear. Basic idea behind using kernel function is to map the low dimensional data into the high dimensional feature space where data points are linearly separable [15]. A pattern gratitude network, which is a feed-backward network with tan sigmoid transfer functions in both the hidden layer and the output layer, is used. The network has only one output neuron, as there are 24 input vectors. The hidden layer neurons are 100 and the learning rate is 0.1. The momentum factor is 0.9 and total numbers of epochs are 500. The error is minimized by 0.001 and the performance of the classifier is evaluated by calculating accuracy.

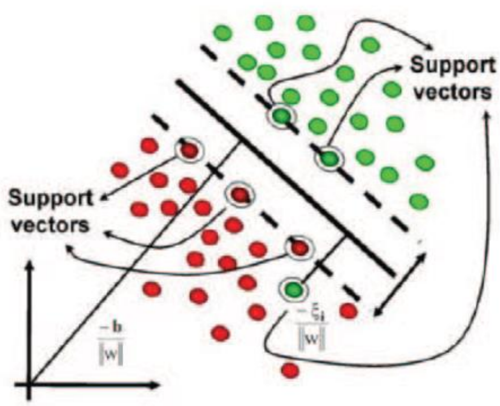

Figure 2: The classification process of SVM

SVM are based on optimal hyper plane for linearly pair able patterns but can be complete to patterns that are not linearly divisible by transformations of unique data to map into new space. They are clearly based on a abstract model of learning and come with theoretical guarantees about their performance. They also have a modular design that allows one to separately apply and design their components and are not affected by local minima. Support vectors are the elements of the training set that would change the location of the dividing hyper plane if removed. Support vectors are the grave elements of the training set. The problem of discovering the best hyperplane is an optimization problem and can be solved by optimization techniques.

IV. RESULTS AND DISCUSSION

The test of projected technique to discover and segment brain tumor is performed using MR images of diverse long suffering. Each test image has brain tumor of diverse size, shape and intensity. Manual examination is used to check the correctness of automated segmented tumor area. The experimental result for different MR images containing tumor of different shapes, sizes and intensities.

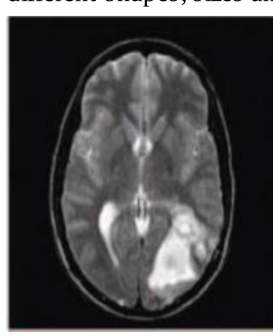

Figure 3:Image with skull

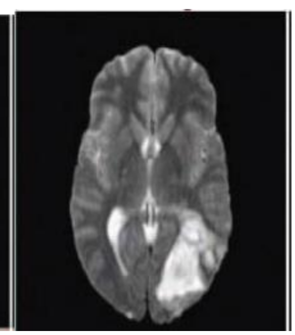

Figure 4: Removing skull tissues

In figure 3 this is one of the MRI image with skull in next figure 4 the result showing after skull striping.

The figure 5 shows the input MRI brain image which is affected by brain tumor. Figure 6 shows the tumorous region. Classifier output detected as tumorous image is shown in figure 7. with tumor percentage area 4.7886%

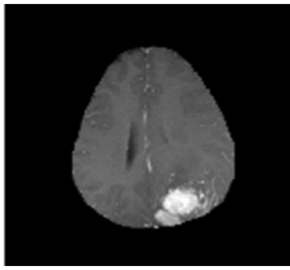

Figure 5: Original Image

Figure 6: Tumorous Region

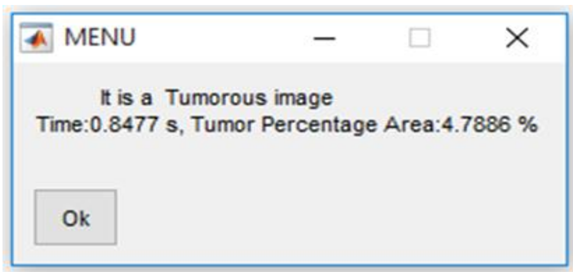

Figure 7: Classifier Output

V. CONCLUSION

This work proposed a method for automatic segmentation and classification of MRI brain image with tumor. The tumor region is extracted using BCFCM. The features are extracted from the decomposed image. The extracted features are given as input to the support vector machine. Now the SVM classified the input image as timorous or non-tumorous. This work was implemented using MATLAB 2015a. The accuracy of the proposed method is 92.5%. The validation of the proposed method with existing clinical results is planned to implement as future work.

REFERENCES

[1] Shweta A. Ingle, Snehal M. Gajbhiye; "A review on Brain tumor detection technique", International Journal of Science and Research,2017

[2] Priyanka Shah, Manila Jeshnani , Sagar Kukreja, Priyanka Ailani; "Survey on algorithm for Brain tumor detection" International Journal of Computer Science and Information Technologies, Vol. 8 (1) , 2017, 56-58

[3] Amitava Haider, Chandan Giri, Amiya Haider; "Brain Tumor Detection using Segmentation based Object Labeling Algorithm", in Proceedings in IEEE International Conference On Advances In Engineering, Science And Management,2016

[4] Jinal A. Shah, S. R. Suralkar; "A review on Brain tumor detection for MRI images" International Conference on Global Trends in Engineering, Technology and Management (ICGTETM-2016)

[5] Arvan Aulia Rachman , Zuherman Rustam ; "Cancer Classification using Fuzzy C-Means with Feature Selection" 2016 12th International Conference on Mathematics, Statistics, and Their Applications (ICMSA), Banda Aceh, Indonesia

[6] R.Muthukrishnan and M.Radha, "Edge Detection Techniques for Image Segmentation" International Journal of Computer Science & Information Technology, Vol 3, No 6, Dec 2011

[7] M.Saritha and K.Paul Joseph, "Classification of MRI brain images using combined wavelet entropy based spider web plot and probabilistic neural network"ELSEVIER, pattern Recognition letters 34, pp. 2151- 2159, 2013.

[8] P.N.Gopal and R.Sukanesh," wavelet statistical feature based segmentation and classification of brain computed tomography images" IET Image Prosess Vol.7 pp 25 -32 2013

[9] A. Laxmi and P.Samata, "Optimization of visual presentation of MRI image for accurate detection of tumor in human brain using virtual instrument" the Biomedical Engineering International Conference 2012.

[10] Reema Mathew A, Dr. Babu Anto P "tumor detection and classification of mri brain image using wavelet Transform and svm" International Conference on Signal Processing and Communication (ICSPC'17) – 28th & 29th July 2017

[11] Zeynel Cebeci, Figen Yildiz ; "Comparison of K-Means and Fuzzy C-Means Algorithms on Different Cluster Structures" Journal of Agricultural Informatics (ISSN 2061-862X) 2015 Vol. 6, No. 3:13-23

[12] Noureddine AITALI, Ahmed EL ABBASSI, Bouchaib CHERRADI, Omar BOUATTANE, Mohamed YOUSSFI "Parallel Implementation of Bias Field Correction Fuzzy C-Means Algorithm for Image Segmentation" International Journal of Advanced Computer

Science and Applications(IJACSA), Vol. 7, No. 3, 2016

[13] Jeetashree Aparajeeta, Pradipta Kumar Nanda, Niva Das ,"Bias Field Estimation and Segmentation of MR Image Using Modified Fuzzy C Means Algorithms" IEEE Transactions on Fuzzy Systems, vol. 1, no. 2, pp. 98-110,2015

[14] Jinal A. Shah, S. R. Suralkar, "Brain Tumor Detection from MRI Images using Fuzzy C-Means Segmentation" International Journal of Advanced Research in Computer and Communication Engineering Vol. 5, Issue 6, June 2016

[15] M. Shasidhar, V.Sudheer Raja, B. Vijay Kumar, "mri brain image segmentation using modified fuzzy c-means clustering algorithm" 2011 International Conference on Communication Systems and Network Technologies

[16] Nikhil R. Pal, Kuhu Pal, James M. Keller, James C. Bezdek, "A Possibilistic Fuzzy c-Means Clustering Algorithm," IEEE Transactions on Fuzzy Systems, vol. 13, no. 4, pp. 517-530, 2005.