Brain Tumor MR Image Detection and classification using kernel SVM

B. Lalitha, T.Ramashri

Abstract- ***At Present Day the detection and classification of brain tumor MR Image is more complicated and time consuming task. Further experts are required for detection of tumor in brain which may lead to misclassification. Tumor in brain is an growth of unwanted cells which lead to cancer. In this paper k means clustering technique is used for Segmentation of tumor region from brain MRI . Features are extracted such as mean, median, skweness etc.. This Extracted feature will give more information content of tumor which helps in classification of tumor as Normal or Abnormal using Kernel SVM Classifier.***

Key Words: MRI Image, GLCM, K Means clustering, Kernel Support vector machine.

I. INTRODUCTION

Medical image processing is most challenging field especially for MRI imaging modalities.MRI is a 3-D Imaging modality suits for detection of abnormality in soft tissues..High resolution brain structure were viewed using MRI Imaging Techniques of T1 weighted, T2 weighted, PET and PD (proton density) weighted images for detection of brain tumor..High fat content of brain appears bright and dark for brain tissues filled with water.So,T1 weighted images suits best for clear and improved brightness intensity level.[1] The abound tumor is an uncontrolled growth of cancerous cells in any part of the body, whereas a brain tumor is an uncontrolled growth of cancerous cells in the brain. Tumor in brain has different features like tumor shape, type,size and area of location. Brain tumor are classified into two types as benign and Malignant tumor based on part of brain affected.

Benign Tumor:

Benign tumor is normal tumor, that has property which do not effect healthy tissue around it[1].This tumor develops slowly and can be visualised clearly with sharp edges of tumor region. Benign tumor threatens life when it touches sensitive parts of brain[2].

Malignant Tumor:

Malignant tumor are cancerous cells, which effects neighbouring healthy tissues of brain and easily occupies to other parts of brain. Malignant tumor grows faster than benign tumor. Since the cancerous cells are deeply penetrated in nearby cells edges can't be clearly visualized[1]-[2]

In this Method, dissimilar MRI sequence of images are employed for diagnosis, with T1-weighted MRI, T2-weighted MRI, fluid-attenuated inversion recovery-(FLAIR) weighted MRI, and proton density weighted MRI since, Detection of brain tumor at an early stage is a key factor to provide treatment.

Once a tumor region in brain is diagnosed clinically. It is required to predict its size, its type, and its effect on the surrounding areas radiological. Based on reports given by radiologist the best treatment, surgery, radiation, or chemotherapy, is decided. It is apparent that,there is chances of endurance of a tumor-infected patient by the detection of tumor accurately at its before time stage [3]. thus, the study of brain tumor using MRI imaging modalities has gained importance in the field of radiology .

II. RELATED WORKS

Recently there are many techniques available to classify and detect tumor in brain MRI images. The most well known algorithms such as fuzzy clustering means ,K-means, artificial neural network(ANN) Expectation maximization algorithm are used to extract the important information from MRI images. This section presents the review of some researches that are prominent and recently developed..

Damodharan and Raghavan [4] have presented a technique based on neural network for MR Image brain tumor detection and classification. The accuracy of this method produces 83% and segmented white matter, Gray matter, CSF and obtained quality rate separately.

Q.Ain, M[5]. Proposed Fuzzy anisotropic diffusion based segmentation and texture based ensemble classification of brain tumor method. According to Ain Brain MRI images is to be separated in to two regions with one region containing tumor cells of brain and other region with non tumor cells to extract the tumor part. Anisotropic diffusion filter is used in this method for pre-processing.

[5]. One region contains the tumor cells of the brain and the second contains the normal brain cells

Zanaty [6] proposed hybrid segmentation technique for detection of MRI image brain tumor. Author combined FCM and seed region growing algorithm as hybrid technique. to measure jaccard similarity coefficient for segmented gray matter,white matter,CSF From brain tissues .This method outputted average segmentation score S of 90% with noise level of 3% and 9%, respectively.

Kong et al. [7] investigated automatic segmentation of brain tissues from MR images using discriminative clustering and future selection approach.

Demirhan et al. [8] proposed a novel tissue segmentation algorithm by combination of wavelets and neural networks, which gives effective segmentation of brain MRI images

Revised Manuscript Received on June 10, 2019

B. Lalitha, Research scholar, Department of Electronics and communication Engineering, S.V.University, Tirupati, A.P, India

Dr T.Ramashri, Professor, Department of Electronics and communication Engineering, S.V.University, Tirupati, A.P, India

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

into the tumor, WM, GM, edema, and CSF. In this method texture based features are extracted using artificial neural network (ANN) as segmentation and classifier tool .

Cui et al. [9] Developed a localized fuzzy clustering method to segment MRI images. the author used jaccard similarity index as a metric to obtain accuracy. This localized fuzzy clustering method obtained the segmentation accuracy of 83% to 95% segment white matter, grey matter and cerebrospinal fluid.

From the discussions of related work it has been exposed that algorithms are developed only for segmentation or only for extracting the features or for classification of tumor region. The combined approach of segmentation, feature extraction ,classification has not yet been conducted in existing methods. Some algorithms are developed for analysis on combined method with few feature Extraction and hence low accuracy is obtained for tumor detection.

In the proposed work a combination of GLCM and Kernel SVM as a classifier tool were used to improve analytic accuracy. The purpose of this work, is from large dataset of medical images detect and classify the tumor as normal and abnormal by extracting information from segmented tumor region.

III. PROPOSED WORK

The Algorithm and various stages processed in proposed work and related tool for each stage is

a. Median filter Pre-processing

b. Apply K-Means clustering algorithm for enhanced image

c. Feature extraction using GLCM Matrix

e. Classification of tumor based on kernel Support Vector Machines with GRB kernel

f. classification of tumor

The flow chart of proposed method is shown in fig1

A. pre processing:

The first and most important tasks for the tumor detection is pre processing. Generally medical images appear inhomogeneous and of poor contrast which requires pre processing for image enhancement. In this work, pre processing include enhancement which helps to give more accurate tumor diagnosis. Noise present and Background in the MRI image can be removed using median filter . The median filtering is applied to remove the high frequency components in MR images. The median filter reduces the noise and improves image quality.. The median filter chooses 3x 3 neighbour pixels and arranges the pixel in numerical values, replaces each pixel value with its middle pixel. Thereby preserves edges in MRI images.

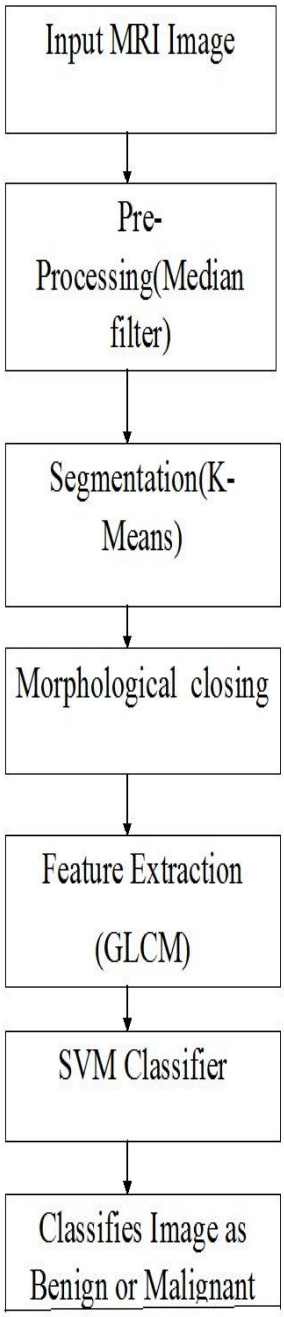

Fig 1flow chart of proposed work

B. Segmentation

Segmentation of tumor from non tumor region is done using unsupervised K-Means clustering algorithm .This algorithm selects k clusters randomly as initial centroids. Pixels are grouped in the clusters based on similar feature and dissimilar features are grouped in next clusters.

The process involved in K-Means clustering is as follows

(i). Select K cluster centroids randomly.

(ii). Perform histogram

(iii).choose centroids randomly based on pixel intensities

(iv).Next, step is to find new centroids based on Euclidean distance measure

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

(v). Each pixel is compared to every centroids and reallocate the pixels to its nearest centroids to form a cluster.

(vi). The process is continued . no longer in centroids movement exist.

(ix). Finally K Clusters are segmented from MRI Image. Flow chart of k-Means clustering segmentation algorithm is shown

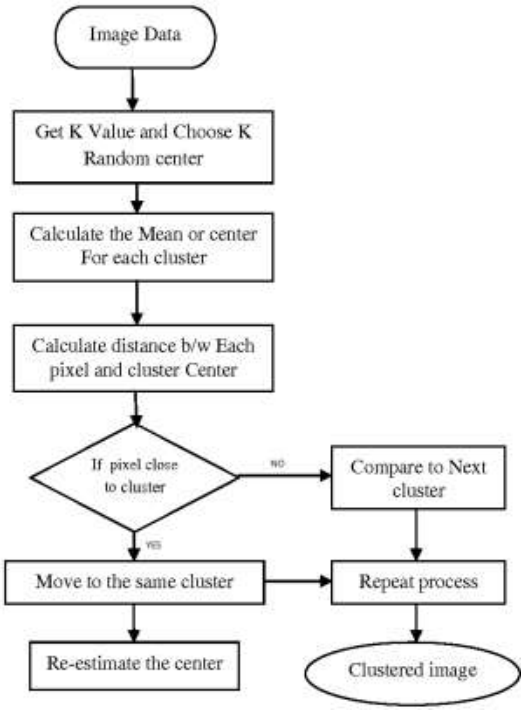

Fig 2.Flow chat of K-Means Clustering

C. Morphological closing

Segmented image is applied to morphological operator to extract the tumor region. Disk structuring element is used to perform morphological closing operation. Morphological closing operator gives smooth edges and exact shape of shape of tumor region.

D. Feature Extraction

Valuable information content of MRI images can be obtained using Feature extraction. The technique used for feature extraction is gray level co-occurrence matrix. In this proposed work GLCM matrix is applied to retrieve the texture based information content, which is required for improving the accuracy of diagnosis system. Four different texture information is obtained using GLCM[12].

Entropy: $-\sum_{i=0}^{G-1}\sum_{j=0}^{G-1} C_{ij}\log_2 c_{ij}$ (1)

Correlation: $\sum_{i=0}^{G-1}\sum_{j=0}^{G-1}\frac{ijc_{ij}-\mu_x\mu_y}{\sigma_x\sigma_y}$ (2)

Homogenity: $\sum_{i=0}^{G-1}\sum_{i=0}^{G-1}\frac{c_{ij}}{1+|i-j|}$ (3)

Energy: $\sum_{i=0}^{G-1}\sum_{j=0}^{G-1}(c_{ij})^2$ (4)

Where cij is the (i,j)th element of co-occurrence matrix

Along with this some other useful features like mean, skewness ,kurtosis, median are also extracted. Mean gives the information about average brightness intensity value of an image. variance indicates the amount of deviation in the intensity value over its mean. skewness describes the irregularity of histogram around its mean. Kurtosis gives information about how flat the histogram is.The formulae for these features are [12].

Mean: $\mu = \sum_{i=0}^{M-1} ip(i)$ (5)

Skewness: $\mu_3 = \sigma^{-3}\sum_{i=0}^{M-1}(I-\mu)^3$ P(i) (6)

Kurtosis: $\mu_4 = \sigma^{-3}\sum_{i=0}^{G-1}(I-\mu)^4$ *P(i)-3* (7)

Where M is the maximum gray level of image and P() is the probability density of the intensity levels which is obtained from:

P(i)=h(i)/N (8)

where h(i) is the total number of pixels with intensity level p(i) and N is the total number of pixels in the image.

D. SVM Classifier

Classification of normal and abnormal tumor cases are done using Kernel SVM Classifier .SVM is a binary classification method, in which input data has 2 classes. For normal tumor cases we take '0' whereas for abnormal tumor cases we take '1'. SVM is a linear classifier which can not classify dataset lying on different sets of hyper plane. In kernel SVM non linear kernel function is applied to every dot product. Kernel SVMs allow to fit maximum-margin hyper plane in a transformed feature space.

IV. RESULT AND DISCUSSIONS

In Proposed work is Executed on matlab 2015. The data set consists of T2 -weighted MR images with size of 256x256. For execution of this algorithm 70 MR images (normal and abnormal) are considered, out of which in training phase 27 abnormal images and 10 normal images are utilised and 10 abnormal and 5 normal images has been taken for testing. From the results it is clear almost all images are classified successfully as either malignant or benign , only two images are misclassified cases found during execution . Hence the overall accuracy of this classification is 96 percent.

Table1: Classification of normal and abnormal Image

Phase	Normal images	Abnormal images	Classified images	Misclassified images
Training phase	10	27	37	-
Testing phase	5	10	13	2

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

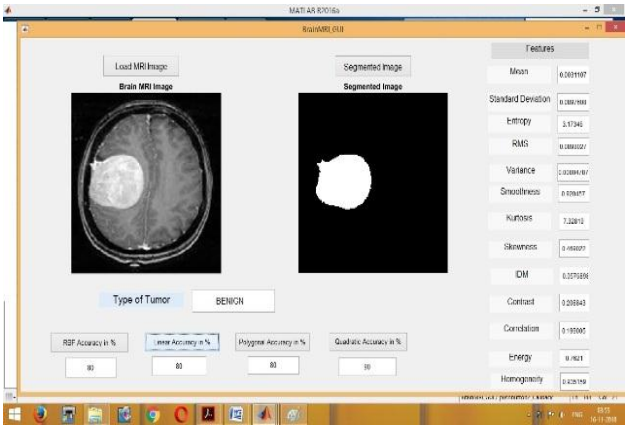

Fig 4.1 shows the tumor extracted image and classification of benign tumor

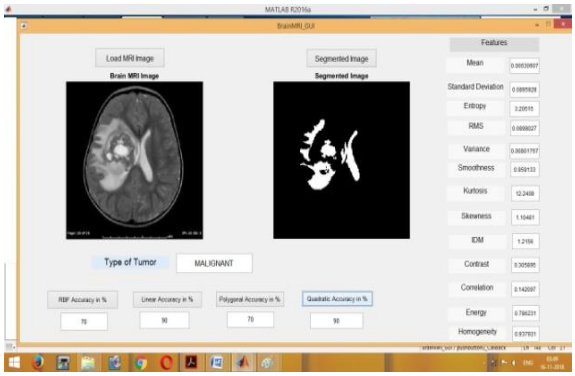

Fig 4.2 shows the tumor extracted image and classification of Malignant tumor

V. CONCLUSION

This proposed work utilized k-means clustering for segmentation to get better accuracy, feature extraction of segmented image was carried out using GLCM matrix. The extracted feature are utilized for classification of tumor types. The proposed work produces better overall accuracy as compared to existing methods. In future we are trying to increase the dataset of more patients of different age groups.

REFERENCES:

1. Nidhi, P. Kumari, "Brain Tumor and Edema Detection Using Matlab", International Journal of Computer Engineering and Technology (IJCET), ISSN 0976 - 6375(Online), Issue 3,Volume 5, , March (2014), pp.122-131.
2. L. Guo, L. Zhao, Y. Wu, Y. Li, G. Xu, and Q. Yan, "Tumor detection in MR images using one-class immune feature weighted SVMs," IEEE Transactions on Magnetics, 3849–3852, 2011,vol. 47, no. 10, pp.
3. R.Kumari, "SVM classification an approach on detecting abnormality in brain MRI images, ISSN 1686–1690, 2013."International Journal of Engineering Research and Applications, vol. 3, pp.
4. S. Damodharan and D. Raghavan, "Combining tissue segmentation and neural network for brain tumor detection," International Arab Journal of Information Technology, , pp.42–52, 2015, vol. 12, no. 1.
5. Q. Ain, M. A. Jaffar, and T.-S. Choi, "Fuzzy anisotropic diffusion based segmentation and texture based ensemble classification of brain tumor," vol. 21, pp. 330–340, 2014.Applied Soft Computing Journal.
6. E. A. Zanaty, vol. 45,pp. 16–22, 2012. "Determination of gray matter (GM) and white matter (WM) volume in brain magnetic resonance images (MRI)," International Journal of Computer Applications,
7. Y. Kong, Y. Deng, and Q. Dai, "Discriminative clustering and feature selection for brain MRI segmentation," vol. 22, no. 5, pp. 573–577, 2015,IEEE Signal Processing Letters.
8. A. Demirhan, I. Guler and M. Toru,, "Segmentation of tumor and edema along with healthy tissues of brain using wavelets and neural networks," IEEE Journal of Biomedical and Health Informatics, pp. 1451–1458, 2015, vol. 19, no. 4.
9. W. Cui, Y. Wang, Y. Fan, Y. Feng, and T. Lei, "Localized FCM clustering with spatial information for medical image segmentation and bias field estimation," International Journal of Biomedical Imaging, vol. 2013, 8 pages, 2013, Article ID 930301.
10. V. K. Dehariya, S. K. Shrivastava, R. C. Jain,"Clustering of Image Data Set Using K-Means and Fuzzy K-Means Algorithms", , pp. 386-391, 2010, International conference on CICN.
11. D. L. Pham, C. Y. Xu, J. L. Prince, A Survey of Current Methods in Medical Image Segmentation, In Annual Review of Biomedical Engineer,
12. Chen W, Smith R, Nabizadeh N, Ward K, Cockrell C, Ha J, et al. Texture analysis of brain CT scans for ICP prediction, in image and signal processing. p. 568–75.(2000),Berlin Heidelberg: Springer-Verlag; 2010.

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication