Brain Tumor segmentation and classification using Fcm and support vector machine

Gaurav Gupta[1], Vinay singh[2]

[1]PG student,M.Tech Electronics and Communication,Department of Electronics, Galgotia College of Engineering and Technology, Greater Noida

[2]Asst. Professor, Department of Electronics, Galgotia College of Engineering and Technology, Greater Noida

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Abstract -_MRI is the most important technique, in detecting the brain tumor. In this paper data mining methods are used for classification of MRI images. A new hybrid technique based on the support vector machine (SVM) and fuzzy c-means for brain tumor classification is proposed. The purposed algorithm is a combination of support vector machine (SVM) and fuzzy c-means, a hybrid technique for prediction of brain tumor. In this algorithm, the image is enhanced using enhancement techniques such as contrast improvement, and mid-range stretch. Double thresholding and morphological operations are used for skull striping. Fuzzy c-means (FCM) clustering is used for the segmentation of the image to detect the suspicious region in brain MRI image. Grey level run length matrix (GLRLM) is used for extraction of feature from the brain image, after which SVM technique is applied to classify the brain MRI images, which provide accurate and more effective result for classification of brain MRI images._

Key Words**:** Brain tumour, clustering, GLRLM, SVM

1.INTRODUCTION

Data mining may well be a straight forward and robust tool to extract the data from massive dataset [1]. Classification is a branch of data mining field. During this field, many classification techniques are available for medical footage like artificial neural network (ANN), fuzzy c-means (FCM), support vector machine (SVM), decision tree and Bayesian classification. Variety of researchers has been implement the classification techniques for medical footage classification. Presently many medical imaging techniques like (PET), x-ray, CAT (CT), resonance imaging (MRI), for tumor detection but MRI imaging technique is the smart owing to higher resolution and most researchers have used MRI imaging for designation tumor. During this paper, the MRI images were high during contrast improvement and Mid-Range Stretch techniques. Once the image was improved, segmentation step is usually done simply. Segmentation is a technique to extract suspicious area from footage. In this paper, Segmentation technique was done by Fuzzy C-Mean (FCM) agglomeration [2].
Before applying FCM agglomeration technique, skull masking has been done. Feature extraction means that to

induce the information of image. The strategy uses gray Level Run Length Matrix (GLRLM) to extract feature [3]. The reduced GLRLM qualities are outline to support vector machine for coaching and testing. The brain MRI images were differentiating using SVM techniques which widely used for information analyzing and pattern recognizing. It creates a hyper plane in between information sets to point that category it belongs to [4]. The foremost objective of this work is to develop a hybrid technique, which could classify the brain MRI images successfully and efficiently via Fuzzy C- implies that and support vector machine (SVM). This work is a cheap classification technique is to observe the tumor in MRI images.

2. Related Work

Support vector machines were applied in many researches which are given in [4-6]. H. B. Nandpuru, Dr. S. S. Salankar and educational. V. R. Bora, worked on magnetic resonance imaging brain cancer classification using support vector machine. Support Vector Machines (SVM) was enforced to brain image classification. In this paper feature extraction from brain magnetic resonance imaging images were administrated by gray scale, symmetrical and texture feature. They achieved smart result [4]. A. Padma and R. Sukanesh, their study on SVM depend Classification of lenient Tissues in Brain CT image using wavelet based Dominant Gray Level Run Length Texture feature. they have stressed on the technique of medical CT imaging as one of the widely applied and reliable technique used for the detection and site of pathological changes efficiently, using SVM. They obtained 98 percentage accuracy [5]. S.H.S.A. Ubaidillah, R. Sallehuddin and N.A. Ali, worked on cancer found exploitation artificial neural network and support vector machine: A Comparative study. Throughout this paper, they matched the performance on four completely different cancer datasets exploitation SVM and ANN classifiers. During this study, the ANN classifier gated sensible classification performance on the datasets that have huge amount of input options (prostate and gonad cancer datasets) SVM con together given sensible performance on datasets with smaller amount of input feature (breast cancer and liver cancer), But finally SVM classifier provided higher result for growth [6].

3. METHODOLOGY

The recommended methodology contains of a collection of phases begging from grouping brain picture MRI image. The main steps are shown in Figure 1. This hybrid technique includes the following main steps like enhancement, Skull striping, segmentation, feature extraction and training the SVM classifier using MRI image with GLRLM feature, saving the information and testing. All the above said steps area unit concerned in testing part, exploitation the new magnetic resonance imaging images with GLRLM feature to SVM and brain MRI pictures are classified. This study used dataset of 120 patients MRI brain pictures and classified them as simple and abnormal. The picture is processed through:

- Image Reading
- MRI images Enhancement
- Striping of Skull step
- Segmentation using Fuzzy c-means
- Feature Extraction
- Support Vector Machine Classifier

3.1 Image Reading

Brain MRI images were gathered totally different medical centers. These brain MRI pictures were converting into 2D matrices.
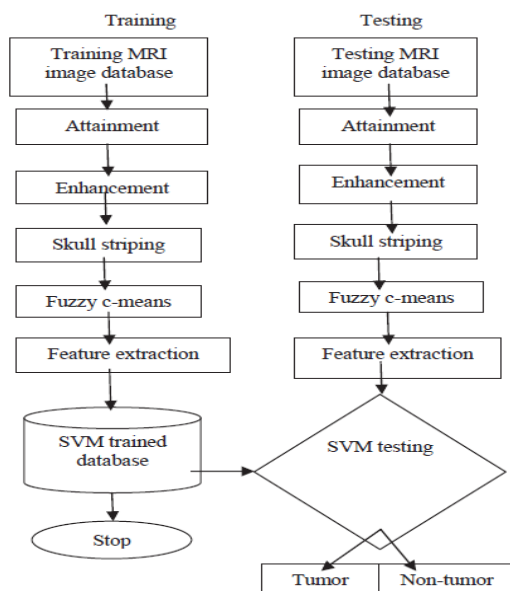

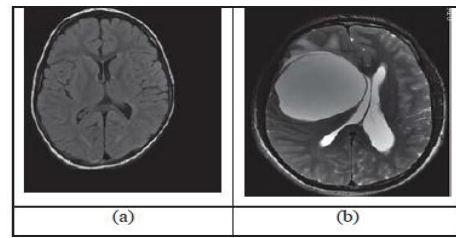**Fig-1**: Proposed classification system.

Fig-2: (a) Non-tumor MRI image (b) Tumor MRI image

3.2 MRI images Enhancement

The qualities of pictures are unit improved using improvement method. It's important to improve the picture information for human viewers, so that right outcomes are gained. The ways given below that are used for improvement of brain MRI image. the 1st step is improving of MRI. Here only the brightness of the photographs was increased to enhance perceptibility. This was done to improve the quality level of the brain MRI images.

- Contrast improvement- MRI images are RGB pictures, which are converting into grey scale pictures. These grey scale images are known as strength pictures. Here intensity values are mapped into less and high intensity values using imadjust (MATLAB function).

- Mid-range Stretch- this is also an addition a technique. In this technique, the center range MRI image intensity values are stretched. So, it improves the standard of brain MRI pictures. During this technique, grey scale image pixels are mapped between 0 and 1value by dividing 255 intensity values as shown in (4).

$$x_{ij} = \frac{Image_i}{255} \qquad (4)$$

Here I for row index of brain image matrix and j for column. To compute the function f(x) on the X matrix obtained from (4). The function f(x) is defined as follows.

$$f(x_{ij}) = \begin{cases} 0.5 * x_{ij} & , x_{ij} < 0.1 \\ 0.1 + 1.5 * (x_{ij} - 0.1) & , 0.1 \leq x_{ij} \ and \ x_{ij} \leq 0.88 \\ 1 + 0.5 * (x_{ij} - 1) x_{ij} > 0.88 \end{cases}$$

(5)

Subsequently applying the above function f (xij) the gray-scale images are converted to indexed images. The output images gained after applying all the method are done to enhance the quality of images.
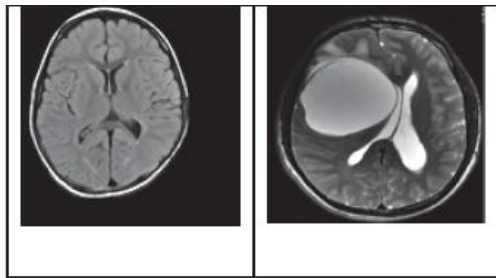
Fig-3: (a) Enhanced Non-tumor image (b) Enhanced Tumor image

3.3 Stripping of Skull step

Skull stripping is a remarkable step. The steps involved in skull stripping are given below.

• Double thresholding- it is a segmentation technique. This method, convert the image into binary form, that is gray scale image to binary image. This method creates the mask by setting each pixel in the range of [0.1*255-0.88*255] to 1 means white and remaining pixels to zero means black. Non-brain tissues pixels were discarded in MRI picture. Here 2000 upper and lower are considered so it is known as double thresholding technique [7].

• Erosion- in these level unwanted pixels are cut from MRI image after thresholding. Thus, the skull areas are removed. Here disk of radius 3 was taken as a structuring element for removing all unwanted pixels which are helping to the brain MRI images.

• Region filling- this technique is implement to pour the holes in the images. After the erosion, eroded images are filled using region filling algorithm. Here the related background pixels are converted into foreground pixels so that the holes present in the eroded images are removed in brain MRI image.
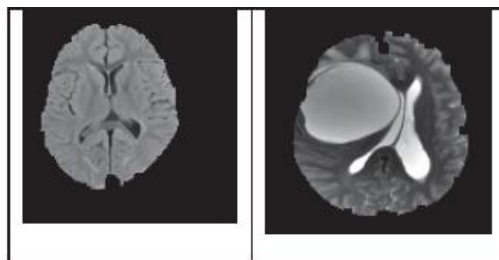
Fig-4: (a) Skull masking Non-tumor image (b) Skull masking Tumor image

3.4 Segmentation using Fuzzy C-Means

Segmentation is the method of separating an image into multiple part and object area. The skull stripes images are used in image segmentation. This delivers good result for tumor segmentation. In this work, fuzzy c-means algorithm was used in MRI image segmentation. Fuzzy C-Means (FCM) algorithm is used to find out the suspicious area from brain MRI image. This fuzzy c-means clustering method provides good segmentation result.
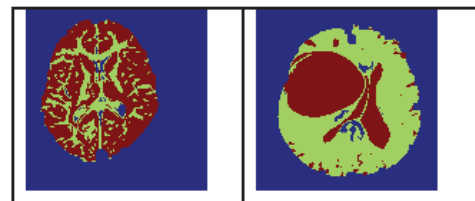
Fig-5: fuzzy c-mean algorithm

3.5 Feature extraction

Feature extraction is a method to search the related features from picture, which are used to understand the picture easily. This input data group picture is transformed into compressed form is called feature extraction. It can reduce the work for further processing such as picture classification. Here the GLRLM feature extraction method is used. GLRLM is used after the fuzzy c-means algorithm. Derive the gray level run length matrix (GLRLM) for second level maximum frequency sub bands of the discrete wavelet decomposed picture with 1one for distance and 0,45,90 and 135 degrees [8]. Here feature extraction is isolating the related features which lead to understand the brain MRI images well.

3.6 Support Vector Machine classifier

SVM is a supervised learning technique. It is a better tool for data analysis and classification. SVM classifier has a 1st learning speed even in huge data. SVM is used for two or more class classification issue. Support Vector Machine is depending on the conception of decision planes. A decision plane is one that differentiates between a set of items having different class memberships. The Classification and detection of brain tumor was completed by using the Support Vector Machine technique. Classification is completed to identify the tumor class present in the image. The use of SVM involves two basic steps of training and testing. In the SVM the classes are assumed to be identified as +-1, and the decision boundary is estimate as $y=0$. So, using the equation:
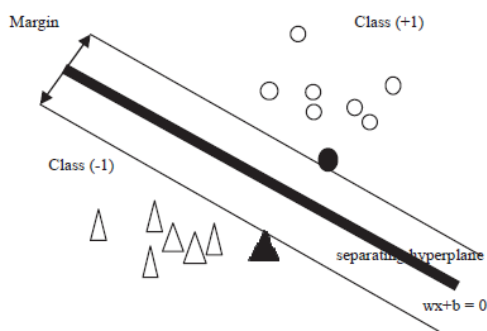
w is the weight vector, b the offset. Since the classes are defined as +-1 the equation for the line dividing the classes will be:

$$x_i w + b \geq 1 \; when \; y = +1$$
$$x_i w + b \geq 1 \; when \; y = -1$$

The distance from the hyper-plan ($x_i \, w + b = 0$) to the origin is $\frac{-b}{||w||}$, where || w || is the norm of w. The distance from the hyper-plane to the origin is: $M = \frac{2}{||W||}$

Where M is the margin. So, the maximum margin is obtained by minimizing $||W||$.

Fig-6: SVM classification (the separating margin between the two classes)

Classification is the process where a given test sample is assigned a class by the classifier during training. We have used the SVM classifier [9].

    1. Performance measures

Classification, the sensitivity, specificity and accuracy were calculated using below formulas:

    • True Positive (TP): Abnormal brain correctly identified as abnormal.

    • True Negative (TN): Normal brain correctly identified as normal.

    • False Positive (FP): Normal brain incorrectly identified as abnormal.

    • False Negative (FN): Abnormal brain incorrectly identified as normal.

    1) Sensitivity = TP/ (TP+FN) *100%

    2) Specificity = TN/ (TN+FP) * 100%

    3) Accuracy = (TP+ TN)/ (TP+ TN+FP+FN) * 100%

All these three parameters are used to check the classifiers performance.

4. RESULTS

In this paper, SVM technique with fuzzy c-means is used for segmentation and classification of brain MRI images. Real data set of 124 MRI brain images has been used to detect 'tumor' and 'non-tumor' MRI images. The soft tissues in brain MRI images are segmented with Double

Thresholding, Morphological operations and fuzzy c-means algorithm for clustering and gray level run length matrix for feature extraction. The SVM classifier is trained using 100 brain MRI images, after that the remaining 24 brain MRI images was used for testing the trained SVM. The result for classification provides accurate for large data sets.

Table 1: SVM Classification results

Sr. No.	Kernel function	Specificity	Sensitivity	Accuracy
1	Linear	100%	88.45%	91.77%
2	RBF	100%	87.36%	90.01%

5. CONCLUSIONS

In this proposed system brain MRI methods verified to be a significant way to find the brain tumor. The hybrid methodology of gathering support vector machine and fuzzy c-means clustering for classification gives precise result for identifying the brain tumor. For future work, to get better accuracy rate and less error rate a hybrid SVM algorithm is to be proposed. In future work, different data mining techniques can be used to train using different kernel functions in order to improve the performance of the classifiers and the data sets can also be increased.

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