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Advancement of Brain Tumor Detection Using SOM-Clustering and Proximal Support Vector Machine

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ABSTRACT: In recent days, image processing is an interesting research field and mainly the medical image processing is increasingly challenging field to process various medical image types. In this paper we have find out advanced technique for detection of brain tumor using SOM-clustering for image segmentation & PSVM is used to automatically detect the tumor from MRI brain image the result is compared with existing a hybrid technique based on the support vector machine (SVM) and fuzzy c-means. The result shows the accuracy comparison result of existing SVM and proposed PSVM algorithm, it is well known that the proposed system works better than existing SVM system with the high accuracy, high precision rate, and high recall rate as it has less execution time than the SVM algorithm.

KEYWORDS: SVM; PSVM; Fuzzy c-means; MRI; image processing;.

I.INTRODUCTION

The brain and spinal cord together form the central nervous system (CNS). The CNS is the core of our existence. It controls our personality, thoughts, memory, intelligence, speech and understanding, emotions, senses, and basic body functions. Current research shows that the symptoms associated with depression are common in people with brain tumors. In cases where a brain tumor is suspected, a number of tests may be done to help doctor reach a brain tumor diagnosis. Scans generate images of brain for purpose of diagnosing tumors. The most common scans for diagnosis are magnetic resonance imaging (MRI). In disease diagnosis, the high resolution and non-invasive MR images have a vital control thus the image segmentation has more importance. The segmentation process used to detach the soft brain tissues like White Matter (WM), Gray Matter (GM) and Cerebral Spinal Fluid (CSF) etc in the form of neuroanatomical structures surrounded by the medical images and these regions are considered as pathological tissues. Segmentation is a technique to extract suspicious region from images. In this paper Segmentation technique was done by Fuzzy C-Mean (FCM) clustering [2]. Before applying FCM clustering technique, skull stripping has been done. Feature extraction means to obtain the information of image. The method uses Gray Level Run Length Matrix (GLRLM) to extract features [3]. The reduced GLRLM features are deferred to support vector machine for training and testing. The brain MRI images were classified using SVM techniques. This method is compared with advanced method in which for segmentation SOM-Clustering and classifying Proximal Support Vector Machine (PSVM). In which Clustering techniques executes as a main role in image segmentation field. SOM [4, 5] is a clustering technique which is used for unsupervised segmentation of MR brain images. SOM maps high dimensional data to a low dimensional discrete lattice of neurons. The proposed work consists of two phase for effective MR image segmentation and classification. The First phase utilizes the information from the volume image histogram to construct feature vectors which is to be classified using SOM. MRI image is segmented by using SOM clustering which uses each SOM unit as a cluster. The Second phase takes the input as segmented images and computes feature extraction using GLCM. PSVM are trained by using vectors as an input which comprises the selected features. The SVM also presented good performance on datasets with smaller amount of input features (breast cancer and liver cancer), but finally PSVM classifier provided better result for tumor.

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II.SYSTEM MODEL AND ASSUMPTIONS

The existing methodology consists of a set of stages starting from collecting brain MRI images. The main steps are shown in Figure 1. This hybrid technique involves the following main steps such as enhancement, skull stripping, segmentation, feature extraction and training the SVM classifier using MRI images with GLRLM features, storing the database and testing. All the above said steps are involved in testing phase, using the new MRI images with GLRLM features to SVM and brain MRI images are classified. This study used dataset of 120 patients MRI brain images and classified them as normal and abnormal. The image is processed through:

- Attainment of images
- Enhancement of MRI images
- Skull stripping
- Fuzzy c-means
- Feature Extraction
- SVM Classifier

In Attainment of images Brain MRI images were collected from different medical centers. These brain MRI images were converted into two dimensional matrices using MATLAB (R2013a). The qualities of images are improved using enhancement technique. It is essential to improve the image information for human viewers, so that accurate outcomes are achieved. The first step is enhancement of MRI. Here only the brightness of the images was increased to enhance perceptibility. This was complete to improve the quality of the brain MRI images

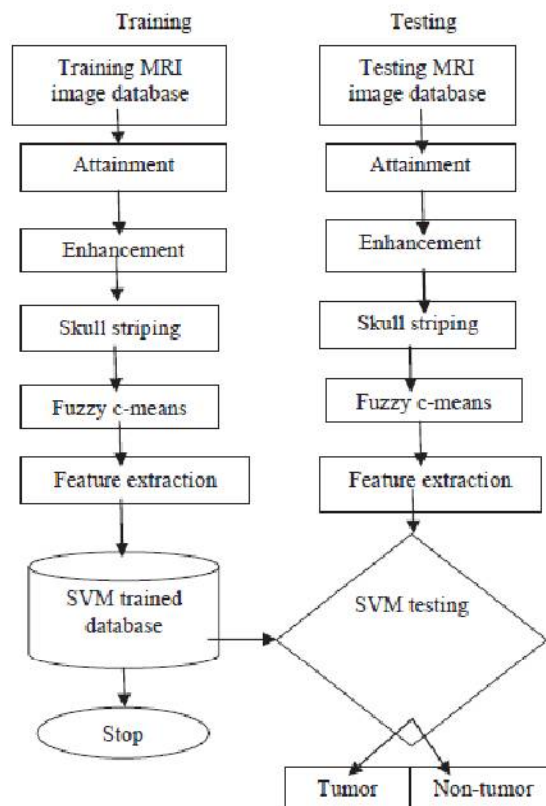


Fig.1. Existing Classification System

- Contrast improvement- MRI images are RGB images, which are converted into gray scale images. These gray scale images are called intensity images. Here intensity values are mapped into low and high intensity values using `imadjust` (MATLAB function).

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- Mid-range Stretch- this is also an enhancement technique. In this method, the middle range MRI image intensity values are stretched. So it improves the quality of brain MRI images. In this technique, gray scale image pixels are mapped between 0 and 1 value by dividing 255 intensity values as shown in(4).

$$X_{ij} = \text{Image}_i / 255 \quad (4)$$

Here i for row index of brain image matrix and j for column.

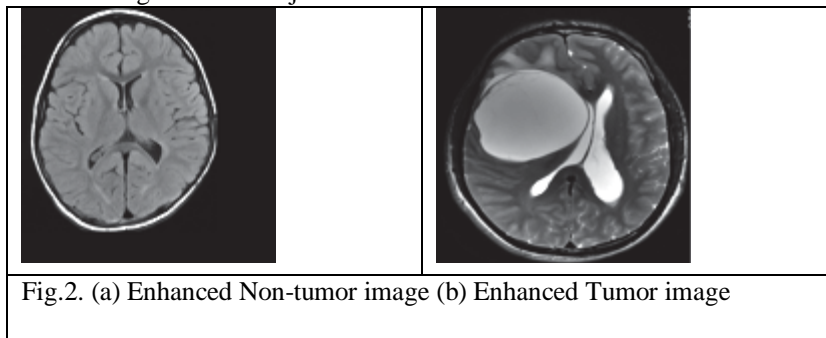


Fig.2. (a) Enhanced Non-tumor image (b) Enhanced Tumor image

In Skull stripping is a significant step. The steps involved are

- Double thresholding- it is a segmentation technique. This technique, convert the image into binary form, that is gray scale image to binary image. This technique generate the mask by setting each pixel in the range of $0.1 * 255 - 0.88 * 255$ to 1 means white and remaining pixels to 0 means black. [7].
- Erosion- in this stage unwanted pixels are removed from MRI image after thresholding. Thus the skull portions are removed. Here disk of radius 3 was taken as a structuring element for removing all unwanted pixels which are contributing to the brain MRI images.

In Fuzzy C-Means

Segmentation is the technique of separating an image into multiple slices and object region. The skull stripes images are used in image segmentation. The fuzzy c-means clustering algorithm was used in MRI image segmentation. Fuzzy C-Means (FCM) algorithm is used to find out the suspicious region from brain MRI image. Feature extraction is a technique to find the relevant features from images, which are used to understand the images easier. Here the GLRLM feature extraction technique is used. GLRLM is used after the fuzzy c-means algorithm. Here feature extraction is isolating the relevant features which lead to understand the brain MRI images well.

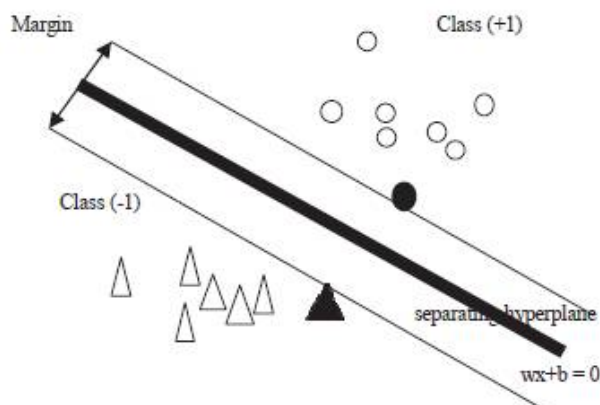


Fig.3. SVM classification (the separating margin between the two classes)

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 different class memberships. The Classification and detection of brain tumor was done by using the Support Vector Machine

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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.

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:

$$y = \sum_{i=1}^N w_i + x_i + b$$

Where x_i is the input patterns, 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:

$$x_i w + b \geq 1 \text{ when } y = +1$$

$$x_i w + b \leq -1 \text{ when } y = -1$$

The distance from the hyper-plan ($x_i + b = 0$) 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 .

II. ADVANCED SOM CLUSTERING AND PSVM SYSTEM

In Advanced Brain tumor detection system following operations performed,

A. Image preprocessing

As soon as MR image has been acquired, a pre-processing is performed to remove noise and clean-up the image background. Several algorithms have been constructed for the purpose of Brain tissue extraction from the undesired structure such as Brain Surface Extractor (BSE), Brain Extraction tool (BET), Minneapolis Consensus Strip (McStrip) or Hybrid Watershed Algorithm (HWA) [9]. These structures are already removed from the ISBR 1.0 database. However, images are provided by IBSR 2.0 which is distributed without the scalp/skull already removed. In the latter database, the brain has been extracted in the pre-processing stage using BET.

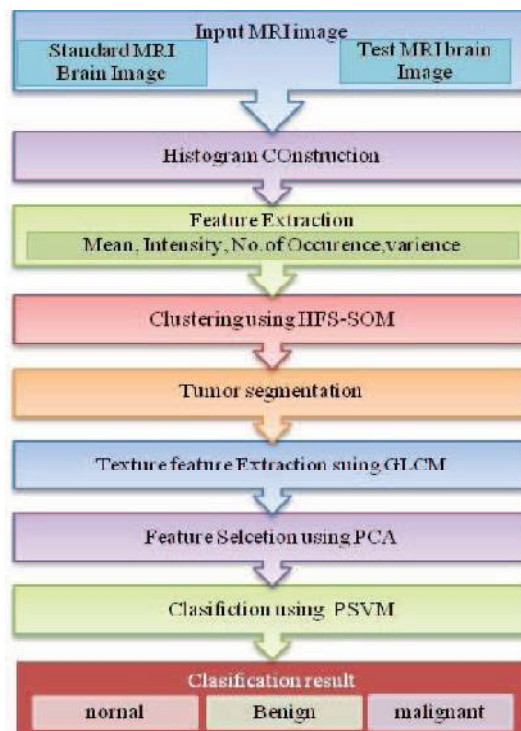


Fig.4. Advanced System with SOM clustering & PSVM classifier



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In order to remove background noise uses a binary mask that built by detecting the greatest contiguous object in the image. After multiplying the binary mask (which contains 0 at the background voxels and 1 otherwise) by the original image, gets the background in black.

B. An Automated MRI Brain Image Segmentation

i) Histogram Equalization for Feature Extraction

Histogram equalization technique is used to increase the dynamic range of the histogram of an image. This technique [10] assigns the input image with their intensity values of pixels. In such a way, there is uniform distribution of intensities in the output image. This improves the contrast of an image. It is known that the good feature set will increase the classification accuracy result and it is very difficult too. As the tissues exists in brain are tedious to classify using only shape features or texture features or shape which defines the intensity level of information. Most of the works done in this area is utilized only the texture features or the shape and texture combination feature for MRI brain classification. By considering this fact and to improve the performance of the system color, texture and shape features which have been extracted in this work and considered for diagnosis. To achieve this goal Mean, intensity, number of occurrences and variance values are calculated to each MRI brain images.

ii) Clustering using SOM

The first step in the system is presented for isolating the tumor from the image. Since the tumor appears dark on the image, the detection of the edge of the tumor becomes confusing. Histogram Equalization is used to overcome this problem. The fast volume segmentation algorithm (HFSSOM) method is used for effective segmentation of brain image. The method is based on image histogram and the features are generated from the computed histogram. Tumor regions are effectively segmented by SOM clustering algorithms and thus the tumor portion from MRI image is detected.

C. An Automated MRI Brain Image Classification for Tumor Detection

i) Feature Extraction

In this module, Texture feature is defined by using Gray Level Co-occurrence Matrix (GLCM) [11]. Grayscale image from the segmentation phase is obtained from the color image, and then the image co-occurrence matrix is generated. As already known the features are the unique characteristics of in an image or object. To extract these features, various feature extraction techniques is proposed in such a way that the within-class similarity is maximized and between-class similarity is minimized. In this work, the GLCM feature extraction is utilized. The work involves extraction of the important features for brain tumor recognition. The features extracted gives the property of the texture, and are stored in knowledge base and further compared with the features of unknown sample image for classification. Thus, texture features are used to distinguish between normal and abnormal brain tumors. The important texture features are Autocorrelation, Contrast, Correlation, Cluster Prominence, Cluster shade, Dissimilarity, Energy, Entropy, Homogeneity, Maximum probability, Sum of squares, Sum average, Sum variance, Sum entropy, Difference variance, Difference entropy, Information measure of correlation, Inverse difference moment.

ii) Feature Reduction using PCA

In feature reduction stage, which have been applied Principal Component Analysis (PCA) in order to reduce dimensionality of data to get most favorable features from entire data set [4]. PCA converts input feature space to high dimensional feature space wherever they are linearly distinguishable. The reduced Principal Components are then sorted in ascending order. The reduced matrix of PCA features has been arranged as in (1);

$$PC1 \geq PC2 \geq PC3 \dots \dots PCL \quad (5)$$

PCA features have selected first L columns of matrix M. Although, we have chosen first few columns of PCA reduced feature that have high variations. Where L is the number of columns in above equation. Detail of PCA method is given in [12]. Finally, PSVM classification is performed to identify brain tumor.

III. EXPERIMENTAL RESULTS AND DISCUSSIONS

In this section the classification for normal and abnormal detection with segmentation results are discussed with real MRI brain images from IBSR database. The proposed method is implemented in MATLAB language. Image preprocessing followed by segmentation using SOM clustering produces an effective result than the manual

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segmentation and other existing clustering methods such as K-means, FCM etc. The segmentation result for MRI brain image is shown in Fig.5.

A. 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.

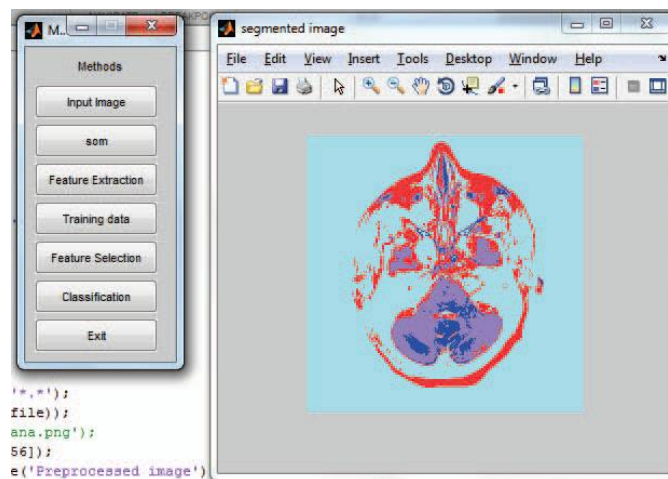


Fig.5. Result Analysis of tumor detection

The overall accuracy percentage details are shown in fig 6.

And the comparative analysis is shown in Table 1.

Technique	Accuracy%
SVM- Fuzzy C-means	91.66
SVM- HFS-SOM	92
SVM- HFS-SOM-GLCM-PCA	94
PSVM- HFS-SOM-GLCM-PCA	97

The accuracy comparison result of existing SVM and proposed PSVM algorithm. From the Fig.7, it is well known that the proposed system works better than existing SVM system with the high accuracy result of 92%.

The values are tabulated in Table.2.

Technique	Accuracy%
SVM	82
PSVM	92

The proposed system has high precision rate of 0.93 which is 0.9 higher than the existing SVM algorithm. The reason is that the proposed system has less computational complexity than the SVM algorithm. The values are tabulated in Table.3.



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Technique	Precision Rate
SVM	0.82
PSVM	0.93

The proposed system has high recall rate as it has less execution time than the SVM algorithm. The values are tabulated in Table.4.

Technique	Recall Rate
SVM	0.82
PSVM	0.94

IV. CONCLUSION

In this proposed work, effective segmentation and classification is proposed using HFS-SOM and PSVM. After segmentation, the resultant image is given as input to the PSVM classifier followed by feature extraction and selection using GLCM-PCA. At the training phase of PSVM, the texture features are utilized which can reduce the computation complexity of PSVM classifier. The experimental result shows that the proposed system shows a high accuracy rate and less error rate. The proposed system is highly effective for classification to classify normal or abnormal brain with high sensitivity, specificity and accuracy rate.

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. In future the system can be improved to support other types of cancer images with few modification either in segmentation and classification stage.

REFERENCES

- [1] Prakash Mahindrakar and Dr. M. Hanumanthappa, "Data Mining In Healthcare: A Survey of Techniques and Algorithms with Its Limitations and Challenges", Int. Journal of Engineering Research and Applications, ISSN : 2248-9622, Vol. 3, Issue 6, Nov-Dec 2013, pp.937-941.
- [2] Kailash Sinha, G.R.Sinha, "Efficient Segmentation Methods for Tumor Detection in MRI Images", 2014 IEEE Student's Conference on Electrical, Electronics and Computer Science, 978-1-4799-2526- 1/14/\$31.00 ©2014 IEEE
- [3] R.S.RajKumar and G.Niranjana, "Image Segmentation and Classification of MRI Brain Tumor Based on Cellular Automata and Neural Networks", IJREAT International Journal of Research in Engineering & Advanced Technology, Volume 1, Issue 1, March, 2013 ISSN: 2320 – 8791.
- [4] Parveen, Amritpal singh, "Detection of Brain Tumor in MRI Images, using Combination of Fuzzy C-Means and SVM" 2nd International Conference on Signal Processing and Integrated Networks (SPIN), India, 2015
- [5] K.B.Vaishnavee, K.Amshakala, "An Automated MRI Brain Image Segmentation and Tumor Detection using SOM-Clustering and Proximal Support Vector Machine Classifier" IEEE International Conference on Engineering and Technology (ICETECH), 20th March 2015, Coimbatore, TN, India.
- [6] J. C. Bezdek, (1981), "Pattern Recognition with Fuzzy Objective Function Algorithms", Plenum Press, New York T. Kohonen, Selforganizing maps, Springer, 2001.
- [7] T. Logeswari, M. Karnan, Hybrid self-organizing map for improved implementation of brain MRI segmentation, in: International Conference on Signal Acquisition and Processing, 2010.
- [8] Jian, Y. U. "Texture Image Segmentation Based on Gaussian Mixture Models and Gray Level Co-occurrence Matrix." In Information Science and Engineering (ISISE), 2010 International Symposium on, pp. 149- 152. IEEE, 2010.
- [9] Mubashir Ahmad, Mahmood ul-Hassan, Imran Shafi, Abdelrahman Osman, Classification of Tumors in Human Brain MRI using Wavelet and Support Vector Machine, IOSR Journal of Computer Engineering (IOSRJCE), Volume 8, Issue 2 (Nov. - Dec. 2012), PP 25-31
- [10] Fung, Glenn, and Olvi L. Mangasarian. "Proximal support vector machine classifiers." In Proceedings of the seventh ACM SIGKDD international conference on Knowledge discovery and data mining, pp. 77-86. ACM, 2001.
- [11] O.P. Verma, M. Hammandlu, S. Susan, M. Kulkarni and P.K. Jain, "A simple single seeded region growing algorithm for color image segmentation using adaptive thresholding," 2011 International Conference on Communication Systems and Network Technologies, ©2011 IEEE.
- [12] G.V. Kumar and Dr G.V. Raju, "Biological early brain cancer detection using artificial neural network", International Journal on Computer Science and Engineering Vol. 02, No. 08, 2010, 2721-2725.
- [13] B. Gupta and S. Tiwari, "Brain Tumor Detection using Curvelet Transform and Support Vector Machine", International Journal of Computer Science and Mobile Computing, Vol.3 Issue.4, April- 2014, pg. 1259-1264, ISSN 2320-088X.