# Advancement of Brain Tumor Detection Using SOM-Clustering and PSVM

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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-clustring 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 result increased by proposed PSVM algorithm, it is well known that the proposed system works better with the high accuracy, high precision rate, and high recall rate as it has less execution time than the SVM algorithm.**

***Keywords*—SVM; PSVM; SOM-Clustring; MRI; image processing;**

## I. INTRODUCTION (*HEADING 1*)

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. Segmentation is a technique to extract suspicious region from images. This method is an 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.

## II. ADVANCED SOM CLUSTRING AND PSVM SYSTEM

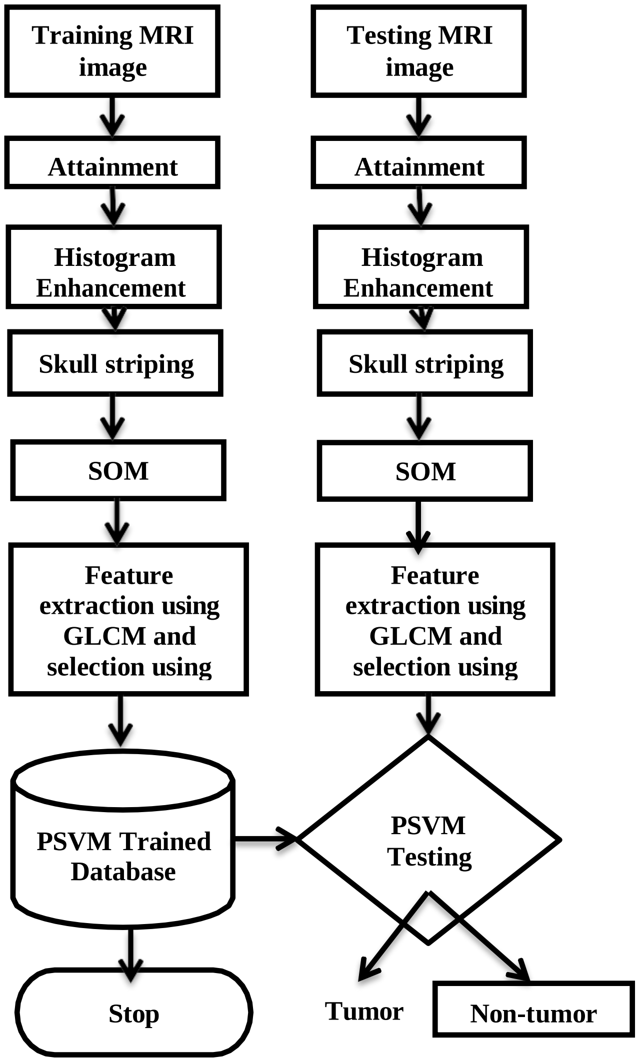

*Fig.1 Advanced System with SOM clustering & PSVM classifier*

*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. 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 bran 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 [12]. 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);

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

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 segmentation and other existing clustering methods such as K-means, FCM etc. The segmentation result for MRI brain image is shown in Fig.2.

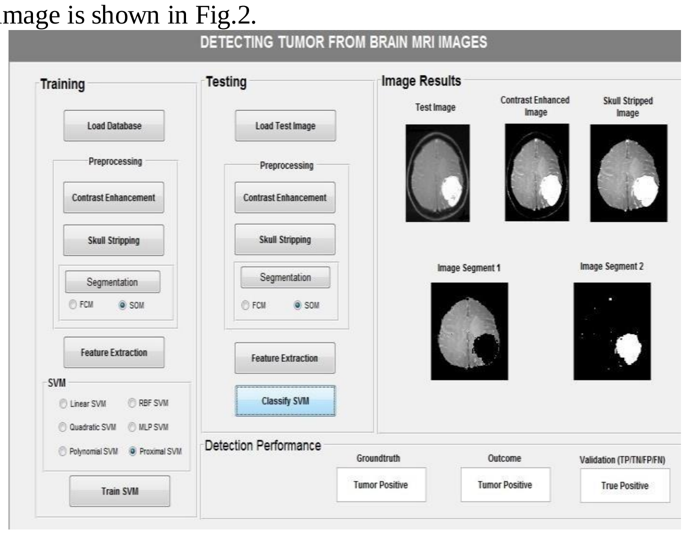


Fig.2 Result Analysis of tumor detection

*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.

The overall accuracy percentage details are shown in fig 6. And the comparative analysis is shown in Table 1.

TABLE I. Accuracy Results Comparison With Other Techniques

| | |
|---|---|
| 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.

Table II. Accuracy Result Comparison

| **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.

TABLE III. Precision Results Comparison

| **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.

TABLE IV. Recall Rate Comparison

| **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.

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