Brain Tumor Detection and Analysis using SVM and LVQ Classifier
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Abstract—Brain tumor is an abnormal and uncontrolled growth of tissues in human brain. Brain tumor diagnosis is very complex task. In biomedical field image processing is strongly growing issue. Many techniques and approaches has been described for image processing. This paper provides more efficient method to detect and analyze brain tumor. Proposed system gives efficient and more accurate quantitative results. Here in this method the steps are preprocessing, anisotropic diffusion, feature extraction, classification. Classifications used are support vector machine (SVM) and Learning vector quantization (LVQ). Here we are comparing these two classification, we get the LVQ classification which is special case of neural network gives more accuracy than the SVM classification.

Key words: Tumor, Classifier, Local Binary Pattern (LBP), Support Vector Machine (SVM), Learning Vector Quantization (LVQ)

I. INTRODUCTION

Imaging plays important role in brain tumor detection. Different techniques are used to take image of human brain. Magnetic Resonance Imaging (MRI) or Computer tomography (CT) scan is used to study the anatomy of brain. In this paper (MRI) images are used. Due to complex and variable structure it is difficult to locate the certain structure without detailed information about the brain. Brain-tumor MRI images are more comfortable than CT scan images. Brain tumor classified as benign and malignant. Benign type of tumor can be removed and these are not cancer cells. These types of tumors are having the constant size, there size will not increase or they not spread other surrounding parts of brain, but they can be threat to the life. Another type of brain tumor is the malignant. Its size will increase rapidly with the time that it consist of the cancer cells. Depend on the stages the doctors it grouped as the grade I, II, III and IV [1]. There were many algorithms were developed to diagnose brain tumor using image processing. This paper deals with support vector machine and learning vector quantization classification. Classification is the method for classifying objects into corresponding classes. This is the one of the effective method for the analysis of brain tumor.

II. PROPOSED SYSTEM

The proposed system model for brain tumor detection is illustrated in Fig.1. Method is mainly consists of two phases training and testing. In training phase the database will be created, which will store the features of the all images from the training set. The features determined in this method are GLCM features, LBP features, gray level based features and wavelet based features. The second phase is the testing phase, here we detect the given MRI brain image is normal or affected. The testing set of images which is different from the training set is selecting the image.

A. Preprocessing

Image preprocessing is applied to the source image to improve quality of image. It also included automatically cutting the background of images. During the digitization of brain images may be corrupted by noise, basically this step is applied to remove these noises. Noise is removed by filtering method, here we have used anisotropic diffusion filter which remove the noise and keep the original information unchanged. It performs well for noises like impulse or shot noise.

B. Feature Extraction

Feature extraction is done after the preprocessing. In this proposed method the features are extracted like GLCM, gray level based features, wavelet based features are extracted. 1) GLCM features

Gray level co-occurrence matrix (GLCM) is the way of extracting the texture features. GLCM is created by gray scale image. It is the matrix where the number of columns

Fig. 1: Process flow of proposed method

Fig. 2: MRI image: (a) Normal brain (b) Brain affected with tumor

Fig. 2(a) Fig. 2(b)
and rows indicates the number of gray levels. In statistical texture, features are computed from the statistical distribution of observed combinations of intensities at specified positions relative to each other. With respect to the pixels (intensity points) in each combination, statistics are classified as first order, second order and higher order [2]. In four directions we can use to calculate GLCM features that is 0, 45, 90 and 145 degrees. There are four properties of GLCM namely contrast, energy, homogeneity and correlation, and computed using following equations.

\[
\begin{align*}
\text{Contrast} &= \sum [(i - j)^2]p(i,j) \\
\text{Energy} &= \sum p(i, j)^2 \\
\text{Homogeneity} &= \sum \frac{p(i,j)}{1 + |i-j|} \\
\text{Correlation} &= \sum \frac{(i-\mu)(j-\mu)p(i,j)}{\sigma_i \sigma_j}
\end{align*}
\]

2) Local Binary Pattern
In various applications Local Binary Pattern (LBP) features have performed well. The LBP operator labels the pixels of an MRI image by thresholding neighboring pixels. Consider the 3x3 matrix, the central value considered as the threshold value.

3) Gray level based features
Gray level based features are the important features to detect the brain tumor, since the blood vessels are darker than their surroundings, features based on surroundings is good choice, set of gray level descriptors taking this account were derived from images, these features are determined using following equations.

\[
\begin{align*}
F_1(x,y) &= I_H(x,y) - \min\{I_H(s, t)\} \\
F_2(x,y) &= \max\{I_H(s, t)\} - I_H(x, y) \\
F_3(x,y) &= I_H(x,y) - \text{mean}\{I_H(s, t)\} \\
F_4(x,y) &= \text{std}\{I_H(s, t)\} \\
F_5(x,y) &= I_H(x, y)
\end{align*}
\]

4) Wavelet features
Wavelets are the powerful tool in image and signal processing. It is recently developed mathematical tool for many problems.

\[
\psi_{a,b}(t) = \frac{1}{\sqrt{a}} \psi\left(\frac{t - b}{a}\right)
\]

Where a is scaling parameters and b is the shifting parameters, one of the we apply Haar wavelet transform equation given as

\[
f(a^l d^l)
\]

Where L is decomposition level, a is the approximate sub band and d is the detail sub band. Here in proposed method first wavelet transform is applied for each row and column, of the image. The decomposition level is considered as LL, LH, HL and HH sub bands (L-low, H-high). The LL sub band contains the approximation values of the MRI image which can be further decomposed [3]. Fig. 6 shows decomposition pyramid and Fig. 7 shows the wavelet based feature images for level 1 and 2.

C. Classification
This paper concerns SVM and LVQ classification

1) SVM
Support vector machine (SVM) is a new, popular and easy to use for classification. Introduced by Vipnik in 1998. It is based on the structural minimization. Generalization of performance is the ability of the machine to predict the
output. Minimizing the risk could not get good result, the condition that the limited samples, generalization performance and accuracy are pair of contradiction. With complex machine we get smaller error but generalization performance will become lower. Support vectors are the data points that lie most closest to the hyperplane or decision surface. These are the critical elements of training phase. These data points are most difficult to classify. The basic concept behind this is to find hyper plane, which divides data separately into two classes.

2) LVQ
Learning vector quantization (LVQ) has been introduced by Kohonen, LVQ a is special case of Artificial Neural Networks (ANN). This type of algorithm is widely used because of easy implementation and clear learning process. It runs efficiently and gives good performance. LVQ is introduced as an algorithm that efficiently learns prototype position used for classification in various applications. As in neural networks there are three layers input layer, output layer and in between hidden layer. According to the given input hidden layer classify at the output.

III. RESULTS

In this method the features are extracted from the image. Based on the results we calculating some parameters using following equations,

Sensitivity = \[Se = \frac{Tpos}{Tpos + Fneg}\]
Specificity = \[Sp = \frac{Tneg}{Tneg + Fpos}\]
Accuracy = \[Acc = \frac{Tpos + Tneg}{Tpos + Tneg + Fneg + Fpos}\]

Where \(Tpos\) is the true positive, \(Tneg\) is the true negative, \(Fpos\) is false positive, \(Fneg\) is false negative. Sensitivity is the measure of positive also called as positive rate and specificity is the measure of negatives also called as negative rate. Sensitivity is complementary to the false negative, similarly specificity is complementary to the false positive. These parameters help to determine performance of the proposed classifications.

IV. COMPARISON OF RESULTS

Below table gives the comparison of the SVM and LVQ classification, which shows that the accuracy of LVQ is more compared to the SVM. The graph shows the respect to the result. For LVQ and SVM accuracy comparison is also shown in Table 1.

<table>
<thead>
<tr>
<th>Classifier</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>SVM</td>
<td>0.653846</td>
<td>0.75</td>
<td>86.67%</td>
</tr>
<tr>
<td>LVQ</td>
<td>0.62963</td>
<td>1</td>
<td>90%</td>
</tr>
</tbody>
</table>

Table 1: Comparison of results

V. SOFTWARE TOOLS USED

The entire work is implemented using MATLAB; MATLAB is Matrix Laboratory software, which has the powerful Image processing and mathematical tools.

VI. CONCLUSION

In this paper, a new approach for brain tumor detection and analysis using SVM and LVQ algorithm is proposed. It determines the MRI input image is healthy or tumor brain. The experimental results of SVM algorithm were compared with LVQ based algorithm, in this proposed method the accuracy of LVQ is more compared with SVM algorithm. The intention of this paper is to detect tumor and get more
accurate classification. The proposed work provide us one of the best method to detect and analyze the brain tumor.

REFERENCES


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