Review on MRI Brain Tumor Classification Using SVM Classifier

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***Abstract*— The field of medical imaging gains its importance with increase in the need of automated and efficient diagnosis in a short period of time. 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 modified fuzzy c-means for brain tumor classification is discussed. The purposed algorithm is a combination of support vector machine (SVM) and modified fuzzy c-means, a hybrid technique for prediction of brain tumor. In this algorithm the first stage is noise reduction using Median Filtering. Modified fuzzy c-means (FCM) clustering is used for the segmentation of the image to detect the suspicious region in brain MRI image. Texture based features such as GLCM(Gray Level Co-occurrence Matrix)features 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.**

Keywords— Data Mining, MRI, Modified Fuzzy C-means clustering, Gray level co-occurrence matrix (GLCM), Support Vector Machine (SVM).

I.INTRODUCTION

Data mining is a simple and robust tool to extract the information from large dataset [1]. Classification is a branch of data mining field. In this field many classification techniques are available for medical images such as artificial neural network (ANN), fuzzy c-means (FCM), support vector machine (SVM), decision tree and Bayesian classification. A number of researchers have been implemented the classification techniques for medical images classification. Presently many medical imaging techniques such as positron emission tomography (PET), x-ray, computed tomography (CT), magnetic resonance imaging (MRI), for tumor detection but MRI imaging technique is the good because of its higher resolution and most researchers have used MRI imaging for diagnosing tumor.

In this paper, we have to preprocess the given test image for reducing noise and to enhance the contrast. Then, we have to segment the brain image using modified fuzzy c-means algorithm to visually show the abnormalities such as tumor. Afterwards, texture features (GLCM) will be extracted from it. In feature extraction stage, statistical measurements are calculated from the gray level co-occurrence matrix for different directions and distances. Among the various features extracted. We have to select the distinct features that will be utilized for classification purpose. For the selection of features SFS (Sequential Forward Selection) is used. Support vector machine (SVM) is used to classify whether the test image comes under normal, benign and malignant.

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II. RELATED WORK

A researcher in the field of biomedical engineering not only needs to be familiar with the relevant applications of engineering in medicine but also with the basic life sciences [2].This interaction between the traditional engineering field and modern medicine is for us the motivation to tackle this paper. It is interesting to see how new techniques in the field of engineering can improve medical diagnosis and health care. Many techniques have been reported for clustering and classification of brain tumor in MR images. Clustering is one of the widely used segmentation technique. Fuzzy C-Means algorithm is mostly preferred due to its flexibility. But major o operational drawback is that it is time consuming [3]. A hierarchical FCM algorithm uses the concept of template matching proposed by Kwon and Han[4].But has drawback of requirement of accurate emplate.FCM is also implemented by parallel processing [4] but hardware implementation is not effective it will not achieve desired efficiency. Cheng and Goldgof [5] proposed the fast clustering algorithm based on random sampling. Fast fuzzy clustering for web documentation which is highly robust is proposed in [6] .Modified Fuzzy C-Means algorithm uses the technique of data compression for clustering [7].But has the drawback it is not able to specify the class of tumor. Many techniques have been reported for classification of brain tumors in MR images, most notably, support vector machine (SVM) [8] neural network [9], knowledge based techniques [10].Classification rate of Neural Network is lower than SVM [11].SVM is an very powerful method of obtaining model for classification [12].SVM provides a mechanism for choosing model structure in which it gives low generalizationrisk.SVM produces output which is combination of the training example projected on high dimensional feature space through the use of kernel space.

II. METHODOLOGY

The 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 preprocessing, segmentation, feature extraction and classifying MRI images using multi SVM classifier with GLCM features.

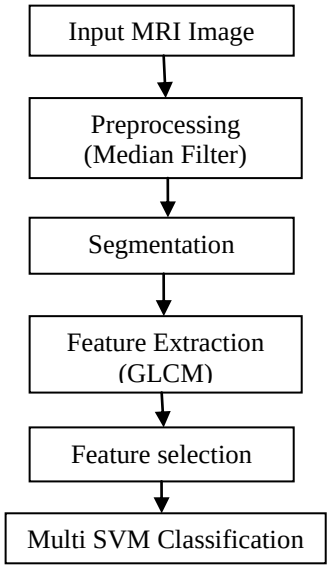

Figure 1: Classification system

The image is processed through:

- Preprocessing –Median Filter
- Segmentation – Modified Fuzzy C-means
- Feature Extraction – Gray level co-occurrence matrix (GLCM)
- Feature Selection – Sequential Forward Selection (SFS)
- Classification by SVM (Support Vector Machine)

A. Preprocessing –Median Filter :

In the median filtering operation, the pixel values in the neighborhood window are ranked according to intensity, and the middle value (the median) becomes the output value for the pixel under evaluation. Median filtering does not shift boundaries, as can happen with conventional smoothing filters. Since the median is less sensitive than the mean to extreme values (outliers), those extreme values are more effectively removed. Median filtering preserves the edges.

B. Segmentation-Modified C-means:

The modified FCM algorithm is based on the concept of data compression where the dimensionality of the input is highly reduced. The data compression includes two steps: quantization and aggregation. The quantization of the feature space is performed by masking the lower '*m' bits of the feature value. The* quantized output will result in the common intensity values for more than one feature vector. In the process of aggregation, feature vectors which share common intensity values are grouped together. A representative feature vector is chosen from each group and they are given as input for the conventional FCM algorithm. Once the clustering is complete, the representative feature vector membership values are distributed identically to all members of the quantization level.

C. Feature Extraction –Gray level co-occurrence matrix (GLCM):

A gray level co-occurrence matrix (GLCM) contains information about the positions of pixels having similar gray level values. Gray-level co-occurrence matrix (GLCM) is the statistical method of examining the textures that considers the spatial relationship of the pixels. The GLCM functions characterize the texture of an image by calculating how often pairs of pixel with specific values and in a specified spatial relationship occur in an image, creating a GLCM, and then extracting statistical measures from this matrix. The gray co-matrix function in MATLAB creates a gray-level co-occurrence matrix (GLCM) by calculating how often a pixel with the intensity (gray-level) value *i* occurs in a specific spatial relationship to a pixel with the value *j*.

D. Feature Selection – Sequential Forward Selection (SFS):

Feature selection algorithms are important to recognition and classification systems because, if a feature space with a large dimension is used, the performance of the classifier will decrease with respect to execution time and to recognition rate. Sequential Forward Selection is the simplest greedy search algorithm**.** Starting from the empty set, sequentially add the feature x^+ that results in the highest objective function $J(Yk+x^+)$ when combined with the features Yk that have already been selected.

E. Classification by SVM (Support Vector Machine):

Aim of SVM classifier is to group items that have similar feature values into groups. Classifier achieves this by making a classification decision based on the value of the linear combination of the features.

- Data setup: our dataset contains three classes as normal, benign (non-cancerous), malignant (cancerous) each N samples. The data is 2D plot original data for visual inspection.
- SVM with linear kernel (-t 0). We want to find the best parameter value C using 2-fold cross validation (meaning use 1/2 data to train, the other 1/2 to test).
- After finding the best parameter value for C, we train the entire data again using this parameter value.
- Plot support vectors.
- Plot decision area.

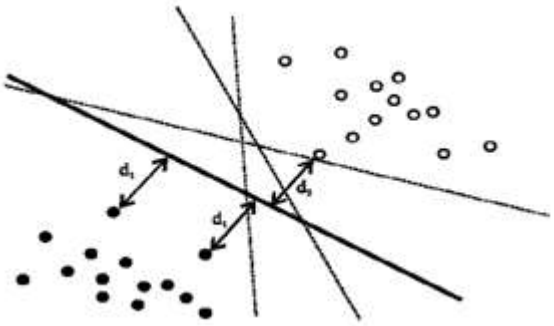

Figure 5. Support Vector Machine classifier

Expression for hyper plane: w.x+b = 0
Margin is d1+d2.
where x – Set of training vectors
w–vectors perpendicular to the separating hyper plane
b–offset parameter which allows the increase of the margin

A grouping of all the classes in two disjoints groups of classes. This grouping is then used to train a SVM classifier in the root node of the decision tree, using the samples of the first group as positive examples and the samples of the second group as negative examples. The classes from the first clustering group are being assigned to the first (left) subtree, while the classes of the second clustering group are being assigned to the (right) second subtree. The process continues recursively until there is only one class per group which defines a leaf in the decision tree.

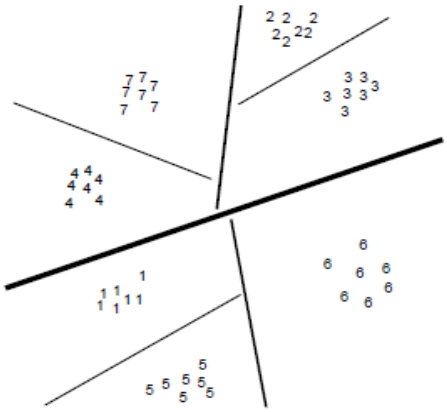

Figure 6. n-class SVM

III. CONCLUSION

The field of medical imaging gains its importance with increase in the need of automated and efficient diagnosis in a short period of time. Classification is an important part in retrieval system in order to distinguish between normal patients and those who have the possibility of having abnormalities or tumor. In this paper set of stages for detection and classification process of brain tumor MR image have been discussed. Using the knowledge from the above discussions our M.E. project is proposed as detection of brain tumor in MRI image using SVM classifier.

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