Brain Tumour Segmentation

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Abstract—Tumor is unwanted growth of unhealthy cell which increase intracranial pressure within skull. Medical image processing is the most challenging and innovative field specially MRI imaging modalities. The strategy presented involves preprocessing, segmentation, feature extraction, detection of tumour and its classification from MRI scanned brain images. Magnetic Resonance Imaging (MRI) is a non-invasive imaging modalities which is best suited for the detection of brain tumor. The segmentation method proposed in this paper is fuzzy c-means (FCM) which can improve medical image segmentation. The algorithm is easy to handle and identification of tumour and its classification in scanned region has been done accurately. A user friendly environment has been created by using GUI in MATLAB resulting in an automated brain tumor detection system for MRI scanned images. By using the GUI tool, the physician and other practitioners are facilitated in detecting the tumor and its geometrical feature extraction. Multi-SVM has used to classify the various type of tumors like Gliomas, Metastasis, Astrocytoma etc. In this work, Multi Support Vector Machines (m-SVMs) has been proposed and applied to brain scanned image slices classification using features derived from slices. This work helps in recognition of tumor which in turn saves the precious time of medical diagnostic to diagnose the tumor automatically in short span of time.

I. INTRODUCTION

Magnetic resonance imaging (MRI) is an imaging technique that produces high quality images of the anatomical structures of the human body, especially in the brain, and provides rich information for clinical diagnosis and biomedical research. The diagnostic values of MRI are greatly magnified by the automated and accurate classification of the MRI images. Wavelet transform is an effective tool for feature extraction from MR brain images, because it allows analysis of images at various levels of resolution due to its multi-resolution analytic property. However, this technique requires large storage and is computationally expensive. In order to reduce the feature vector dimensions and increase the discriminative power, the principal component analysis (PCA) was used. PCA is appealing since it effectively reduces the dimensionality of the data and therefore reduces the computational cost of analyzing new data. Then, the problem of how to classify on the input data arises. In recent years, researchers have proposed a lot of approaches for this goal, which fall into two categories. One category is supervised classification, including support vector machine (SVM) and nearest neighbors (k-NN). The other category is unsupervised classification, including self-organization feature map (SOFM) and fuzzy c-means. While all these methods achieved good results, and yet the supervised classifier performs better than unsupervised classifier in terms of classification accuracy (success classification rate). However, the classification accuracies of most existing methods were lower than 95%, so the goal of this paper is to find a more accurate method. Among supervised classification methods, the SVMs are state-of-the-art classification methods based on machine learning theory. Compared with other methods such as artificial neural network, decision tree, and Bayesian network, SVMs have significant advantages of high accuracy, elegant mathematical tractability, and direct geometric interpretation. Besides, it does not need a large number of training samples to avoid overfitting. Original SVMs are linear classifiers. In this paper, we introduced the kernel SVMs (KSVMs), which extends original linear SVMs to nonlinear SVM classifiers by applying the kernel function to replace the dot product form in the original SVMs. The KSVMs allow us to fit the maximum-margin hyperplane in a transformed feature space. The transformation may be nonlinear and the transformed space high dimensional; thus though the classifier is a hyperplane in the high dimensional feature space, it may be nonlinear in the original input space. The structure of the rest of this paper is organized as follows. Next gives the detailed procedures of preprocessing, including the discrete wavelet transform (DWT) and principle component analysis (PCA). It first introduces the motivation and principles of linear SVM, and then turns to the kernel SVM. Then introduces the K-fold cross validation, protecting the classifier from overfitting. It also use totally 160 images as the dataset, showing the results of feature extraction and reduction. Afterwards, we compare our method with different kernels to the latest methods in the decade. Final Section 6 is devoted to conclusions and discussions.

II. PROPOSED SYSTEM

A. Introduction

Medical image processing specially MRI imaging modalities is the most challenging and innovative field. MRI is a 3-d non-invasive imaging modality, which is best suited for soft tissue abnormality detection. The MRI imaging technique is the best for detection of brain tumors due to its high resolution and ability to show clear brain tumors, tumor’s size and location. From MRI brain image, the useful information is obtained for the detection of tumors. Nowadays there are several methodologies for classifying MRI images, viz. fuzzy methods, region growing method, neural networks, knowledge based methods, watershed segmentation methods and various other segmentation methods. MRI consists of T1 weighted, T2 weighted and proton density
(PD) weighted images. Main part of brain contains tissue with high fat content and appears bright; whereas, compartments filled with water appears dark. So, T1 weighted images are best suited for high resolution and clarity.

Brain tumor is unwanted growth of diseased/abnormal cell in brain in uncoordinated fashion. Brain tumor rises the intracranial pressure within the skull which affects the region of white matter (WM), Gray matter (GM), Cerebrospinal fluid (CSF). Brain is the CPU of world’s most complicated bio-computing machinery, which act as the center of thoughts, emotions, wisdom, communication, coordination of muscular movements from sense organ (pain, taste, sight, hear, touch etc.). The brain tumor has various properties like tumor size, type and location. Tumor can affect any part of brain. Brain tumors are of two type, either Benign or Malignant.

B. Image Acquisition

Image acquisition is the first step in the form of RGB image. The original MRI brain image has dimension 256*256*3 pixels and after conversion to gray scale image the dimension becomes 256*256 pixels. The steps are formulated in figure 1. After acquisition of image, convert to gray scale and the contrast is increased up to a certain level. Contrast image is partitioned into left and right hemisphere. Threshold / Binarization converts the image up to 256 gray level into black and white image as shown in Figure below.

The final segmented image is then superimposed on the edge-boundary image which clearly distinguishes tumor images from non-tumor ones and the boundaries are detected.

C. Expected Output

GUI is build using MATLAB. MRI Brain Image of Normal, Benign or Malignant respectively is loaded into the program code with the use of GUI(Graphical User Interface), which can be seen in the following figure.

After loading the image, it is then enhanced in order for the features of the image to be very specific and accurate for the classification. Thresholding of the selected image is performed to discriminate the tumor in the brain and the other brain area.

FCM Segmentation is performed on the selected image and other clustered are formed with first image having gray scale level from 0-63, second image having grey scale level from 64-127 and the third image having grey scale level from 128-255.
For the classification to happen we then have to choose the cluster with which the SVM classification will be performed. As a result of the classification, the selected MRI Image will be classified into Normal(No Tumor), Benign or Malignant with the help of the features of the image. For the result to be accurate, then RBF, Linear, Polygonal and Quadratic Accuracy will be measured with 100 iteration performed continously.

III. CONCLUSION

In this discussion an algorithm in Matlab GUI has been developed for the detection and classification of brain tumor from MRI scanned brain images based on various operation like preprocessing, Fuzzy C- means segmentation, feature extraction and by using SVM classifier. The accuracy of the method was 91% when run on a dataset of various images. This work helps in detection of tumor which in turn saves the precious time of doctor and pathologist to diagnose the tumor and its classification automatically in short span of time.

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