Automatic Brain Tumor Detection in MR Images Using Neural Network Based Classification

C.Ramalakshmi† and A.Jaya Chandran††

†Student,PSN College of Engineering and Technology,Tirunelveli††
Associate Professor, PSN College of Engineering and Technology, Tirunelveli ,India

ABSTRACT
This article presents a neural network-based process for automatic classification of magnetic resonance images (MRI) of the brain in two categories of benign, and malignant. The proposed method consists of five following stages; i.e., preprocessing, connected component labeling (CCL), fuzzy connectedness segmentation, feature extraction using DWT and classification using RBF and SVM respectively. Preprocessing involves removing low-frequency surroundings noise, normalize the intensity of the individual particles images, remove reflections, and masking portions of images. Anisotropic filter is used to remove the background noise and thus preserving the edge points in the image. In the third stage, once all groups dogged, each pixel is labeled according to the element to which it is assigned to. In the third stage, the fuzzy Connectedness segmentation is used for partitioning the image into meaningful regions. have been In the fourth stage, the obtained feature connected to MRI images using the discrete wavelet transform (DWT).In the classification stage, the RBF kernel and SVM is used to classify the subjects to normal or abnormal (benign, malignant) and Level set method is used for automatic finding and segmentation of Meningioma and glioma tumor. The proposed technique gives high-quality results for brain tissue detection and is more robust and efficient compared with other recent works.
Keywords:
Fuzzy Connectedness Segmentation, Support Vector Machine (SVM), Connected Component labeling, Discrete Wavelet Transform (DWT).

1. Introduction

Brain tumors can be either malignant (cancerous) or benign (non-cancerous). Primary brain tumors (i.e., brain cancer) comprise two main types: gliomas and malignant meningiomas[1]. Gliomas are a familiar type of malignant tumors that consist of a variety of types, named for the cells from which they occur: astrocytomas, oligodendrogliomas, and ependymomas. Meningiomas arise from the meninges, which are tissues that surround the external part of the spinal cord and brain. The majority of meningiomas are benign and can be cured by surgery. There are a number of extraordinary brain tumors, with medulloblastomas, which develop from the primitive stem cells of the cerebellum and are most often seen in children. The brain is a site where both primary and secondary malignant tumors can occur; secondary brain tumors usually begin to another place in the body and next metastasize, or spread, to the brain.

The causes of brain tumors are unknown, a small number of risk factors have been proposed. These include head injuries, hereditary syndromes, immune suppression, prolonged exposure to ionizing radiation, electromagnetic fields, cell phones, or chemicals like formaldehyde and vinyl chloride. Symptoms of brain tumors include persistent headache, nausea and vomiting, eyesight, hearing and/or speech problems, walking and/or balance difficulties, personality changes, memory lapses, problems with cognition and concentration, and seizures.

Magnetic resonance imaging (MRI) provides detailed information about brain tumor anatomy, cellular structure and vascular supply, making it an important tool for the valuable diagnosis, treatment and monitoring of the disease [2,3].

Meningioma is a variety of tumor that develops from the meninges. The dura mater, arachnoid and Pia mater are the layers of meanings. Meningiomas are categorized as benign tumors, with the 10% being atypical or malignant [4]. Benign meningiomas grow gradually that depends on where it is located, a meningioma achieve a relatively large size before it causes symptoms. Other meningiomas grow more rapidly, or have sudden growth spurts. There is no way to calculate the growth for a meningioma.

Glioma is a tumor that starts within the brain or spine. It is called glioma since it arises from glial cells. The most common position of gliomas is the brain.

2. Methodology

The tumor classification method follows the steps

- Preprocessing
- Fuzzy Connectedness Segmentation
- Connected Component Labeling

Manuscript received May 5, 2014
Manuscript revised May 20, 2014

- Feature Extraction Using DWT
- Classification Using RBF and SVM

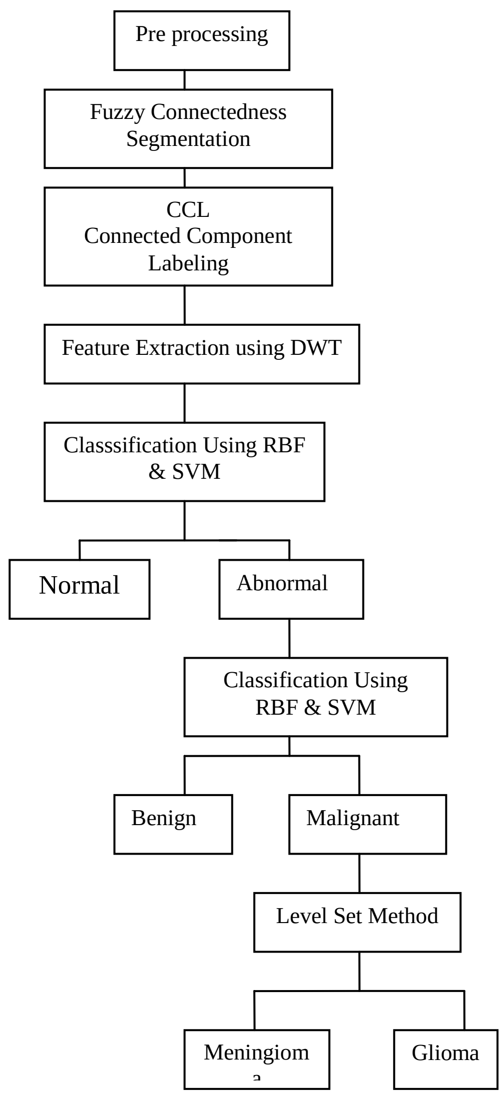


Fig: Block diagram of proposed tumor Classification Method

2.1 Preprocessing

Preprocessing involves removing low-frequency surroundings noise, normalizing the intensity of the individual particle images, removing reflections, and masking portions of images. Anisotropic filter is used to remove the background noise and thus preserving the edge points in the image. The acquisition system corrupts MR images by generating noise. In order to improve the image quality an anisotropic filtering is used. This technique applies a concurrent filtering and contrast stitching. During filtering homogenous zones, anisotropic filter preserves the edges of objects.
In Anisotropic filter, a diffusion constant related to the noise gradient and smoothing the background noise by filtering an proper threshold value is chosen. For this purpose higher diffusion constant value is chosen compare with the absolute value of the noise gradient in its edge. Head mask was constructed by thresholding the filtered image. Matching intensity ranges in all the images, the highest and lowest intensities are limited to the interval [0,255].

2.2 Fuzzy Connectedness Segmentation

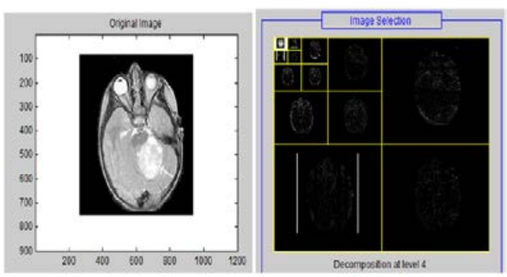
Segmentation refers to partitioning an image into important regions, in order to distinguish objects (or regions of interest) from background. There are two main approaches, region-based method in which similarities are detected, and boundary-based method in which discontinuities are detected and connected to form boundaries around the regions. Segmentation of nontrivial images is one of the most complicated tasks in image processing. Segmentation accuracy determines the eventual success or failure of computerized analysis procedures.
Thresholding segmentation is used to differentiate brain regions from scalp and pathological tumor tissues from normal tissues. Segmentation, hierarchically, starts by brain detection from skin-neck-bone and
ventricles and finally tumor detection from brain images. For detecting brain regions from scalp the algorithm in [4] is used.
After brain detection from other parts such as skin-neck-bone and ventricle using thresholding segmentation, the FCS algorithm is used to separate different parts of the brain such as a tumor. In FCS [8] the region is iteratively grown by comparing all unallocated neighbouring pixels to the region. The difference between a pixel's intensity value and the region's mean, is used as a measure of similarity. The pixel with the smallest difference measured this way is allocated to the respective region.

2.3 Connected Component Labeling

After FCS segmentation, every group has been determined, each pixel is labeled according to the element to which it is assigned to. The labeling of connected elements in an image is mid to many automated image analysis applications.

2.4 Feature Extraction using DWT

The feature extraction of MRI images is obtained using DWT domain subimages. The DWT [5] is implemented using cascaded filter banks in which the lowpass and highpass filters satisfy particular constraints. For feature extraction, only the subimage LL is used for DWT decomposition at next scale. The LL submerge at the last level is used as output features. Using this algorithm, using a 4-level DWT, the size of the input matrix is reduced from 65536 to 64.



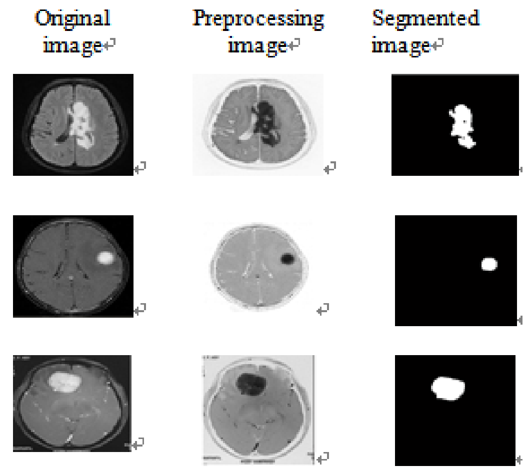
(a) (b)

(a) Original image (b) Decomposition at level 4.

2.5 Classification using SVM

This is a 2D classification technique. In this paper, we treat the classification of MR brain images as a two class pattern classification problem. In every wavelet-coded MR image, we apply a classifier to determine whether it is normal or abnormal. The use of SVM involves training and testing the SVM [7], with a particular kernel function, which in turn has specific kernel parameters. Training an SVM is the most essential part of the machine learning process. The standard training and testing sets are created. Second order approximate wavelet coefficients of normal and abnormal images used for training and testing the SVM.The RBF and polynomial functions have been used for non-linear training and testing with degrees 2, 3 and 4. The linear kernel was also used for SVM training and testing, but it shows lower classification rate than the polynomial and RBF kernels.The accuracy of classification is high in RBF kernel compared with polynomial and linear kernels.

3. Experimental Results



4. Conclusion

In this paper, we have developed a network-based classifier to differentiate normal and abnormal (benign or malignant) brain MRIs. The proposed technique consists of five steps, especially, preprocessing, Fuzzy Connectedness segmentation, connected component labeling, feature extraction using DWT and classification using RBF and SVM respectively. In the preprocessing stage, an Anisotropic filter is used to remove the noise and thus preserving the edge point of the image. In the FCS stage, an automatic seeded region rising is used for partitioning an image into important regions. In the third stage, once all groups have been determined, every pixel is labeled according to the component to which it is assigned to. In the fourth the features are extracted using DWT and finally to classify normal and abnormal brain MR images RBF and SVM is used.According to experimental results, the proposed method is efficient for classification of human brain into normal and abnormal classes.

References

[1] R. Silipo; G. Deco, and H. Bartsch, “Brain tumor classification based on EEG hidden dynamics”. Intelligent Data Analysis, Volume 3, Number 4, pp. 287-306(20), October 1999.

[2] C. Majós, M. Julià-Sapé, J. Alonso, M. Serrallonga, C. Aguilera, J. Acebes, C. Arús and J. Gili. “Brain Tumor Classification by Proton MR Spectroscopy: Comparison of Diagnostic Accuracy at Short and Long TE”. American Journal of Neuroradiology 25:1696-1704, November-December 2004.

[3] L. Lukas, A. Devos, J.A.K. Suykens, L. Vanhamme, F.A. Howe,C. Majo´s, A. Moreno-Torres, M. Van Der Graaf, A.R. Tate, C. Aru´s, and S. Van Huffel. “Brain tumor

classification based on long echo proton MRS signals". Artificial Intelligence in Medicine: 31, 73—89, 2004.
[4] M. Schmidt, I. Levner, R. Greiner, A. Murtha, and A. Bistritz. "Segmenting Brain Tumors using Alignment-Based Features". International Conference on Machine Learning and Applications, Los Angeles, December 2005.
[5] Lashkari, A., 2010. A Neural Network Based Method for Brain Abnormality Detection In MR Images Using Gabor Wavelets, International Journal of Computer Applications, 4(7): 9-15.
[6] Rosenfeld and A. C. Kak, Digital Picture Processing. New York: L_ Academic, 1976, Chap. 10.
[7] Sandeep Chaplot, L.M. Patnaik, N.R Jagannathan," Classification of magnetic resonance brain images using wavelets as input tosupport vector machine and neural network" Biomedical Signal Processing and Control 1 (2006) 86–92
[8] Mehdi Jafari, Shohreh Kasaei, "Automatic Brain Tissue Detection in Mri Images Using Seeded Region Growing Segmentation and Neural Network Classification", Australian Journal of Basic and Applied Sciences, 5(8): 1066-1079, 2011.

C.Ramalakshmi received the B.E. degree from PET Engineering College in 2011 and now pursuing her M.E degree from PSN College of Engineering and Technology.