ABSTRACT

Tumor identification is a major challenge in the field of medical science. The fatal consequences of the disease can be averted if detected early. Tumor in the brain is inherently serious and poses a threat to life. Its threat level depends on a combination of various factors like the type of tumor, its location in the brain, its size, and its developmental stage. As the brain is well protected by the skull an early detection technique is necessary for the identification and treatment of brain tumor.

Magnetic resonance imaging (MRI) is a powerful medical imaging modality to produce high-resolution images with good contrast of the different biological soft tissue types. As a non-invasive technique, the large quantity of data provided by MRI for brain imaging in particular aids statisticians and medical professionals in disease diagnosis and functional understanding of the human brain. In particular, interest to this study is the classification of brain MR images.

This study proposes new automatic classification techniques to study the problem of the classification of brain MRI. Three classification techniques have been proposed and implemented in this research work to improve classification efficiency, speed of classification under two broad categories of image classification: orthogonal based and Local ternary operator based methods. Experiments were performed on 172 T1 weighted
MR brain images having tumour and normal brain images of human and the performance of the proposed algorithms were compared with that of the existing algorithms. True Positive (TP), True Negative (TN), False Positive (FP), False Negative (FN) were used to measure the performance of classification output.

The first method, combination of convolution of orthogonal and Edge detection operators using Support Vector Machine (SVM), classification technique uses convolution of orthogonal operator of sizes 3, 4 and 5 with Sobel operator.

This is done to overcome the problem of Sobel operator which involves sensitivity to noise and inaccuracy in detecting the edges in brain MRI by way of eliminating inaccuracies through point spread orthogonal operator for classifying the MRI. In this method there are also orthonormal operators of various sizes which are convolved with sobel to overcome the problem of Sobel operator.

A reduction of feature space is done using grouping of the values in order to reduce the processing time of the classifier. The grouping is varied from a minimum of 160 groups to a maximum of 180 groups to check the classification accuracy and machine time.

In the first approach another classifier ARTMAP of mirror neurons is used to classify the brain MR images. This proposed approach is the combination of convolution of orthogonal and Edge detection operators using ARTMAP of mirror neurons. The results obtained are compared with
proposed combination approach of SVM. In proposed approach, using SVM classifier for the combination of orthogonal operators of all the sizes considered gives a better result than proposed approach of the combination of orthogonal operators of all the sizes considered using ARTMAP of mirror neurons classifier for the combination. For the proposed approach of combination of SVM classifiers with convolution of orthogonal operators of all sizes gives a better result than the proposed approach of combination of SVM classifiers with convolution of orthonormal operators of all sizes.

The second proposed method uses the combination of two dimensional discrete wavelet transform (2D-DWT) with orthogonal operators and SVM classifier. The use of 2D-DWT solves the problem of choice of run length and direction for Gray-Level Co-occurrence Matrix (GLCM) thus increasing classification accuracy of brain MRI with improved speed.

A reduction of feature space is done using grouping of the values in order to reduce the processing time of the classifier. The grouping is varied from a minimum of 6 groups to a maximum of 13 groups to check the classification accuracy and machine time. The orthogonal operators used were of sizes 3, 4 and 5. As the size of the operator increased the number of groups decreased. The combination of two dimensional discrete wavelet transform (2D-DWT) with orthogonal operators and SVM classifier outperformed the combination of two dimensional discrete wavelet transform (2D-DWT) with orthonormal operators and SVM classifier.
The third proposed method uses Multilevel Local Ternary Pattern (MLTP) operator with SVM. This method assesses the distribution of micro primitives at different levels and also considers the similarity among the neighboring pixels. This operator combined with SVM classifier suggests a new scheme for brain MRI classification. The proposed sizes of the operators were MLTP 5x5 and MLTP 7x7 combined with SVM for classification of brain MRI.

To map all pixels from the grayscale pattern space onto a ternary pattern space both the proposed operators considered the octets values of the neighbouring pixels. To calculate the octet threshold values were varied. To reduce the pattern size grouping of values was done. The various number of number of groups with combination of various threshold values was analyzed. Proposed MLTP operator of size 7x7 outperformed MLTP operator of size 5x5 with less number of bins for the same threshold value.

In this thesis, three improved classification techniques have been proposed for robust, fast and more precise classification of images. These proposed techniques were tested and were found to be more robust in producing accurate results when compared with existing algorithms. Extensive quantitative validations were performed on real brain MRIs. Amongst the proposed techniques combination of 2D-DWT with orthogonal operator using SVM classifier demonstrated improvement in classification accuracy as 99.41%.