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CLASSIFICATION OF BRAIN TUMOUR IN MRI USING PROBABILISTIC NEURAL NETWORK

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Abstract: Brain tumor is an abnormal growth of cells within the brain and it is one of the major causes of death among people. The chances of survival can be increased by detecting tumor in brain and classified correctly at its early stage. Conventional methods involve invasive techniques such as biopsy, lumbar puncture and spinal tap method, to detect and classify brain tumors into benign (non cancerous) and malignant (cancerous). A computer aided diagnosis algorithm has been designed to increase the accuracy of the detection of brain tumor and classification, and thereby replace conventional invasive and time consuming techniques. The efficient method of brain tumor classification has been used in this paperand the real Magnetic Resonance (MR) images are classified into normal, non cancerous (benign) brain tumor and cancerous (malignant) brain tumor.

1. INTRODUCTION

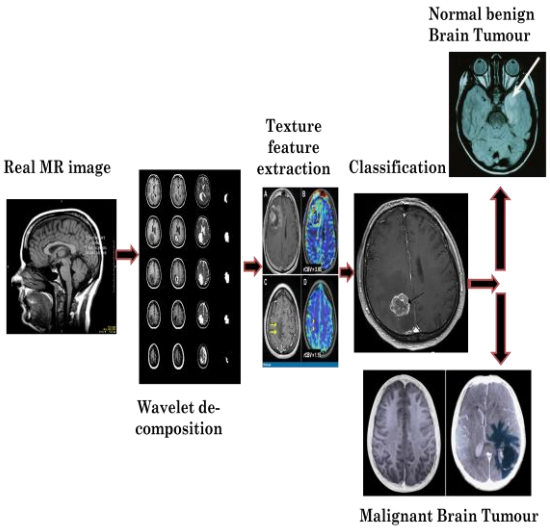
Brain tumour is any mass that results from an abnormal and an uncontrolled growth of cells in the brain. Its threat level depends on a combination of factors like the type of tumour, its location, its size and its state of development. Brain tumours can be cancerous (**Malignant**) or non cancerous (**Benign**). Benign brain tumours are low grade, non cancerous brain tumours, which, grow slowly and push aside normal tissue but do not invade the surrounding normal tissue. They are homogeneous, demarcated, well defined and are known as non-metastatic tumours, because they do not form any secondary tumour. Whereas, malignant brain tumours are cancerous brain tumours, which grow rapidly and invade the surrounding normal tissue. They are heterogeneous, not well defined, grow in a disorganized manner and are known as metastatic tumours, because they initiate growth of similar tumours in distant organs. Malignant brain tumours (or) cancerous brain tumours can be counted among the most deadly diseases.

Many diagnostic imaging techniques can be performed for the early detection of brain tumours such as Computed Tomography (CT), Positron Emission Tomography (PET) and Magnetic Resonance Imaging (MRI). Compared to all other imaging techniques, MRI is efficient in the application of brain tumour detection and identification, due to the high contrast of soft tissues, high spatial resolution and since it does not produce any harmful radiation, and is a non invasive technique. Although MRI seems to be efficient in providing information regarding the location and size of tumours, it is unable to classify tumour types, hence the application of invasive techniques such as biopsy and spinal tap method[7], which are painful and time consuming methods .

Biopsy technique is performed where, the surgeon makes a small incision in the scalp and drills a small hole, called a burr hole, into the skull and passes a needle through the burr hole and removes a sample of tissue from the brain tumour, to check for cancerous cells or the spinal tap method, where the doctor may remove a sample of cerebrospinal fluid and check for the presence of cancerous cells. This inability related to invasive technique requires development of new analysis techniques that aim at improving diagnostic ability of MR images. A wavelet and texture based neural

network method is proposed in order to classify the MR images into normal, benign and malignant brain tumour images non-invasively, thereby, prevent the intervention of invasive techniques such as biopsy, spinal tap or lumbar puncture method [1],[2]..

2. MAGNETIC RESONANCE IMAGE:



Steps involved:

(1) Wavelet decomposition

(2) Textural feature extraction

(3) Classification.

The proposed method has been applied on real MR images, and the accuracy of classification using probabilistic neural network (PNN) is found to be nearly 100%. It introduces the brain tumour classification using Principal Component Analysis for feature extraction and PNN for classification. They concluded that PNN is a promising tool for brain tumour classification, based on its fast speed and its accuracy which ranges from 73 to 100% for spread values (smoothing factor) from 1 to 3. PNN has been used for classifying brain tumors, since it is considered to be superior over SVM and other neural networks in terms of its accuracy in classification.

Advantages: PNNs are much faster than multilayer perceptron networks. It can be more accurate than multilayer perceptron networks. Wavelets are that they offer a simultaneous localization in time and frequency domain. Computationally is very fast due to fast wavelet transform.

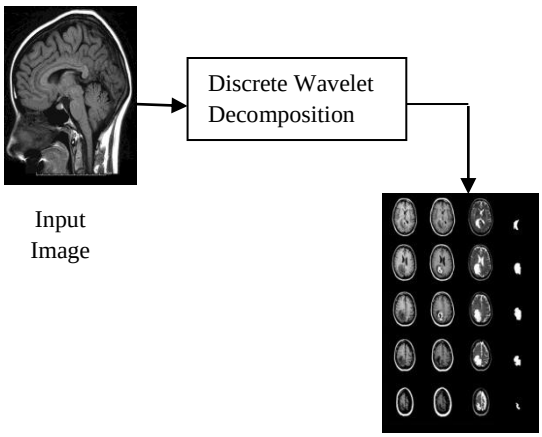
3. IMAGE DESCRIPTION:

A. Real MR Image:

The magnetic resonance images in DICOM format were collected from the patients. Magnetic Resonance image database considered for the implementation of textural feature extraction and classification.

B.Discrete Wavelet Decomposition

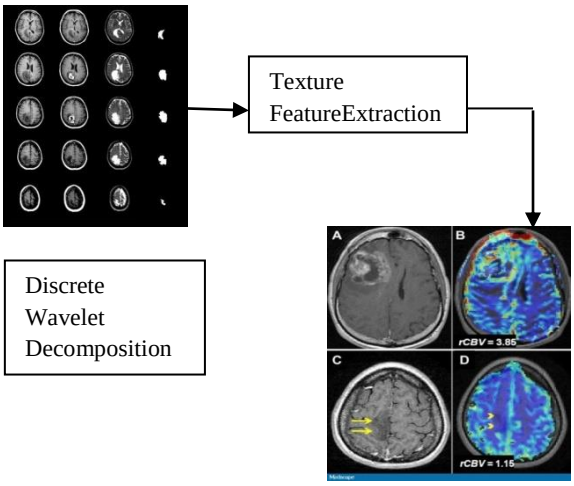
The wavelet is a powerful mathematical tool for feature extraction, and has been used to extract the wavelet coefficients from MR images. In this method, a five level decomposition using daubechies wavelet was computed and the features were extracted from LH and HL sub bands formed using DWT.



C.Texture Feature Extraction:

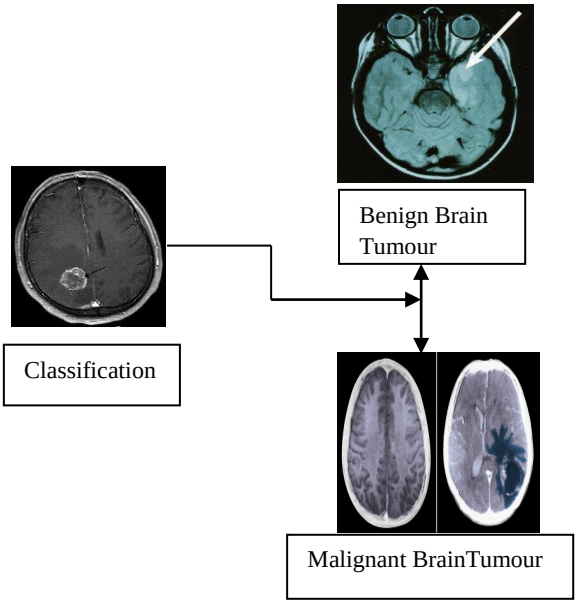
Texture analysis makes differentiation of normal and abnormal tissue easy. It even provides contrast between malignant and normal tissue, which may be below the threshold of human perception. In first-order

statistical texture analysis, information on texture is extracted from the histogram of image intensity. In second-order statistical texture analysis, information on texture is based on the probability of finding a pair of gray-levels at random distances and orientations over an entire image.



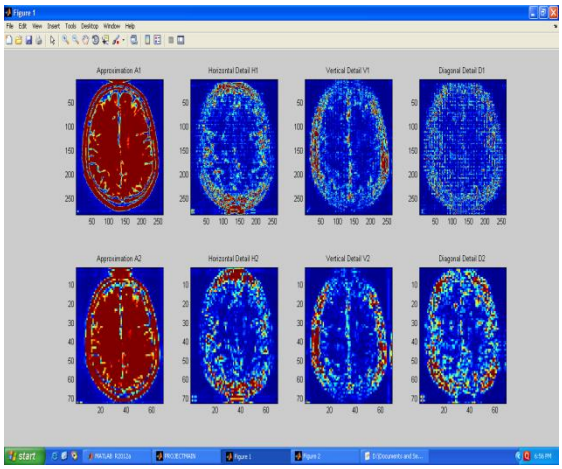
D.Classification:

Probabilistic Neural Network (PNN) is a Radial Basis Neural Network, which provides a general solution to pattern classification problems by following an approach developed in statistics, called Bayesian classifiers. It is employed to implement an automatic MR image classification of brain tumors into normal, benign and malignant.



4. SIMULATION RESULTS:

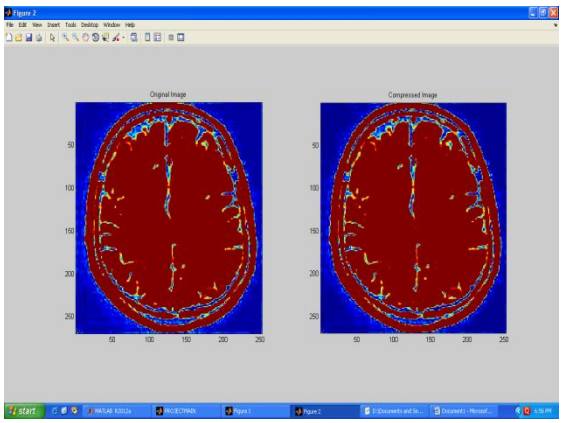
The desired output is obtained from the input image using Discrete Wavelet Decomposition and Texture based techniques. Output Obtained from DICOM format of input after Wavelet decomposition.



Wavelet Decomposition Images

5 Levels are used in Wavelet decomposition are:

- Level 1: Approximation, denoted as A1
- Level 2: Horizontal H1
- Level3: Vertical V1
- Level 4: Diagonal D1
- Level 5: Desired level



Output Image

The last level 5 gives the desired level which the output image in which Noise are reduced by using LPF and HPF

CONCLUSION:

Proposed System presents an efficient method of classifying MR brain images into normal, benign and malignant tumor, using a Probabilistic Neural Network. The proposed approach gives very promising results in classifying MR images. Most of the existing methods can detect and classify MR brain images only into normal and abnormal. Whereas, the proposed method, with the help of the texture statistics obtained from LH and HL sub bands, is able to classify brain tumor into benign and malignant. The percentage of accuracy of classification using PNN is found to be nearly 100 %, when the spread value is set to 1. Based on the experimental results, PNN is considered to have major advantages over conventional neural networks, due to the fact that PNN learns from the training data instantaneously. This speed of learning gives the PNN the capability of adapting its learning in real time. This method of automatic early detection and classification of MR brain images into normal, benign and malignant, based on their statistical texture features, not only replaces conventional invasive techniques, but also helps in reducing the fatality rate. Future works are related with classification of brain tumours into different grades by using advanced texture analysis methods, so that done easily and effectively brain tumour diagnosis.

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