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# BRAIN TUMOUR DETECTION VIA EEG SIGNALS

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**ABSTRACT** Electroencephalogram (EEG) is a way of monitoring the brain's spontaneous electrical activity. It is considered to be the best way for diagnosing tumour and other brain disorders in the human brain. This work presents a diagnostic system to classify EEG signal as tumour or normal. Here the system uses the back propagation with a feed forward algorithm for classification, which uses the neural network classifier. During the neural network training phase, the extracted statistical features from the EEG signal were presented to the neural network with the help of set of database samples. During the neural network testing phase, the neural network classifies the test sample set as normal or brain tumour based on the training given. The obtained results show that, the proposed system gives better classification accuracy for the different test samples over the existing methods.

**KEYWORDS :** Brain, Brain tumour, EEG, SWT, GLCM, ANN classifier.

## INTRODUCTION

Signal processing plays a major role in the analysis of the different modes of signals, images, sounds and various biological measures. The processing of the biological signals is mainly concerned with the detection of various disorders related to the patient's physical nature. Thus, forthe analysis of different states of the human brain we need to extract the brain signals with the help of electrodes and electroencephalogram. Extraction of the brain signals needs some sort of filters and wave metrics to work on the extracted signal input. We have to select a proper algorithm to process the signal and obtain the output for future detections. In this research paper, brain signal is extracted using electroencephalogram and further pre-processing techniques are performed to obtain the final classification of the brain tumour

Electroencephalogram remains the primary reorganisation test of brain function. EEG is especially valuable in the investigation of patient's electrical activity produced by the cerebral cortex nerve cells and it is extensively used in clinical categorization of brain activities. The scalp may produce various electrical potentials which represent the variation in the brain's activity. Besides from various new imaging techniques like MRI, SPECT and PET, EEG provides better diagnostics responds to the tumours. EEG signals are broadly classified into delta, theta, alpha, beta and gamma signals. while processing the EEG signals, the first part includes acquisition of signal, removal of disturbance or noise in the signal, thresholding, enhancement and finally detection of the signal. The final stage in EEG signal analysis includes selecting matching algorithms and techniques to define the brain's activity

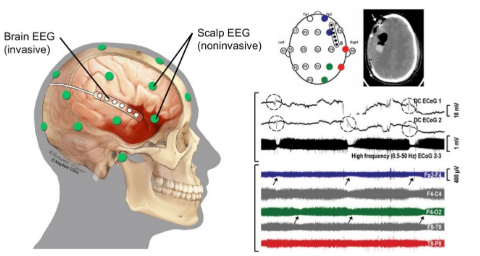


**figure 1**

In recent years, several brain-computer interfacing technologies were developed to analyse the activities of the brain functions. This technology has a great impact because it reduces the risk of any damage to the brain while recording the signals. Direct measurement in the brain lead to complications, but with the use of scalp electrodes finds an easy way to obtain the brain signals as shown in fig 1. Brain signal extraction mode are subdivided as statistical characteristics and syntactic descriptions

Analysis of the brain tumour by the physicians only records the neural activity of the brain. It is very important to detect the brain tumour in the human in its early stages. Mostly examining the signals of the brain is a time-consuming process, but it may be analysed by using accurate methods and visualizing of the signals. The presence of any external stimulus and disturbances in the brain leads to non-stationary EEG recordings.

Several symptoms are related to the detection of brain tumour. The most common types of tumours are gliomas and meningeal tumours. These tumours are related to certain symptoms indicated by the brain signals. Particularly in this paper, we use SWT for extracting the EEG signal to analyse the different stages of brain functioning. SWT provides a more flexible way of time-frequency representation of signals. The wavelet transform used may be either continuous or a discrete one which gives finer low or high frequency resolution signals. Using of slow, stationary wavelet transform will reduces the externally generated artifacts and gives a clear view of generating the slow waves into the patient's head without any chance of radiation affecting them

Artificial Neural Network (ANN) classifier is designed based on the neural structure of the brain and it provides a classification between the normal or tumour. The ANN can be classified as back propagation network and general regression network in which here we use the back propagation technique for analysing the neural network.

## LITERATURE SURVEY

Murugesan [1] et al proposed an automated detection of brain tumour in EEG signals using artificial neural networks (ANN). The ANN used is a feed forward back propagation system. Adaptive filtering is used to remove artifacts present in the EEG signal. Generic features present in the EEG signal are removed fromspectral analysis. Spectral analysis is achieved by fast Fourier transform. At last, when EEG signal is fed as a test input, the trained feed forward back propagation neural network detects the presence of brain tumour Shashank Bhardwaj[2] et al proposed a adaptive neuro-fuzzy system for brain tumour. This system uses an adaptive Neuro fuzzyinference system(ANFS). This system investigates brain tumour by a set of predefined rules. The rules consist of symptoms of brain tumour. Triangular falsifier is widely used. If any error is presented in the EEG signals it will assume the presence of brain tumour

Zakaria [3] et al proposed a time-frequency analysis of executing and imagined motor movement EEG signals for neural-based home appliance system. This paper describes the analysis of EEG signals using time frequency analysis. Open BCI records the EEG signals and then pre-processed by short time Fourier transform. The short time Fourier transform withdraws the executed and the hand grasping signals successfully. Then this signal is used as a parameter to activate the home appliances.

Luzhengbi [4] et al proposed a queuing network modelling of driver EEG Signals based steering control. In this paper instead of using limbs to control steering, we use brain-controlled steering control by combining queuing network(QN) with brain computer interface (BCI). The output of this model will control the car steering.

## PROPOSED METHOD

A complete survey over the literature have not been shown an effective method for brain tumour detection from EEG signals. The proposed system gives the better classification accuracy of EEG signals by using back propagation with feed forward which uses Artificial Neutral Network Classifier. The proposed diagnosis system composed of three stages, namely,

1. Pre-processing
2. Feature extraction and
3. Classification

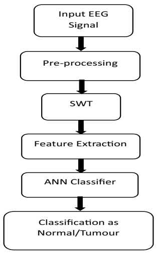


**fig-2**

## PREPROCESSING

Image pre-processing is the term of operation on images at the lowest level of abstraction. These operations do not increase the image information content, but they decrease it if entropy is an information measure.

The aim of pre-processing is an improvement of the image data that suppresses undesired distortions or enhances some image features relevant for further processing and analysis task.

It removes the distortions from the EEG signals and improves the system performance and useful for further processing. It also improves the quality of signal to noise ratio. Short time Fourier Transform is applied on EEG signal to remove the distortions.

## STATIONARY WAVELET TRANSFORM (SWT)

Wavelet (WT) plays an important role in recognition and diagnostic field. It compresses the time-varying biomedical signal, which comprises many data points, into a small few parameters. As the EEG signal is non-stationary, the best way to feature extraction from the raw data is WT. WT allows the use of variable sized windows, it gives a flexible way of time frequency representation of the signal. In order to get a finer low frequency resolution, WT long time windows are used. The EEG signal is represented by wavelets (building blocks) in the WT method

The stationary wavelet transforms (SWT) is a wavelet transform algorithm designed to overcome the lack of translation invariance of the discrete wavelet transform.

The SWT is an inherently redundant scheme as the output of each level of SWT contains the same number of samples as the input. So, for a decomposition of N levels, there is a redundancy of N in the wavelet coefficients. as shown in fig-3

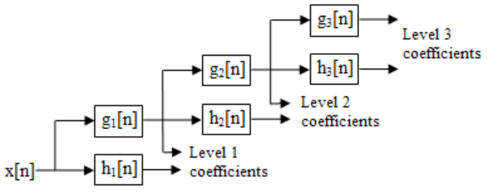


**fig-3**

## GRAY LEVEL CO-OCCURRENCE MATRIX (GLCM)

A statistical method of examining texture that considers the spatial relationship of pixels is the GLCM also known as Gray level spatial dependence matrix.

A Co-occurrence matrix (CCM) by calculating how often a pixel with theintensity (gray-level) value i occurs in a specific spatial relationship to a pixelwith the value j.

By default, the spatial relationship is defined as the pixel of interest and thepixel to its immediate right(horizontally adjacent), but you can specify otherspatial relationships between the two pixels.

Each element (i,j) in the resultant ccm is simply the sum of the number oftimes that the pixel with value i occurred in the specified spatial relationshipto a pixel with value j in the input image.

The number of gray levels in the image determines the size of the CCM.

**Energy:** It is a measure the homogeneousness of the image and can be calculated from the normalized COM. It is a suitable measure for detection of disorder in texture image.

$$J = \sum_{i=1} \sum_{j=1} (p(i,j))^2$$

**Entropy**: Entropy gives a measure of complexity of the image. Complex textures tend to have higher entropy

$$S = -\sum_{i=1} \sum_{j=1} p(i,j) \log(p(i,j))$$

**Where,**
p(i , j) is the co occurrence matrix

- **Contrast:** Measures the local variations and texture of shadow depth in the gray level co-occurrence matrix.
- **Correlation:** Measures the joint probability occurrence of the specified pixel pairs.
- **Homogenity:** Measures the closeness of the distribution of elements in the GLCM to the GLCM diagonal.

## ARTIFICIAL NEURAL NETWORK

A neural network consists of units (neurons), arranged in layers, which convert an input vector into some output. Each unit takes an input, applies a (often nonlinear) function to it and then passes the output on to the next layer. Generally the networks are defined to be feed-forward: a unit feeds its output to all the units on the next layer, but there is no feedback to the previous layer. Weightings are applied to the signals passing from one unit to another, and it is these weightings which are tuned in the training phase to adapt a neural network to the particular problem at hand. This is the learning phase.

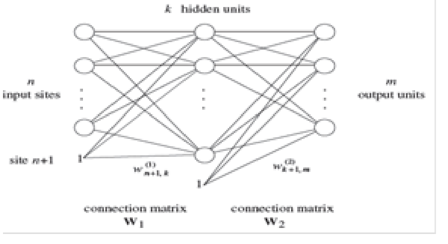


**fig-4**

Neural networks have found application in a wide variety of problems. These range from function representation to pattern recognition, which is what we will consider here.

- **Feed-forward:** the input x is fed into the network. The primitive functions at the nodes and their derivatives are evaluated at each node. The derivatives are stored. as shown in fig-4
- **Back propagation:** The constant is fed into the output unit and the network is run backwards.

Artificial neural networks have been recognized as a powerful tool for pattern classification problems, but a number of researchers have also suggested that straightforward neural-network approaches to pattern recognition are largely inadequate for difficult problems such as handwritten numeral recognition.

## EXPERIMENTAL RESULTS

The results obtained from experimentation of the proposed system are discussed in this section. The proposed system is programmed using python.as shown in fig-5 It takes EEG signal as input which is recorded from the patients. Initially, the signal undergoes preprocessing which is nothing but the removal of artifacts. The preprocessed signal is given as input to SWT. SWT is used to separate the low and high signals. And GLCM is used to identify the intensity of the signal. Now, the processed signal is compared with the data set of EEG signals. Afterwards, the clean data obtained is given as training input to the feedforward backpropagation neural network.

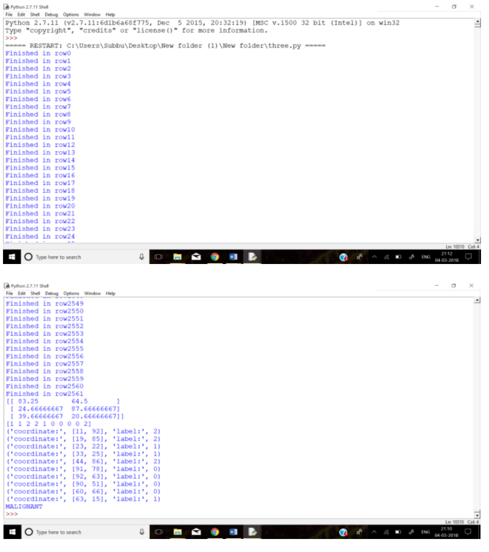

**fig-5**

Based on the input signal, it determines whether it is a normal or tumour. The results gives the effectiveness in detection of brain tumour.

## CONCLUSION

In this paper,we presented SWT and ANN for the detection of brain tumour.First EEG signals were processed by pre-processing and fed as input to SWT(stationary wavelet transform).The low and and high signals were separated by SWT. The features were extracted for the processed signal and trained to the ANN. Based on the training given to the ANN it classifies the test EEG signal as normal or brain tumour. The result show that, the classification accuracy of the proposed method using SWT and ANN better over the existing methods.

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