AN EFFICIENT DETECTION OF BRAIN TUMOR USING SEGMENTATION AND CLASSIFICATION TECHNIQUES

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***Abstract*-- Brain tumor is a collection of abnormal cells in our brain. Human skull can be made up of high rigid bones naturally. If there is any growth inside a restricted space it may cause several problems. Brain tumors can be two types as cancerous or noncancerous. When benign or malignant tumors have grown, they can cause the pressure inside the human skull to increase. It causes brain to damage, and it can become life-threatening. To identify and overcome these problem, Image processing is one the main research field in medical domain to detect these tumours. Here, the segmentation and classification techniques have been used to detect the brain tumour. Discrete Wavelet Transform and Principal Component Analysis are the two algorithms have been used to detect and analyse the tumour inside the human brain.**

Keywords*-- Brain tumour, Benign/ Malignant, Segmentation, Classification, DWT/ PCA.

I. INTRODUCTION

Brain tumour develops because of unusual cell growth within the brain. Brain tumour generally classified into two types benign and malignant tumors. Malignant tumors are fast growing cancerous tissues. Benign are slow growing, stagnant cancerous tumour. Most of the tumors are life threatening, brain tumour being one among them. Primary brain tumors originates in the brain. In the Secondary type of brain tumour the tumour expansion into the brain results from other parts of the body. Detecting tumors with more accuracy plays a vital role in diagnosis of tumors. It involves high resolution techniques like MRI, CT and PET etc. MRI is an important mean for studying the body's visceral structures. MRI image can be used mostly because it produce the good quality image of the brain. Cancerous tissues are compared with other medical imaging techniques such as X-Ray or Computed Tomography (CT). As being a non-invasive technique MRI are majorly used. The basic principle behind MRI is to generate images from MRI scan using strong magnetic field and radio waves of the body which helps in investigating the anatomy of the body. To identify a tumour, a patient will undergo several tests. Most commonly Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) are used to locate brain tumour. As the process of separation is very important, much attention in the construction of the expert diagnosis system has to be paid to the segmentation stage. Segmentation is one of the important step in image processing to perform some tasks in images. Segmentation is one of the methods for partitioning animage into a set of homogeneous regions which can have similar properties. In fact the enhancement step is needed to improve the quality of images since the majority of images dealt with have low contrast. The contrast correction is conducted for each colour channel separately resulting in an image being better defined for later stages of the presented hybrid segmentation methods.In the last decade, there has been a major development in machine learning based classification. These advances which prove to be useful for biomedical image analysis include support vector machine, kernel principal component analysis and independent component analysis, bagging and boosting techniques. Classification algorithms are categorised into supervised and unsupervised; although each category has its basic principal and properties. Both categories have a common objective which is the detection and extraction of tumour.Magnetic Resonance Imaging (MRI) is a diagnostic technique that uses magnetic fields and radio waves to produce a detailed image of the body's soft tissue and bones. An MRI image can be produced by using a magnet that goes around the body to excite hydrogen atoms. This passes the radiation into the human body to produce an image.

II. EXISTING SYSTEM

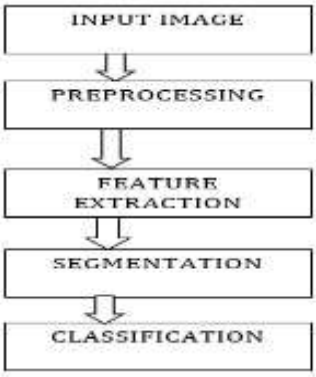

Fig 1 BLOCK DIAGRAM FOR FEATURE EXTRACTION

The above block diagram explains that, an image can be taken from the medical dataset as two types as we mentioned already as benign and malignant. With the images the pre-processing techniques using the MATLAB software have done. Pre-processing is nothing but, one of the technique in image processing to improve the image data that suppresses unwanted distortions with some image features. Feature extraction can be defined as when the input data to an algorithm is too large to be processed and it is suspected to be redundant then it can be transformed into a reduced set of features. Determining a subset of the initial features is called feature selection. The selected features are expected to contain the relevant information from the input data, so that the desired task can be performed by using this reduced representation instead of the complete initial data. Feature

extraction involves reducing the amount of resources required to describe a large set of data. When performing analysis of complex data one of the major problems stems from the number of variables involved. The process of splitting an image into multiple parts is known as segmentation. It creates various sets of pixels within the same image. Segmenting an image makes it easier for us to further analyse and extract meaningful information from it. It is also described as "The process of labelling each pixel in an image such that they share the same characteristics". The process results in pixels sharing a common property.

III. LITERATURE REVIEW

1. Ahmed Kharrat, 2009: Author introduces an efficient detection of brain tumor from cerebral MRI images. The methodology consists of three steps: enhancement, segmentation and classification. To improve the quality of images and limit the risk of distinct regions fusion in the segmentation phase an enhancement process is applied. We adopt mathematical morphology to increase the contrast in MRI images. Then we apply Wavelet Transform in the segmentation process to decompose MRI images. At last, the k-means algorithm is implemented to extract the suspicious regions or tumor.

2. Y. Zhan and L. Wu, 2012: According to the author, presented a novel method to classify a given MR brain image as normal or abnormal. The proposed method first employed wavelet transform to extract features from images, followed by applying principle component analysis (PCA) to reduce the dimensions of features. The reduced features were submitted to a kernel support vector machine (KSVM). The strategy of K- fold stratified cross validation was used to enhance generalization of KSVM. They performed our proposed methods with four different kernels, and found that the GRB kernel achieves the highest classification accuracy as 99.38%.

3. Vipin Y. Borole, 2015: An author says that,MRI images are best suitable for brain tumor detection. Inthis study Digital Image Processing Techniques areimportant for brain tumor detection by MRI images. Thepre-processing techniques include different methods likeFiltering, Contrast enhancement, Edge detection is usedfor image smoothing. The pre-processed images are usedfor post processing operations like; threshold, histogram,segmentation and morphological, which is used toenhance the images.

4. Sonali B. Gaikwad, 2015: Author says that, the proposed method for tumor classification in magnetic resonance brain image is the human inspection. Magnetic Resonance Imaging (MRI) plays an intrinsic role in the brain tumor disease diagnostic application. Various types of tumor that leads decision complicated. So that correct classification of brain tumor is important to detect the types of tumor. In this paper, Probabilistic Neural network (PNN) is used for brain tumor classification. Decision making was performed in two steps: 1) Feature extraction using Principal Component Analysis (PCA). And 2) Classification is done by Probabilistic neural network (PNN). Brain tumor is classified into three classes: Normal, Benign and Malignant. Again malignant tumor is classified as Glioma and Meningioma. PNN is faster and provide good classification accuracy.

5. NileshBhaskarraoBahadure, 2017: Author explains that, the segmentation, detection, and extraction of infected tumor area from magneticresonance (MR) images are a primary concernbut a tedious and time taking task performed by radiologists or clinical experts, and their accuracy depends on their experienceonly. To improve theperformance and reduce the complexity involves in themedical image segmentation process, we have investigated Berkeley wavelet transformation (BWT) based brain tumor segmentation. Furthermore, to improve the accuracy and quality rate of the supportvector machine (SVM) based classifier, relevant features are extracted from each segmented tissue. The experimental results achieved 96.51% accuracy,94.2% specificity, and 97.72% sensitivity, demonstrating the effectiveness of the proposed technique for identifying normal and abnormal tissues frombrain MR images.

6. NileshBhaskarraoBahadure, 2017: According to author there is a need to improve theperformance and reduce the complexity involves in themedical image segmentation process, we have investigated Berkeley wavelettransformation (BWT) based brain tumor segmentation. Furthermore, to improve the accuracy and quality rate of the supportvector machine (SVM) based classifier, relevant features are extracted from each segmented tissue. The experimental results ofproposed technique have been evaluated and validated for performance and quality analysis on magnetic resonance brain images,based on accuracy, sensitivity, specificity, and dice similarity index coefficient.The experimental results achieved 96.51% accuracy,94.2% specificity, and 97.72% sensitivity,demonstrating the effectiveness of the proposed technique for identifying normal andabnormal tissues frombrain MR images.

7. Luxit Kapoor, 2017: An author says that, his paper surveys the various techniques that are part of
Medical Image Processing and are prominently used indiscovering brain tumor from MRI Images. At first thevarious methods that are being currently used in medicalimage processing were extensively studied. This involvedstudying the available research. Based on that research thispapers was written listing the various techniques in use. Abrief description of each technique is also provided. Also ofall the various steps involved in the process of detectingtumor, Segmentation is the most significant and propitious.

IV. PROPOSED SYSTEM

Fig 2 Input image

An image can be taken from the medical field for detecting the presence of tumor in human brain with the help of image processing technique. An input image can be pre-processed using some techniques for extracting the features of an image.

Fig 3 Segmented image

From the above figure, an image can be segmented for the further processing steps. Image segmentation is nothing but the process of dividing an image into multiple parts. This is typically used to identify an objects or other relevant information in digital images. There are many different ways to perform image segmentation. In the proposed system an image can be chosen as benign MRI image to detect the tumors. It will split an image into N numbers and extraction can be implemented for detecting the tumors.

Fig 4 Thresholded image

From the above fig, an image can used for processing threshold operation. Where thresholding is nothing but an analyses of an images using image thresholding techniques. It is a simple, yet effective, way of partitioning an image into a foreground and background. This image analysis technique is a type of image segmentation that isolates objects by converting grayscale images into binary images.

Fig 5 Tumor detected from MRI image

From the above fig, the tumour have detected by performing the above mentioned pre- processing
Techniques in existing techniques.

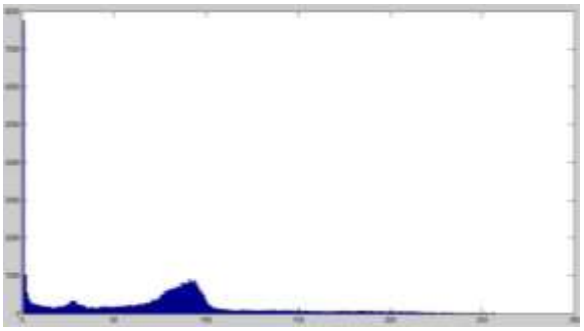

Fig 6 Histogram value for input image

From the above fig, Histogram is nothing but the graphical representation of an image. The histogram of a digital image with gray levels in the range [0, L-1] is a discrete function. The histogram of an image mostly represents the comparative frequency of the various gray levels in the image, histogram techniques apply on input MRI image

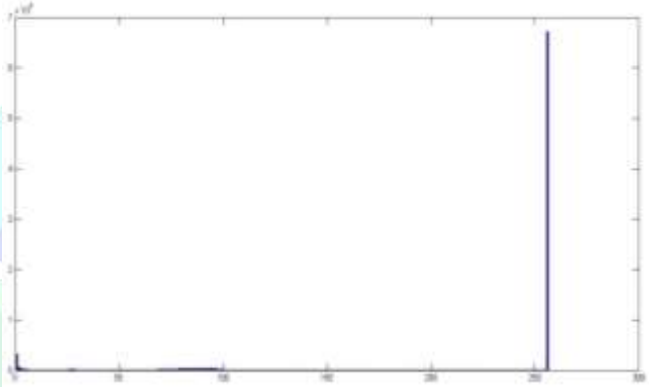

Fig 7 Histogram value for MRI brain Tumor detection

The histogram value have been calculated here for the Tumor detected MRI images.

Accuracy	Percentage
Polygonal accuracy	90%
Quadratic accuracy	80%
Linear accuracy	90%

Table 1. Accuracy of Brain Tumor Detected

Features	Values obtained
Mean	0.0032427
Standard Deviation	0.0897562
Entropy	3.57973
RMS	0.0898027
Variance	0.00801859
Smoothness	0.923447
Kutosis	6.27346
Skewness	0.633152

Table 2. Features shows different values

V. PROPOSED ALGORITHM

i. Discrete Wavelet Transform (DWT):

Discrete wavelet transform and k- means algorithm are two proposed algorithms have been used in this proposed system. The DWT algorithm is the most popular transformation technique which can be used to adopt for image compression for de-noising an image.Image consists of pixels that are arranged in two dimensional matrix, each pixel represents the digital equivalent of image intensity. In spatial domain adjacent pixel values are highly correlated and hence redundant.

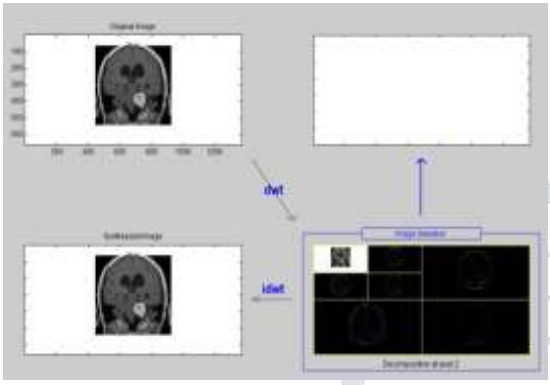

Fig 8 Procedures of 3-Level 2D DWT: (a) Normal brain MRI (b) Level 3 wavelet co-efficient

In order to compress images, these redundancies existing among pixels needs to be eliminated. DWT processor transforms the spatial domain pixels into frequency domain information that are represented in multiple sub-bands, representing different time scale and frequency points. One of the prominent features of JPEG2000 standard, providing it the resolution scalability, is the use of the 2D-DWT to convert the image samples into a more compressible form. The JPEG 2000 standard proposes a wavelet transform stage since it offers better rate/distortion (R/D) performance than the traditional DCT.

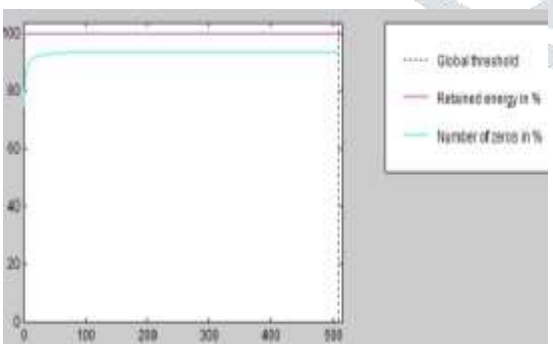

Fig 9 Graph shows the retained energy and zeros in %.

During compression the number of zeros and the energy retention will be as high as possible. In DWT the retained energy is 97.07% and in Haar transform it is 93.89%

ii. Principal of Component Analysis (PCA):

The most successful techniques that have been used in image recognition and compression is the Principal Component Analysis (PCA) and it is used to reduce the large dimensionality of the data.In this paper, the PCA algorithm is used as a dimensionality reduction technique which transforms the vector Φ1 to a vector ω1 which has a dimensionality d, where d << M x N. For each training image Ωi , these feature vectors ωi are calculated and stored. In the testing phase, the feature vector ωj of the test image Ωj is computed using PCA. In order to identify the test image Ωj , the similarities between ωj and all of the feature vectors ωi 's in the training set are computed. The similarity between feature vectors is computed using Euclidean distance. The identity of the most similar ωi is the output of the image recognizer. If i = j, it means that the MR image j has correctly identified, otherwise if i ≠ j, it means that the MR image j has misclassified

VI. RESULTS

From the proposed system the tumor have been detected from MRI Image using some image processing techniques like histogram, thresholding, gray conversion and so. With implementation of K- Means algorithm and DWT algorithm have produced a very good result in detecting the tumor from MRI images with calculating some accuracies like quadratic, linear and polynomial. An MRI image can be processed with edge detection and segmented the image which can be used more for extract some regions of the image to detect the tumor. Time analysis is an important factor of calculating the duration taken to execute the classified and segmented image. In the proposed system the time second of 0.030s to execute an image. The total duration of time taken for each image with 225 x 225 size about 0.273s. Which is enough for real time diagnosis. As finally the result executed by detecting the tumor for both Benign and Malignant tumors by applying DWT and K-means clustering algorithms with very good result.

VII. CONCLUSION

MRI images are best suitable for brain tumor detection. In this study Digital Image Processing Techniques are important for brain tumor detection by MRI images. A brief description of each technique is also provided. Also of all the various steps involved in the process of detecting tumors, Segmentation is the most significant and propitious. In this paper, an efficient detection of brain tumor has been introduced. It's based on mathematical morphology, wavelet transform and K-means technique. The algorithm reduces the extraction steps through enhancement the contrast in tumor image by processing the mathematical morphology. The segmentation and the localisation of suspicious regions are performed by applying the wavelet transforms. Finally K-means algorithm is implemented to extract the tumor. Results are presented, using a real image of brain tumor as illustrative example, which indicate significant concordance, comparing with expert result. Although the performances of proposed algorithm has been produced a very good result.

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