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Brain Tumor detection and identification in brain MRI using supervised learning: A LDA based classification method

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Abstract – *Brain tumor is generally diagnosed by a specialist called a neurologist. Imaging tests performed on magnetic resonance imaging (MRI) and/or computed tomography (CT) scan utilize computer technology to engender detailed pictures of the brain. In previous years, MRI plays a vital role in detecting brain abnormalities by determining the size and location of affected tissues. Because of the high contrast of soft tissues, high spatial resolution and since it does not produce any harmful radiation and is a non-invasive technique, MRI is efficient as compared with all other imaging techniques in the application of brain tumor detection and identification. Computer aided diagnosis system is required to avoid human based diagnostic error such as missing diagnosis and is laborious when a large number of brain MRI are examined. The proposed structure uses the k-means algorithm for successful segmentation and The Gray Level Statistical Analysis (GLCM) based feature extraction. The Linear Discriminate Analysis (LDA) based classification is used for classifying brain tumor of type benign with that of malignant.*

Key Words: **Benign, Algorithm, Diagnosis, Specialist, Image, Application.**

1. INTRODUCTION

The classification of brain tumor plays a significant role now a day in biomedical applications in the context of medical image diagnosis. The necessity of identifying of brain tumor has risen over the years with the increase of analytical field such as neural networks and artificial intelligence along with different analytical methods. However, the primitive stage prior to medical image analytics involves (signal) particularly image processing which led to development of robust and efficient algorithms in the context of image processing. However, in the context of practicality of the application, Most of these algorithms fail due to effective methods of analysis of the algorithm and its application, not because of inherent characteristic of the algorithms.

The First limitation observed in the medical images diagnostics is that of manual interpretation. Diagnosing a patient with Scanner often involves manual interpretation which is done by doctors which in-turn increase the price and is time consuming. Hence, the necessary of automated method to detect the brain tumour classification is signified.

The second limitation observed in the medical image diagnosis is that of the inherent noise present in the image data due to various factors such as quantization, encoding error, channel noise (such as Additive White Gaussian Noise, AWGN), etc. Another major factor is that of the resolution of the image often caused due to low dynamic range.

In the proposed work, a framework for brain tumour classification is developed for involving noise reduction, segmentation, and feature extraction and classification process. A performance validation for the classification method id performed along with image quality assessment for the de noised image obtained after pre-processing stage.

1.1 System Design

The proposed work considered is mainly in the development and analysis of the brain tumor detection using K-means based segmentation and classification involving the following objectives such as Image de noising, Image segmentation, Feature extraction and DWT based decomposition, Classification based on Linear Discriminate analysis.

1.2 System Architecture

The figure1 shows the architecture of the proposed system.

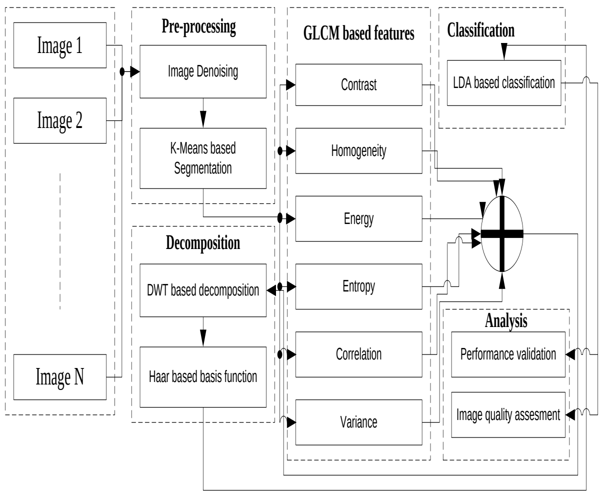

Fig -1: block diagram of proposed System Architecture

The proposed system is basically divided into four modules involving pre-processing, image segmentation, feature extraction, decomposition and classification modules. The pre-processing stage consists of addition of noise and noise removal method. The segmentation is performed using K-means based segmentation method. The feature extraction is performed using Gray Level Co-occurrence Matrix (GLCM) method followed by DWT based decomposition. Finally, the extracted features are then sent to the classifier based on the Linear Discriminate Analysis (LDA) method.

A. Pre-processing:

In the context of proposed system, the noise considered in this context is the Gaussian noise, which reflects the channel noise (Additive white Gaussian Noise: AWGN) that is prevalent in the wireless communication system. The characteristic observed in the Gaussian noise is an implicit random distribution of high intensity values (1's and 0's) which makes distorts the respective histogram of the image. The filtering method considered in this context is the median filter (also known as the averaging filter). The significance of median filtering is its ability to preserve the edges in an image while maintaining minimum system and computational complexity. The median filter calculates the median which is obtained from the defined pattern from the adjacent pixels in numerical order, consequently the computed median value is replaced with the middle pixel value. The size of mask considered in this filter is of order 3.

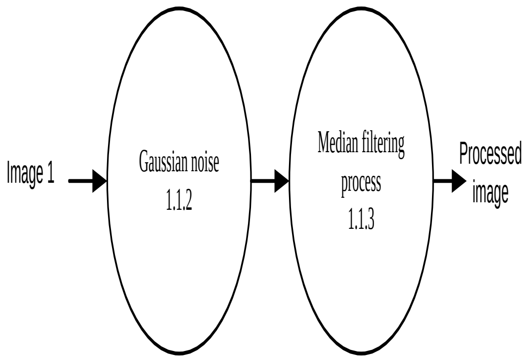

Fig -2: Data-flow diagram corresponding to the working of the pre-processing stage.

B. Image segmentation using K-means algorithm:

The pre-processed de noised image is further applied for image segmentation method to identify and segment the region of interest particularly the brain tumour area. A random centre K is chosen for user specified value. Consequently, the distance between each pixel and cluster centre is chosen, for if the pixel intensity belongs to the particular cluster, it defines that particular cluster among the group, else, it discards the pixel as non-member from the cluster group.

C. GLCM based image attributes for statistical analysis for tumour detection:

The Gray Level Statistical Analysis (GLCM) based feature extraction is performed which is intended to calculate the correlations between the adjacent pixels of a greyscale image.
The statistical, spatial and textural relations are derived from the GLCM based feature extraction method. The attributes are as follows,

1. Contrast
2. Energy
3. Entropy
4. Correlation
5. Homogeneity
6. Variance

D. LDA based Classification process:

It was observed that there was a certain type of linearity between the features set which was considered. Hence LDA was performed. The LDA basically calculates the least distance between the futurist that is observed to be the differentiating factor considering the criteria of the statistical, spatial and textural attributes of the brain tumour region.

2. Results

A general interface of the proposed system is given in figure 3 as follows,

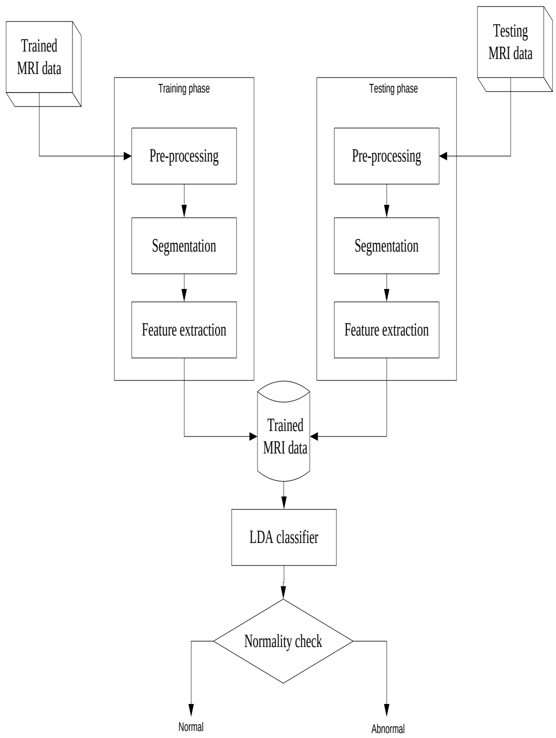

Fig -3: Overall interface for the proposed method

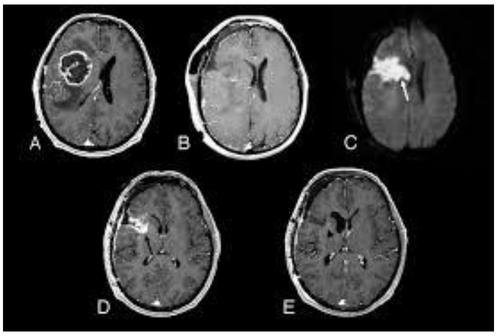

Fig -4: Brain MRI outputs

The overall observations for the images considered are given in the following table 2 as shown below for controlling parameter as given in table 1.

Table 1: controlling parameter

sl.no	Parameter	Value
1.	Gamma factor	0.71
2.	Noise scaling	2
3.	compression scaling	0.62
4.	image size	245 X 428

Table 2: observations for brain tumor values

sl.no	Image	Value
1.	PSNR	13.8344
2.	SNR	7.8052
3.	Contrast	0.00271
4.	Energy	0.99459
5.	Entropy	0.27297
6.	Correlation	0.001356
7.	Homogeneity	0.99664
8.	Variance	2741281.5

3. CONCLUSION

The overall propose method considers the identification and classification of brain tumor region. The extraction of features is performed using GLCM based feature extraction method. The obtained features are then sent to the LDA based classifier for further classification process. The LDA based classifier gives an accuracy of 70%. Image quality assessment for the pre-processed image is given which is gives an overall of improved PSNR and SNR values.

In future works, more classification techniques could be considered for a variety of applications concerning medical diagnostics. Practicality of the techniques could be tested on real time imaging data to test the feasibility, performance and robustness of the image classification techniques, finally different methods of obtaining the coefficients for image classification could be identified which leads to more effective methods of analysis given for a particular type of image.

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