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Feature Extraction Based Brain Tumor Detection in MRI Images

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Abstract— **Medical Image Processing is proficient, composite and exigent field. Magnetic Resonance Imager (MRI) images are major and imperative part in medical image processing and also it is commonly used for diagnosis. In this proposed work have several stages to detect brain tumor in MRI images using feature extraction with the help of physical measures. Initially pre-processing is performed by Median filter for removing noise in the images. After that to improve the contrast of the filtered image using enhancement techniques by using sharpen and histogram equalization method. Then the next method is segmentation it is performed by edge detection method, for getting tumor image from the MRI brain image. The final method is feature extraction; it's performed by physical dimensional measurements. An experimental result shows the effectiveness of brain tumor detection in MRI brain images and also features extraction metrics are verified.**

Keywords— **MRI; Median filter; Enhancement; Image segmentation; Feature extraction .**

I. INTRODUCTION

Tumor is defined as the unusual growth of the tissues. Brain tumor is an extraordinary collection of tissue in which cells grow and multiply hysterically, apparently unchecked by the mechanisms that manage normal cells. Brain tumors may be primary or metastatic, and also malignant or benign. Primary brain tumors can starts from cells. They can also damage the cells by producing inflammation, placing pressure on further parts of the brain and rising pressure within the skull. A metastatic brain cancer is a cancer that has enlarge from in a different place in the body of the brain. The word Tumor is a meaning for a neoplasm it is shaped by an unbalanced growth of cells. Tumor is a little different from cancer. There are three types of tumors are follows: Benign tumor is the single that do not enlarge in an unexpected way; it doesn't involve its nearest well tissues and also does not enlarge to non-adjacent tissues. Moles are the universal example of benign tumors. Pre-malignant tumor is a pre-cancerous phase, considered as a disease, if not correctly treated it can escort to cancer. Malignant tumor is the kind of tumor which grows inferior with the way of moment and finally ending in the fatality of a human being. Malignant is basically a medical term that describes a severe progressing disease. Malignant tumor is a phrase which is usually used for the report of cancer. [1]

Detection along with classification of brain cancer is very imperative in medical practice. A lot of researchers have proposed dissimilar techniques for the classification of brain tumor based on unusual sources of information. Magnetic Resonance Imaging (MRI) has become a far and wide used method of high quality medical imaging, especially in brain image where MRI's soft tissues contrast and non-invasiveness is a clear advantage.

II. RELATED WORK

Bhagwat *et al.* [2] offered a paper that shows evaluation of K-means, Fuzzy C-means and Hierarchical clustering algorithms for finding of brain tumor, These Three clustering algorithms K-means, fuzzy c-means and hierarchical clustering be tested with MRI brain image in non medical format (.jpg, .png, .bmp etc) as well as Digital Imaging and Communications in Medicine (DICOM) image. It is confirmed that DICOM images create more capable result evaluate to non medical images. Time is necessary for hierarchical clustering is least and fuzzy c-means is maximum to identify the brain tumor where as K-means algorithm make more precise outcome compared to Fuzzy c-means and hierarchical clustering. Discovery of brain tumor involves a variety of stages such as image pre-processing, feature extraction, segmentation and classification.

Laddha *et al.* [3] described a paper to detect the brain tumor using the process of pre process for normalization and enhancement techniques are used to increase the contrast of the image. Then segmentation of the image is performed by threshold segmentation, watershed segmentation and morphological techniques.

Madhikar *et al.* [4] presented the work of tumor detection in brain by extracting feature from the MRI images. Magnetic

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Resonance Image has turn into a widely used process of high quality medical image.

SivaSankari *et al.* [6] used Gray-Level Co-occurrence Matrix (GLCM) for feature extraction for their process.

Pushpa Rathi *et al.*[7] in their work proposed detection of tumor performed by the step of Image collection, Normalization, Intensity, shape and Texture feature extraction, feature selection and classification.

Islam *et al.* [8] in this work, novel multi-fractal (MultiFD) feature extraction and supervised classification techniques for superior brain tumor detection and segmentation are proposed. The MultiFD feature characterizes complicated tumor tissue texture in brain MRI as a spatially varying multifractal process in brain MRI.

Charutha *et al.* [9] processed Brain tumor detection which combines modified texture based region growing and cellular automata edge detection.

Deepthi Murthy *et al.* [10] presented a method for Image acquisition, Image Pre-processing using sobel filter, image enhancement using histogram equalization, Segmentation using thresholding and morphological operations and then the detection of tumor.

III. Proposed Method

The process of the designed technique is steadily evaluated using the MRI brain images collected from the public sources. Fig.1 shows the block diagram of the process.

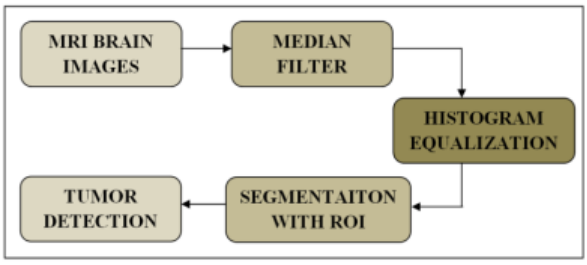

Fig.1 Block diagram of the propose method

Every process of the proposed method is given below:

A. *Image Pre-processing*

Image acquires from MRI devices are not always suitable to perform the desired image processing tasks. Due to occurrence speckle and noise in the MRI images, noise filtering and image enhancement are necessary. An image pre-processing technique normalizes the image by, adjusting the contrast, dropping noise and by removing blurring. The noise and dimness in the image can hinder the true detection. An MRI image requires two pre-processing stage, Image normalization and Image enhancement. Median filter is engaged for image normalization which helps to get clear all little noise particles and blurriness of the images. Histogram equalization is used for image enhancement. It enhance the contrast of images by transforming the values in an intensity images, or the values in the color map of indexed images, so that the histogram of the output image approximately matches a particular histogram.

B. *Image Segmentation*

The motive of segmentation is to split image information into apparent meaningful parts by placing restrictions separating the area of the well brain from the area of the cancerous and tumor brain. A segmented image is classified into non-overlapping regions and then separates the objects from the background. The limitations of the objects are delineated for feature extraction which will aid in classification. Preprocessed images are supplementary analysed in this stage to finding exact Region Of Interest (ROI). Enhanced images are altered from gray level image into binary image. Active contour model is utilized to separate ROI with minimum interactions. This helps in precise segmentation of the ROI that are normalized as dimensional spot and composed as an array of ROIs representing same as MRI images. The extracted spots are then passed to the classification phase, where disease classification is measured.

C. *Feature Extraction*

After that the segment process is completed, the segmentation image is used for feature extraction from an image which provides more comprehensive understanding of the image. The features like geometric plus intensity based statistical features are extracted. Shape measurement that characterizes the look of an object. The reason of feature extraction is to shrink the novel data by measuring definite features, which discriminate one input prototype from another prototype. The extracted feature should give the characteristics of the input category to the classifier by allowing for the description of the applicable properties of the image into feature vectors.

Area: The area is obtained by the outline of areas of pixel in the images that is 1 in the binary image obtained.

Entropy: The statistical measure of uncertainty that can be used to differentiate the texture of the input image.

Contrast: It calculates strength of contrast between a pixel and neighbour pixel for the entire image. Contrast is zero for constant image.

Homogeneity: Measures the nearness of the allocation of the elements in the GLCM.

In this paper, four features are extracted from the segmented image.

D. *Step of the process*

In pre-processing step, the median filter is used to eliminate noise from the brain MRI images. Median filter is more accurate than other filters. Because of that even behind pixel intensity values are changed the edge of the image conserved.

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The increasing mask size is more efficient in minimizing the impact of noise.

Image enhancement is a significant pre-processing method and it's performed after the normalization, to enhance the darker pixel areas. Sharpen and Histogram is used to enhance the contrast of the gray scale image.

After achievement of image pre-processing, Active contour based image segmentation is applied to segment cancerous part (ROI) from enhanced image. The steps are followed to implement active contour model to segment cancer image from MRI brain image.

Step 1: Brain image acquisition from MRI.
Step 2: Convert gray scale image into binary image.
Step 3: Apply active contour model with the help of grayscale images and masked images.
Step 4: Black pixels convert into white pixels.
Step 5: Regions properties of resulting image are under investigated, where segmented ROI can be cropped for further feature extraction.

For feature extraction, features are calculated by using the measurements.

IV. Results and Discussion

A. Experimental Results

In this proposed work include 20 sample images with various types of tumor images. The experimentation of the tumor detection is agreed by using segmentation and feature extraction in MATLAB and the fig.2 shows the various stages of the process.fig.2 (a) is the original image, which is used for the process of the proposed work. Fig.2(b) is the gray scale image, converting original image to grayscale image.Fig.2(c) is the noisy image, it adds some noisy data to the image.Fig.2(d) is the filtered image, which is used to eliminate the noisy from an image.Fig.2(e) shows the histogram of the brain image for enhancement.Fig.2(f) is the sharpened image used for enhance the image.Fig.2(g) is the image of ROI, which is used to select the tumor affected area from the brain image.Fig.2(h) is the segmentation of the tumor image, it is retrieved by the help of ROI.

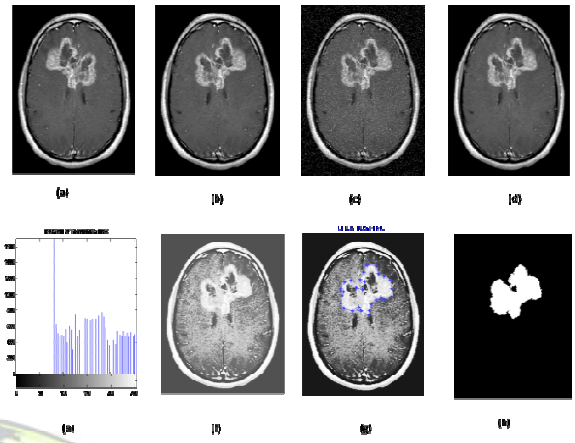

Fig. 2 Detection of Tumor (a) Original Image (b) Grayscale Image (c) Noisy Image (d) Filtered Image (e) Histogram of Image (f) Sharpened Image (g) ROI (h) Segmented Image

B. Performance Analysis

Every MRI images of brain tumor detection is performed by the flow of this above given steps. And then attain values of the features (Area, Contrast, Energy, and Homogeneity) for the segmented images.

Area: To find area of the tumor image by using the formula of the area.

$$A = n\{1\}$$

Where n {} signify the count of the pattern inside the curly brackets.

Contrast: Calculates the local variations in the GLCM.

$$Contrast = \sum\sum (i,j)^2 p(i,j)$$

Where, p(i,j) = pixel at location(i,j)

Energy: The sum of squared elements in the GLCM. It is also identified as uniformity.

$$Energy = \sum\sum (p(i,j))^2$$

Homogeneity: Measures the nearness of the distribution of element in the GLCM.

$$\text{Homogeneity} = \sum \frac{p(i,j)}{1+|i-j|}$$

The extracted feature values are shows in table.I. That is the process of brain tumor detection ranges by using different features like area, energy, etc.

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TABLE I
EXTRACTED FEATURE VALUES FROM BRAIN TUMOR IMAGES

Samples	Area	Contrast	Energy	Homogeneity
Image 1	1.5848e+04	0.4444	0.5062	0.7778
Image 2	4.7265e+03	0.4198	0.5129	0.7901
Image 3	5.7311e+03	0.4586	0.5034	0.7707
Image 4	5.7283e+03	0.4927	0.5001	0.7537

V. CONCLUSION

In this work of feature extraction based brain tumor detection in MRI image is proposed. Median filtering sharpen and histogram techniques are used for Pre-processing. Brian tumor is detected by using Segmentation method of Active contour model in MRI images with the help of ROI. Finally feature values (Area, Contrast, Energy, and Homogeneity) are calculated from the segmented images. In future, Classification techniques are going to be performed for classifies the stages of the brain tumors. For classification Support Vector Machine (SVM) otherwise Artificial Neural Network (ANN) will be used.

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