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Recognition of Brain Tumor utilizing Image Processing Techniques

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Abstract: **Nowadays, the developing of image processing plays a vital role in the medical field. It introduces a different number of imaging methods. Calculated Tomography scans, X-rays and Magnetic Resonance Imaging (MRI) are some of the technologies which help us to recognize even the nominal injuries in a person's body. Irregular expansion of cells in the brain is studied as a brain tumor. The central objective of medical image processing is to diagnose authentic and consequential data using images with the least fault tolerance. For the images of a person's body and tumorous cells in high quality and better resolution MRI is used when compared with other imaging technologies. It is a difficult task to recognize brain tumors with the help of MRI images because of the multiplicity of the brain. For the segmentation of the brain tumor, MRI images can be processed. These tumors can be segmented using various image segmentation techniques. Recognizing brain tumors with the help of MRI images is processed into four different segments; pre-processing, image segmentation, feature extraction, and image classification.**

Keywords: Image Processing Techniques, Brain Tumor, CT scans, MRI, Image Segmentation.

1. INTRODUCTION

The human body gets affected badly by the brain tumors as of the irregular expansion of tissues within the brain. Brain functioning can be disrupted and become life-threatening. Benign tumors and malignant tumors are the two types of recognized brain tumors. Benign tumors cell expansion is slow and is minor adverse when compared to malignant tumors because of the rapid development of cells in malignant tumors.

Visual delegation of the interior of the person's body for medical uses is created with the help of medical imaging technique and noninvasive possibilities can be diagnosed by this technology. The various types of medical imaging technologies based on noninvasive approach like; SPECT, MRI, CT scan, Ultrasound, PET & X-ray [1].

"Magnetic Resonance Imaging" (MRI) is widely utilized when measured to other medical imaging techniques because it provides high-resolution brain images and fatal cancer cells. Hence, brain tumor recognition can be completed through "MRI" images. We research on the recognition of brain tumor utilizing image processing techniques.

The following paper describes, the background of recognition of brain tumors using image processing in section 2. And section 3 has related work. Where section 4 provides the methodology and Section V has the discussion.

2. BACKGROUND

The irregular growth of tissues in bran is described as a Brain Tumor. At present, the predominance of tumors is burgeoning rapidly. In 2016, an approximated 25,800 grownups. (10,350 of women and 13,450 of men) in the US were recognized with the adverse tumors of the brain along with the spinal cord [2]. The shape, size, tumor location, presence, and appearance of the tumor varies from patient to patient making the reasoning more dubious. The tumor cannot be recognized at the beginning stage because the accurate measurement can't be found. But once the brain tumor is recognized at the very beginning, it may be curable with the right treatments.

Nowadays, the developing of image processing plays a vital role in the medical field. It introduces a different number of imaging methods. Computed Tomography scans, X-rays and "Magnetic Resonance Imaging" (MRI) are some of the technologies which help us to recognize even the nominal injuries in the human body.

The conventional methods are used to perform current diagnosis techniques based on a person's body undergoing condition which enlarges the probability of false perception when recognizing brain tumors. Current tools and methods are used to observe tumors and their characteristics which became more prevalent. To recognize brain tumor we can utilize Image processing techniques. Images are converted into digital and do operations on them by image processing techniques, in the process to get high-resolution images [3]. The following study will focus on how to identify brain tumors using techniques of image processing..

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3. RELATED WORK

Image processing is developed to summon images recently in curative flow to cooperate with cell recognition. "S. Mokhled" developed various recognition steps in 2012 through threshold introducing segmenting images to refine the cells from the framework [4]. 'Gabor Filter' is another feature that was introduced along with this segmenting for the classification of cancer cells.

The further steps of image extrication and segmentation of images to recognize fatal cancer cells were proposed by "H. G. Zadeh" in 2013. After appealing the Fast Fourier Transform (FFT), for the filtering purpose, a Gaussian smoothing concept is used [5].

Tumor recognition with machine learning: For the recognition of cells of tumor 'Fuzzy C-mean', 'NN' algorithms were introduced which takes less classification time with low accuracy [6].

Gene counting technology was introduced by X. Chen in 2014 [7]. This mechanism is suitable especially for the adverse development of gene selection.

All the above-illustrated mechanisms and other methodologies are focused on the recognition of brain tumors utilizing techniques of Image Processing.

4. DESCRIPTIVE METHODOLOGY

Brain tumors could be recognized utilizing Image Processing methodologies as per the following steps.

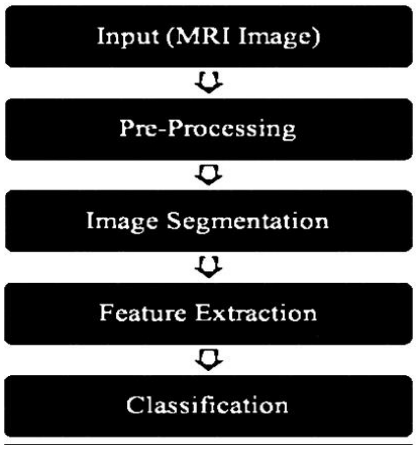
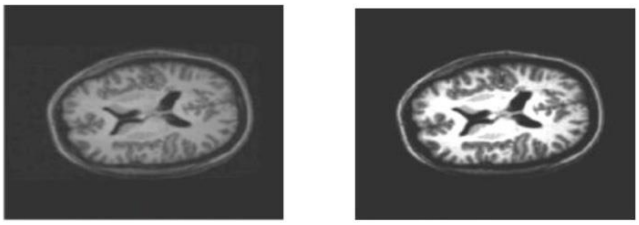


Fig 1: Image Processing work flow

4.1 Pre-Processing of Image

It is extremely hard to summon an image. It is exceptionally notable to withdraw any unwanted cells it may hold before the image is processed. An image can be processed successfully after removing unwanted cells.

The first process of image processing is to pre-process the image [8].



Original Image Enhanced Image

Fig 2: Enhancing of the image[8].

Conversion of the greyscale image, unwanted data removal and resemblance of image restoring are the processes involved in Pre-Processing. The most ordinary practice of pre-processing is the altering of the resemblance of the image to greyscale [9]. So, the unwanted noise is removed using different filtering methods after the image is altered to greyscale.

A. Median filter

This is an irregular filtering technique to be pre-owned for unwanted data elimination. Salt and pepper unwanted noise is eliminated from the greyscale resemblance of the image [10].

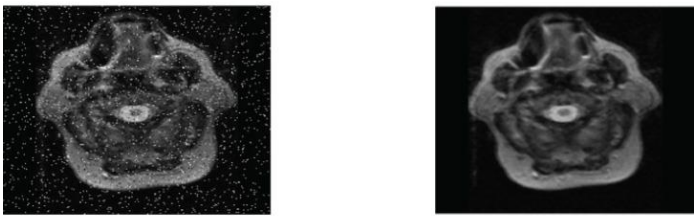


Fig 3: Applying of the Median Filter on resemblance [12].

B. Mean Filter

A de-noising filter distorts boundaries, edges, and reduces Gaussian noise built on the standard number of pixels increasing the feedback time.

C. Wiener Filter

It is also a filter that removes unwanted data which depends on the reverse filtering in the density domain. This eliminates the blurred nature from the images making them high-resolution images but it has low speed.

D. Hybrid Filter

This is a combination of both Median and Wiener Filter which can eradicate unwanted noisy data and blurring effects in the resemblance of the images. But it takes a lot of time to eradicate the noisy data.

E. Modified Hybrid Median Filter

Modified Hybrid Mean Filter is a sequence of both Mean and Median Filter which can eliminate unwanted noisy data, salt, and pepper noisy data and the Gaussian noisy data. But it takes a lot of time when compared to normal filters of Median.

F. Morphology Based De-Noising

Operations of morphology are based on the opening and closing of this filter. This produces outcomes superior to auxiliary filters & the time consumption is very less.

4.2 Image Segmentation

Distribution of the image as minor portions is called Image Segmentation. Here numerous sets of pixels are created with a single image. Every pixel gets a tag and a label that shares the same features [11]. It is easy to classify and recognize the most vital data from a digital image with the help of segments.

A. Threshold Segmentation

In the threshold methodology of image segmentation, the pixels are segmented into super pixels and they will be given

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threshold value. This value will be utilized to convert a greyscale resemblance image to an image of binary. Selecting the threshold value to be used is a major disadvantage.

B. Morphological Based Segmentation

Here the shape and structure of the items are described in Morphology. Binary images may not be accurate and can form unwanted noise. So using morphological based segmentation we can classify the image shape and structure. Recognizing the items and boundaries in the image based on comparison of pixel neighborhoods under pixel value 0 and 1 with the help of logical conversion patterns will make the segmentation easier.

C. K-Means algorithm

K-Means algorithm enhances the resolution of the images with poor contrast. This is mostly used for the selections of fragments and production of sets of fuzzy [12] [13].

J: Objective Function
K: Number of c
N: Number of cases
C*j*: Centroid of cluster 'j'

$$J = \sum_{j=1}^{k} \sum_{i=1}^{n} \left\| x_i^{(j)} - c_j \right\|^2 \quad \text{---------- (1)}$$

Table 1: Segmentation Methods and Their Characteristics

Techniques of Segmentation	Use	Impressionable to
Method of Threshold	Gradient magnitude is used to produce the edge of super pixels [15].	Images with low contrast cannot show good results
Based on Region	Regions with similar properties are separated accurately [15].	At the final result, noise can't be eliminated.
Kmeans, FuzzyC sets and Set of Level Methodologies	High pixel images with less contrast are benefited	Fragment selection and classification of fuzzy sets may become extremely hard [16].

4.3 Feature Extraction

We know that the brain tumor has a complex texture which is a hard task to extract it accurately. Depending on the size, shape and image location the tumor can be recognized and classified.

A. Edge Detection

Sometimes the intensity of the image gets changed. And the pixel whose density is altered is called an Edge Pixel. Algorithms are used to detect this type of edges and their quality when they are not identified in the final result [17].

1. "Prewitt Edge detection"

This is the unmistakable classification operation. Its derivatives both horizontally and vertically using 3x3 masks [17].

2. "Robert Edge detection"

Using the unmistakable differentiation gradient of an image is calculated with a matrix and high spatial frequency regions will be highlighted according to the edges in the image resemblance [17].

3. "Sobel Edge detection"

Two limits 2 and -2 are located in the middle of first and third columns of both horizontal and vertical masks same as "Prewitt Mask" to provide the high intensity of the edge [17].

B. Histogram of Feature Extraction

This can be done in the following manner: The pre-processed image is classified into a 32 x 32 pixel image where the density of pixel will be either 0 or 1. Now the output will be taken into Histogram oriented gradient hog [18]. As per the figure 4. The architecture of HOG which shows the then classified 8x8 pixels called a box. The pixel box will be added to a single block where each box has 9 bins which are 3x3. For the creation of the features in every bin, we use pixel gradient. Which leads to 9x4 characteristics as there are 9 features.

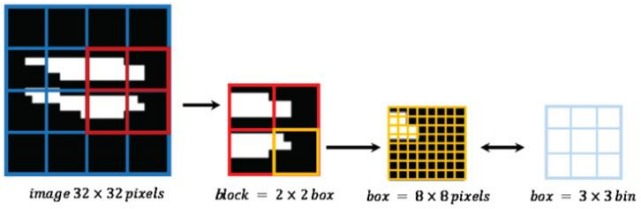

Figure 4: Histogram Classification of an Image

5. DISCUSSION

To diagnose the brain tumor from a digital image, image segmentation plays a vital role in image processing. Table 2 represents the accuracy and complexity of various segmentation methods.

Segmentation Method	Complexity (algorithm)	Accuracy (%)
Seed Region Growing	10	92.5
Threshold Segmentation	8.22	91
Watershed	5.67	88.5
Fuzzy C-Mean	5.29	85
Histogram Thresholding	7.61	81

TABLE 2. DIFFERENT TUMOUR SEGMENTATION METHOD

In Table 3, the edge detection algorithms with their estimation time in seconds and numerous flip flops used are defined. Where Sobel is the best algorithm when compared to Gaussian and Median.

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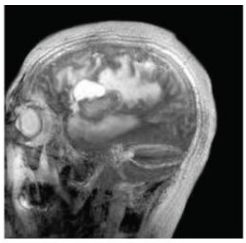
	Sobel	Robert	Prewitt
Advantages	Simplicity	Better noise suppression	Mask simpler as compared to Sobel
Disadvantages	Discontinuity in edges	Not accurate results	Discontinuity in edges
Computation time in sec.	0.3	0.2	0.4
Number used as Flip Flops	343	219	339
Number used as logic	450	322	450

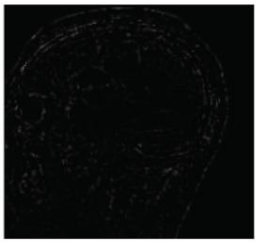
Table 3: Edge Detection Performance

The below figure 5. Shows the image processing techniques used in the detection of brain tumors with original MRI image, grayscale image, filtering image using Median filter, segmentation, morphological filter applied on image to find tumor as a result.

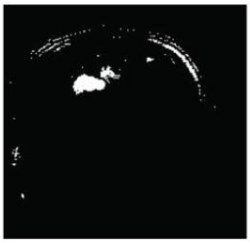
MRI image of tumor



Grayscale image



Median Filtered



Threshold Segmented

Morphological operation

Final Tumor detected

Figure 5. Steps of brain tumor detection [20]

6. CONCLUSION

The brain tumor is recognized where there is irregular growth of tissues in the brain leading to abnormal behavior of the brain. So the goal was to recognize the brain tumor accurately with correct data using images. The brain is so complex so it is impossible to detect the tumor just from an MRI image. So image segmentation techniques are used to identify the tumor with the help of preprocessing, segmentation, extraction of features, and image differentiation. With the filters, the noise is removed and with morphological operations, the images are classified into different edges as discussed above in the paper, we can get the high-resolution images with the enlargement of pixels which helps us to recognize brain tumor.

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