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AN EFFICIENT STRATEGY OVER BRAIN TUMOUR ANALYSIS USING IMAGE PROCESSING TECHNIQUES

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Abstract

Medical image processing is the most exigent and promising field now a day. Processing of MRI signal is the foremost component of this field. This paper proposes a strategy to detect the brain tumour of patient from extraction of MRI scan signals. Detection and extraction of tumour affected region from MRI scan images of the brain are carried out by algorithmic implementation of prime functions of image processing such as noise removal, segmentation, morphological filtering and feature extraction etc. This paper introduces an efficient method of brain tumor classification where, the real Magnetic Resonance (MR) images are segmented and then classified by using classifier algorithm. The overall steps involved are OTSU Image Segmentation, Morphological operations, Feature Extraction and Image Classification.

Keywords: MRI signal , KNN, Segmentation, PSNR(Peak Signal - to - Noise ratio).

I. Introduction

Medical image processing requires a comprehensive environment for data access, Analysis, processing, visualization, and algorithm development. Brain tumour detection and classification involves a series of steps. A lot of research efforts have been directed towards the field of medical image analysis with the aim to assist in diagnosis and clinical studies. Brain tumor is one of the major causes of death among people. It is evident that the chances of survival can be increased if the tumor is detected and classified correctly at its early stage. Conventional methods involve invasive techniques such as biopsy, lumbar puncture and spinal tap method, to detect and classify brain tumors into benign (non cancerous) and malignant (cancerous). Brain tumor is any mass that results from an abnormal and an uncontrolled growth of cells in the brain. Its threat level depends on a combination of factors like the type of tumor, its location, its size and its state of development. This paper introduces an efficient image processing method to detect and classify the brain tumours using classifier algorithm.

II. Existing Work

This paper showed that DICOM images produce better results as compared to non medical images. They found that time requirement of hierarchical clustering was less and that for Fuzzy C means was highest for detection of brain tumour. Since fuzzy C means is an complicated technique and does not provide better results. DICOM images are digital communication images which are the MRI images being processed. [8]

In this paper, a novel and an efficient detection of the brain tumor region from cerebral image was done using Fuzzy C-means clustering and histogram. The histogram equalization was used to calculate the intensity values of the grey level images. The decomposition of images was done using principle component analysis which was used to reduce dimensions of the wavelet co - efficient. The proposed Fuzzy C-means (FCM) clustering algorithm extracted the tumor region from MR brain images successfully and accurately [6]

In this paper ,the tumor affected area is calculated based on symmetrical analysis with several data sets with(which have) different tumor size, intensity and location. They proved that their algorithm can automatically detect and segment the brain tumor. MR images gives better result compare to other techniques like CT images and X-rays. Image pre-processing includes conversion of RGB image into grayscale image and then passing that image to the high pass filter in order to remove noise present in image. **[**5**]**

Hui Zhang et al (2008) compared subjective and supervised evaluation methodology for image segmentation. Subjective evaluation and supervised evaluation, are infeasible in many vision applications, so unsupervised methods are necessary.

III. Algorithm for Tumour Detection

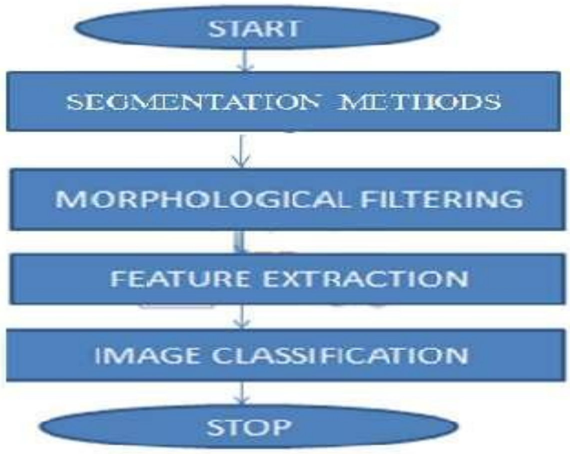

Fig. 1. Design flow for tumor detection.

In this proposed system, a new approach has been used for automatic brain tumour detection. Brain tumor detection helps in finding the exact size and location of tumor. An efficient algorithm is proposed in this paper for tumor detection based on segmentation and morphological operators. Quality of scanned image is initially enhanced and then morphological operators are applied to detect the tumor in the scanned image.

A. Image Segmentation

Image segmentation is a mid-level processing technique used to analyze the image and can be defined as a processing technique used to classify or cluster an image into several disjoint parts by grouping the pixels to form a region of homogeneity based on the pixel characteristics like gray level, color, texture, intensity and other features. The main purpose of the segmentation process is to get more information in the region of interest in an image which helps in annotation of the object

If R represents an image, then the image segmentation is simply division of R into sub regions R_1, R_2…..R_n, such that

$$R = \bigcup_{i=1}^{n} R_i \quad (1)$$

and is governed by following set of rules:

a) R_i is a connected set, i=1,2,…..n.

b) $R_i \cap R_j = \emptyset$ for all i and j, $i \neq j$

c) $Q(R_i)$ = True for i= 1,2,…n.

d) $Q(R_i \cup R_j)$ = False for adjoint regions, R_i and R_j

Where $Q(R_k)$ is a logical predicate**.** The rules described above mentions about continuity, one-to-one relationship, homogeneity and non-repeatability of the pixels after segmentation respectively.

The segmentation methods that are based on discontinuity property of pixels are considered as boundary or edges based techniques. Edge based segmentation method attempts to resolve image segmentation by detecting the edges or pixels between different regions that have rapid transition in intensity and are extracted and linked to form closed object boundaries. The result is a binary image. Based on theory there are two main edge based segmentation methods, gray histogram based and gradient based method. Region based segmentation partitions an image into regions that are similar according to a set of predefined criteria. The region based segmentation is partitioning of an image into similar areas of connected pixels. Each of the pixels in a region is similar with respect to some characteristic or computed property such as color, intensity and/or texture. There are different type of the region based methods like thresholding, region growing and region splitting and merging.

Thresholding is an important technique in image segmentation applications. The basic idea of thresholding is to select an optimal gray-level threshold value for separating objects of interest in an image from the background.

Thresholding operation is defined as:

$$T = M\,[x,y,\,p(x,y),\,f(x,y)] \quad (2)$$

Basically thresholding is divided into two broad categories they are ,Global thresholding & Local thresholding

1) OTSU Image Segmentataion : Otsu's method, named after Nobuyuki Otsu is used to automatically perform clustering-based image thresholding, or the reduction of a gray level image to a binary image. The algorithm assumes that the image contains two classes of pixels following bi-modal histogram (foreground pixels and background pixels), it then calculates the optimum threshold which separating the two classes so that their combined spread (intra-class variance) is minimal, or equivalent (because the sum of pair wise squared distances is constant), so that their inter-class variance is maximal. Consequently, Otsu's method is roughly a one- dimensional, discrete analog of Fisher's Discriminant Analysis.

2) Method : In Otsu's method we exhaustively search for the threshold that minimizes the intra-class variance (the variance within the class), defined as a weighted sum of variances of the two classes:

$$\sigma_w^2(t) = \omega_1(t)\sigma_1^2(t) + \omega_2(t)\sigma_2^2(t) \quad (3)$$

Weights ω_i are the probabilities of the two classes separated by a threshold t and σ_i^2 are variances of these classes.

Otsu shows that minimizing the intra-class variance is the same as maximizing inter-class variance:

$$\sigma_b^2(t) = \sigma^2 - \sigma_w^2(t) = \omega_1(t)\omega_2(t)\left[\mu_1(t) - \mu_2(t)\right]^2 \quad (4)$$

a which is expressed in terms of class probabilities ω_i and class means μ_i.

The class probability $\omega_1(t)$ is computed from the histogram as t:

$$\omega_1(t) = \Sigma_0^t p(i) \quad (5)$$

while the class mean $\mu_1(t)$ is:

$$\mu_1(t) = \left[\Sigma_0^t p(i)\,x(i)\right]/\omega_1 \quad (6)$$

where x(i) is the value at the center of the i^{th} histogram bin. Similarly, you can compute $w_2(t)$ and u_2 on the right-hand side of the histogram for bins greater than t.

The class probabilities and class means can be computed iteratively. This idea yields an effective algorithm.

B. Morphological Filtering

The language of mathematical morphology is set theory. Morphology offers a unified and powerful approach to numerous image processing problems. Sets in mathematical morphology represent objects in an image. In binary images, the elements in the sets are members of the 2D integer space Z2.Gray scale images are sets whose components are in Z3. In this case, two components of each element of the set refers to the coordinates of a pixel, and the third component corresponds to its intensity value. Some basic operations in Set theory which includes,

Fundamental operators of Morphological processing:

1) *Erosion: With A and B as sets in Z2, the erosion of A by B, denoted, is defined as,*

$A \ominus B$

$$A \ominus B = \{z \mid (B)_z \subseteq A\} \quad (7)$$

2) *Dilation: With A and B as sets in Z2, the dilation of A by B, denoted, is defined as*

$A \oplus B,$

$$A \oplus B = \{z \mid (\hat{B})_z \cap A \neq \varnothing\} \quad (8)$$

C. Feature Extraction

Feature extraction plays a key role in area of image processing. Before getting features, various image preprocessing techniques like binarization, thresholding, resizing, normalization etc. are applied on the sampled image. After that, feature extraction techniques are applied on the sampled image. After that, feature extraction techniques are applied to get features that will be useful in classifying and recognition of images. Feature extraction techniques are helpful in various image processing e.g. character recognition.

The most common feature used for brain tumor segmentation are the image intensities. This is based on the assumption that different tissues have different gray levels. Another type of features frequently used are local image textures because it has been observed that different tumor areas exhibit different textural patterns. Textures can be computed according to different strategies. Alignment-based features make use of spatial prior knowledge, which is often encoded by registration of a standard atlas to the patient image or by making use of symmetries between left and right brain hemisphere. Intensity gradients or edge-based features can be used for evolving a contour towards the tumor border. Recently, context-aware features modeling mid or long-range spatial similar contexts are becoming more popular.

D. Image Classification

Image classification is the process of grouping of similar features, separation of dissimilar ones, assigning class label to pixels and resulting in manageable size of classes. The fundamental objective for carrying out image classification in image mining is to acquire content information (the users are interested in) from the image group label associated with the image.

Intelligent classification of image by content is an important way to mine valuable information from large image collection. The classification module in the mining system is usually called classifier. Recognizing the challenges that lies in grouping images and classify into semantically meaningful categories based on low-level visual features. Currently, there are two major types of classifiers, the parametric classifier and non-parametric classifier develops a variety of classifiers to label the pixels in a Land set multispectral scanner image.

1) KNN Classification: A decision tree is a powerful method for classification prediction and for facilitating decision making in sequential decision problems. Often the medical decision maker will be faced with a sequential decision problem involving decisions that lead to different outcomes depending on chance.

If the decision process involves many sequential decisions, then the decision problem becomes difficult to visualize and to implement. They allow for intuitive understanding of the problem and can aid in decision making. Decision tree induction is a very popular and practical approach for pattern classification. KNN is a non-parametric lazy learning algorithm. In other words, there is no explicit training phase or it is very minimal. This means the training phase is pretty fast.

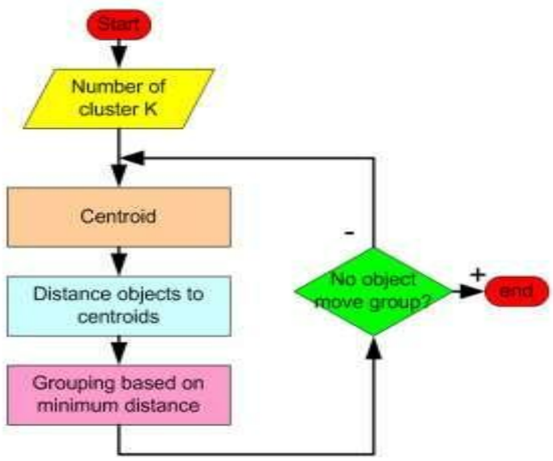

Fig. 2. Design flow for KNN classification.

IV. Results and Discussion

The images were tested using Mat lab software and the simulated results are shown in the following sections. An MRI image obtained from the drive data base is fed as input. Input image is a Gray Scale image.

Fig. 3. Input image.

Segmented input image of MRI image is

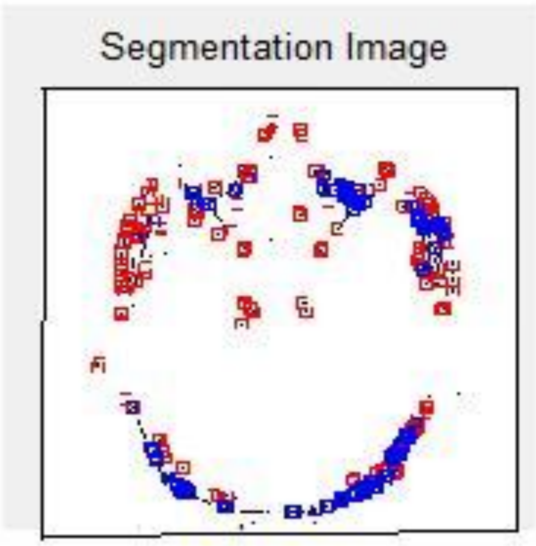

Fig. 4. Segmented Output.

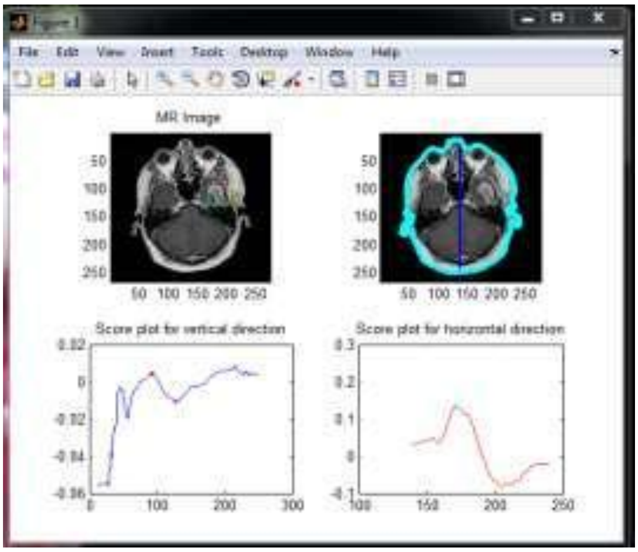

Fig. 5. Segmented output plot for vertical and horizontal direction.

The features that are being considered are brightness, accuracy, Gaussian Noise which are represented in the graphical form.

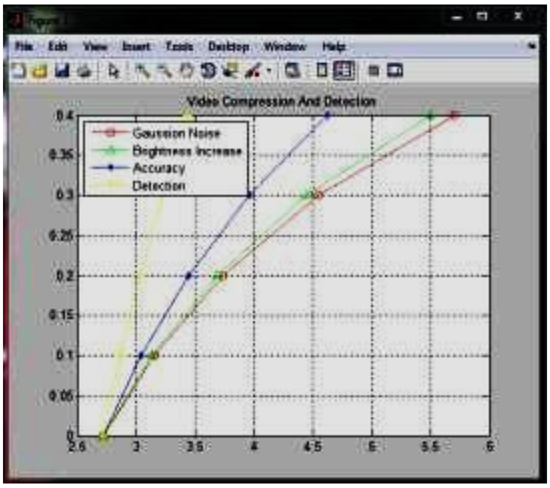

Fig. 6. Graphical view of the features.

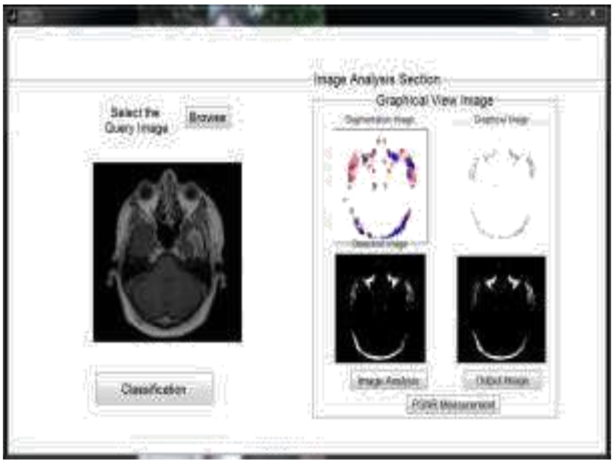

Fig. 7. ***View of GUI in MATLAB.***

Fig. 8. Measurement of PSNR value of Input & Output.

The simulated result as shown in fig.8 shows that the PSNR value of input and output are equal. The above result shows that the proposed system filters out the noise 100%.

V. Conclusion

In this work, an algorithm for brain tumour detection has been developed using Mat lab and GUI. The detection and classification of brain tumour from MRI scanned brain images are done by using various operations like pre-processing, OTSU Image segmentation, feature extraction and by using KNN classifier..This work helps in detection of tumour which in turn saves the precious time of doctor and pathologist to diagnose the tumour and its classification automatically within a short span of time.

This paper has provided a comprehensive view of the state of the art of MRI-based brain tumour detection methods. The purpose of these methods is to provide a preliminary judgment on diagnosis, tumor monitoring, and therapy planning for the physician. Although most of brain tumor segmentation algorithms have relatively good results in the field of medical image analysis, there is a scope for improvement in clinical applications.

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