Middle-East Journal of Scientific Research 24 (6): 2110-2115, 2016
ISSN 1990-9233

DOI: 10.5829/idosi.mejsr.2016.24.06.23604

Tumor Identification Using Self Organizing MAP and BFR Algorithm

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Abstract: The area of Bio-medical image processing and its application act as very important role for increase the need of automation and effective diagnosis in a very short period of processing time. MRI (Magnetic resonance imaging) scan is the technique for identifying brain tumor using certain image processing technique like segmentation that is helpful for identify the anatomy of the brain image. In this paper introduce a hybrid segmentation algorithm; it is a combination of Self Organizing Map (SOM) algorithm and BFR (Bradley Fayyad Reina) clustering algorithm. BFR is the clustering algorithm technique for segmentation and it is an enhancement of k-means clustering algorithm. The hybrid SOM and BFR algorithms comparatively more efficient for existing segmentation algorithms. Experimental result of proposed techniques confirms the performance and efficiency of the proposed SOM with BFR segmentation algorithm. Result of proposed hybrid segmentation algorithm is evaluated based on dice coefficient and the purpose of dice coefficient to calculate the image accuracy of existing algorithm with proposed hybrid algorithm and finally after evaluation the processing time is reduced in this hybrid segmentation model.

Key words: Medical image processing · Segmentation · Self Organizing Map algorithm · BFR algorithm

INTRODUCTION

The most dangerous and special organ in our human body is brain and the tumor in the brain is extremely critical and it may cause damage to our whole body [1]. Tumor leads to the formation of lesions and tumor instead of a manual identification of tumor image regions an algorithm is available which is capable of performing the identification and segmentation of tissues in this paper. Segmentation is an important concept in the medical image processing and it is used to separate the tumor in the brain image [2].

A number of researches have been developed for the medical distance for tumor detection many approaches are developed. But magnetic resonance imaging (MRI) for tumor detection is good because of its higher resolution and exact result is given for the images that are infected. MRI has become a useful medical diagnostic tool for the diagnose of brain and other images [3]. We pre-process an image which reduces the noise and enhances the contrast then we should segment the brain images using segmentation algorithm. Segment is to partition an image into meaningful regions with respect to particular criteria. Segmentation of an image can be based on grey scale, color, texture, depth and motion. In the process of feature extraction, statistical data are calculated from the gray scale level matrix for different distance and directions. After feature extraction, we have to select the special features that are used for classification.

Hybrid SOM(Self Organizing Map) and BFR (Bradley Fayyad Reina) clustering algorithm is used in the proposed paper for identification of tumor images. The process of SOM begins with an initial input image. Then the image is sampled. SOM is used in the input image for initial clustering and reduction of dimensionality. If the given input image is 256*256 dimensions, then it is reduced according to SOM algorithm and the weight function is obtained. BFR is a variant of K-means designed to handle large data set. It assumes that the clusters are normally distributed around the centroid. It selects the infected image region and produces the result along with Hybrid SOM.

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Related Works: Biomedical image processing concentrates on the capture of image for both diagnostic and therapeutic purpose. The biomedical imaging techniques utilizes X-Ray (CT scan), sound (Ultrasound), magnetism (MRI) radioactive pharmaceuticals to know the current condition of the organ and can monitor the patient. The image processing is classified into general purpose image processing and image analyzer [4-7].

Govindaraj and vishnuvarthanam and murugan pallikonda rajasekaran recommended tumor extractor and tissue segmentation using K-means. Ben George and karnan developed bacteria foraging algorithm for segmenting MR images in less time of 31.21 seconds [6]. Somasundaram and kalaiselvi developed automated brain extraction algorithm for axial images. Vasuda and satheesh introduced an FCM algorithm for MR brain segmentation. Logeswari and karnan reported brain tumor detection on hierarchical self organizing map (SOM) technique with an average time period of 29.9708 seconds. Yan li and zheru chi used SOM to reduce the image segmentation time but MSE values are to be reduced.

Image Processing Steps

Some Introduction about Image Processing

Image Acquisition: The medical images are stored in a dataset which are obtained from public health library. The images arein the size of 460*307 bitmap images. The images are represented by each pixel that is used for further processing.

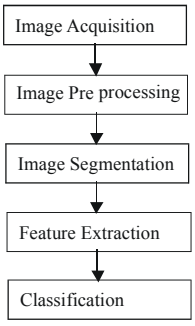

Fig. 1.1: Image processing steps

Image Acquisition: The medical images are stored in a dataset which are obtained from public health library. The images are in the size of 460*307 bitmap images. The images are represented by each pixel that is used for further processing.

Pre-Processing: Pre-processing in the initial stage that is used to process MRI image. Preprocessing is mainly done to remove unwanted noise and background from each image. Preprocessing performs several techniques like edge and corner detection, canny edge detector etc… with all this technique the noise is removed in preprocessing. The main noise removal is for reducing the memory that is consumed by each image [8-10].

Image Segmentation: Each digital image is segmented into multiple segments. The main aim of segmentation is to change the representation of the image into a more meaningful and easy to analyze. It is mainly used to locate the object and boundary [5]. The result of image segmentation is a set of segments that collectively covers the entire image. Each pixel in a region consists of a particular characteristic such as color, intensity and texture. For image segmentation shape and size of the object in the image must be known. The image is segmented based on the required characteristics like size, shape etc. the image are mainly segmented with the thresholding concept in threshold selection [11].

Feature Extraction: Feature extraction has an initial set of measured data and builds derived values. When the input data to an algorithm is large and suspected to be redundant, then it can be transformed into a reduced set of features. This process is called as feature selection. Feature contains the relevant information of the input data.

Classification: In image processing classification is based on contextual information. This technique is focusing on the relationship of the nearby pixels. The goal is to classify image using the pixel values and final output is obtained [8].

Govindaraj and vishnuvarthanam and muruganpallikondarajasekaran recommended tumor extractor and tissue segmentation using K-means. Ben George and karnan developed bacteria foraging algorithm for segmenting MR images in less time of 31.21 seconds [10]. Somasundaram and kalaiselvi developed automated brain extraction algorithm for axial images. Vasuda and satheesh introduced an FCM algorithm for MR brain segmentation. Logeswari and karnan reported brain tumor detection on hierarchical self organizing map (SOM) technique with an average time period of 29.9708 seconds. Yan li and zheru chi used SOM to reduce the image segmentation time but MSE values are to be reduced.

K-Means Clustering Algorithm: Image segmentation is the most used method to classify the pixel of an image. It divides image into number of regions and process the

image according to the needed characteristics. Most used clustering algorithm is K-means clustering. It is simple and computationally faster. It can work with large variables. Each image region has a centroid and k number is initiated to it. It classifies a given set of data into k number of disjoint cluster. Algorithm has two phases. First phase calculates the k-centroid and second calculates each point to cluster that is nearest centroid from data point. Euclidean distance is the method to define the distance of nearest centroid. Once the grouping is done it recalculates the new centroid. Each cluster is defined by its member object and the centroid of the cluster. Centroid of each cluster is the sum of distances from all objects [10].

Let us consider an image with resolution X and Y and image has to be clustered. Let P(x, y) be an input pixel,

K-Means Clustering Algorithm Steps:

Step 1: Initialize number of cluster k
Step 2: Calculate Euclidean distance d, between center and each pixel.

$d = ||p(x, y) - ck||$

Step 3: Assign all pixel to the nearest center based on distance d.
Step 4: Recalculate the new position of the center.
Step 5: Repeat the process.
Step 6: Reshape the pixel into image.

The proposed hybrid segmentation algorithm it's one of the enhancement of K-means clustering algorithm namely BFR (Bradley Fayyad Reina) algorithm. The overall process and methodology of proposed model will be explained in the following section.

Fuzzy C-Means Algorithm: Fuzzy c means is one of the most widely used methods for image segmentation. FCM retains more information of original image. One major disadvantage is that standard FCM is not to consider any spatial information in image context. Fuzzy C-means groups the pixel of the MR brain Images as number of 'n' clusters. The neighboring pixel of least mean distance from centroid is defined with low grad value.

Histogram-Based Method: Histogram method is the most efficient image segmentation method because they require only one pass through the image pixels. All the pixels in the image are processed. The main concept is peaks and valleys that are used to locate the cluster in the image [12]. A refinement in this technique is to recursively apply histogram seeking method to cluster for dividing into small clusters. Histogram approach can be quickly adapted to multiple frames. When multiple frames are considered histogram can be done in multiple fashions. The results of peaks and valleys are obtained and they are merged. Peaks and valley that are previously difficult to identify are likely distinguishable. The histogram is applied per pixel where result is used to determine the more frequent color for pixel location.

Proposed Work: The medical images are segmented using some segmentation algorithm, like K-means clustering algorithm, C-means algorithm etc...These algorithms are fast, simple and run efficiently in a dataset. The proposed model for bio medical image processing involves following stages: Pre-processing, Hybrid segmentation, classification and the evaluation of result. The working flow is shown in Fig. 1.2. MR image as the input for the proposed design and the image noise is removed using pre processing process and after noise removal images goes to segmentation here we are using hybrid segmentation methods that includes two specific algorithms, Self Organizing Map (SOM) and BFR. These algorithms are explained in the following sections.

Preprocessing Stage: This stage is implemented by applying a series of MR images that are taken from dataset. Preprocessing makes each particular image to follow initial procedures on image before it attempts for a special purpose processing. It removes the noise that is present in each image and increases the quality of the image. Normally, brain images are more sensitive than the other images; so it must contain minimum noise and maximum quality to obtain exact result. Therefore, this stage consists of two sub stage: De-noising and skull removal. Fig. 1.2 shows the Proposed architecture model for Hybrid Segmentation algorithm.

De-Noising: MRI images generally contain more noise, like Gaussian and Poisson noise. Majority of de-noising algorithm assume additive white Gaussian noise. Some algorithm is designed to reduce the noise that is present in Gaussian. These algorithms are edge preserving bilateral filter, total variation and non-local means. In this paper we use Median filter. Median filter is non-linear filter that effectively removes noise while preserving edges. Median filter process works by moving to each pixel throughout the image and replaces each value with the median value of neighboring pixel. This pattern of

neighboring pixel is called "window" which slides pixel by pixel over entire image. The process of median calculation is done by first sorting all the pixel values end replaces each values by considering the middle pixel value that is the median value. Image processing researches prefer the median filtering is far better than linear filtering for removal of noise which is by considering to the presence of edges. Finally output of this stage is a noise-free MRI image.

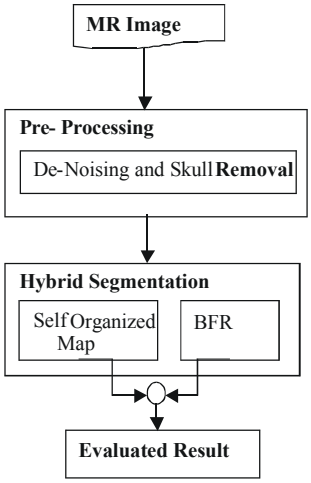

Fig. 1.2: Proposed architecture model for Hybrid Segmentation

Skull Removal: Background in each MR image does not contain any information but take more time to process, so removing background, skull, scalp, eyes and all structure are necessary. It mainly increases the amount of memory and makes it slow to calculate the result. Skull removal process is done using BSE (Brain Surface Extractor) algorithm. This algorithm is used only with MRI image. It filters the MRI images to remove irregularities and detects edges that are present in the image and performs morphological erosions and brain isolation. It performs surface cleanup and image masking. The final output is the removal of skull and a noise free MR image is obtained.

Hybrid Segmentation: Hybrid segmentation technique is integrating two or more technique which works efficiently by giving better results than the segmentation algorithms. This is possible only in the field of image processing, mainly in the area of medical image segmentation. Hybrid segmentation is mainly suitable for the diagnosis of brain tumor. This imaging process is more suitable to identify the lesions and tumor. The MRI image that contains tumor are shown below,

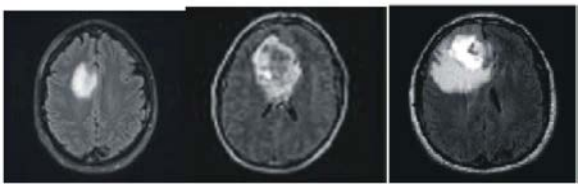

Fig. 1.3: Representation of various tumor images

Normally tumors will look like solid white tissues and consists of holes. Fig. 3. Seems the tumor variations a) represents solid tumor b) the variations among cells c) consists of holes.

Hybrid segmentation consists of two segmentation algorithm BFR and SOM algorithm.

BFR Algorithm: BFR (Bradley Fayyad Reina) is one of the clustering algorithms. Clustering is mainly done for the dataset that must be classified into groups. There are two clustering algorithms 1) hierarchical clustering 2) point clustering. BFR is appoint clustering algorithm, avoids multiple scan of the database. BFR is done by getting the dataset from Gaussian distribution and normally distributed across centroid.

The idea behind BFR algorithm is to keep clusters in the main memory. There are three sets. Discarded set (DS) points which are into the cluster and they are stored in the disk. They are kept in the main memory. Compressed set (CS) are mini cluster the points that are not close to any cluster. Retained set (RS) those points that neither fall in big cluster.

Algorithm for BFR

Input: MR image

Step 1: Datasets
DS - Discarded set
CS- Compressed set
RS - Retained set
Step 2: DS in main memory
Step 3: RS →N
: N=SUM (N) // sum of all points in the tumor image
RS=Sqt (SUM) // component of all points each diameter
Step 4: RS→CS // compressed set
Step 5: CS→DS // now cluster in main memory

Output:
Accurate Tumor is detected in minimum time.

SOM Algorithm: Self organizing map technique is used for the identification of tumor images. The processing commences with initialization, where random variables are taken for initial weight vector. In this paper, SOM is used for reduction of dimensionality and clustering of an image. With this SOM algorithm the tumor images are discovered exactly with accuracy.SOM algorithm explained in the following steps.

S*Step 1*: Processing of SOM starts with initialization where random variables are chosen for the initial weight
Step 2: Includes the sampling process by which input vector is drawn from input image.
Step 3: The neuron that wins is found and weight vector closest to the input vector is done.
Step 4: Finally the drawing of vector from input image is iteratively repeated.

RESULT AND DISCUSSION

Finally the tumor is identified after the long process of preprocessing and hybrid segmentation. Initially the MR images are taken from the dataset. N number of MRI images is sent to the initial processing stage that is De-noising and skull removal. This preprocessing is done to remove the noise from the image and to get the maximum image quality. Next stage is hybrid segmentation where with two algorithms self organized map and BFR algorithm and the tumor is identified. These two algorithms are mainly used in the brain image to identify the tumor and finally the accurate result is obtained.

Dice coefficient is a static method that is mainly used for comparing two samples. Dice coefficient is also known as "Sorensen Index". The required documents can be ranked according to the importance. Similarly coefficient is a function which computes the degree of similarity between a pair of text objects. Sorensen distance retains more heterogeneous datasets. It is popularly used in computer lexicography for measuring the association score of the given words. It is most widely used in image segmentation, for comparing output against reference image in medical applications. It is mainly used in performance measure of segmentation and gives more weighting where two images agree, the value ranges between 0 and 1.

The hybrid segmentation is mainly used to segment the MRI brain images. The images are first sent to the preprocessing technique, which is mainly used to reduce the noise using various techniques. The preprocessed image that is segmented using combined feature by using the techniques like skull removal and median filter. It works well and detects the accurate brain tumor. The image quality and performances are measured by dice coefficient. The dice must have higher value to variant the similarity between image and segmented image. Table 1.1 shows the comparison result for Hybrid Segmentation algorithm and Fig. 1.4 Performance evaluation of Hybrid Segmentation algorithm.

Table 1.1: The comparison result for Hybrid Segmentation algorithm.

Algorithm	Sample images	Dice coefficient
BFR	Image 1	0.5743
	Image 2	0.6342
	Image 3	0.8562
	Image 4	0.8261
SOM	Image 1	0.7271
	Image 2	0.7431
	Image 3	0.8241
	Image 4	0.8531
HYBRID	Image 1	0.8324
	Image 2	0.8531
	Image 3	0.9331
	Image 4	0.9231

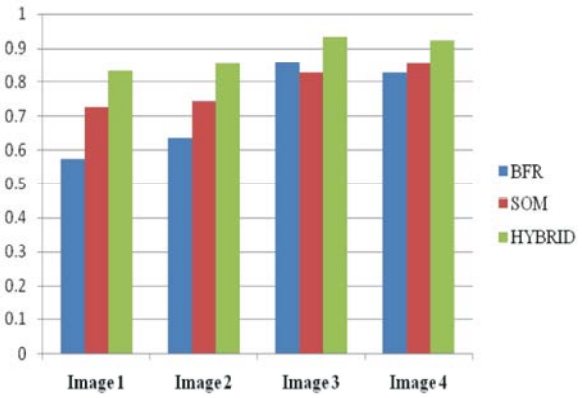

Fig. 1.4: Performance evaluation of Hybrid Segmentation algorithm

CONCLUSION

Hybrid segmentation is the combination of BFR and SOM based segmentation which is being proposed for segmentation of brain tumor images. A new method is implemented and applied on several image and results are compared and analyzed, has more performance with truth image. Comparative analysis of performance metrics has been obtained. This paper compares the performance of segmentation algorithm such as SOM and BFR based hybrid segmentation. Hybrid segmentation algorithm provides more accuracy and the computation is done in a less time. The tumor image is identified accurately by hybrid segmentation algorithm and it shows the exact result with higher accuracy.

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