A HYBRID BIO INSPIRED PSO-ACO TECHNIQUE USING KNN FOR DETECTION OF BRAIN TUMOR

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Abstract: Magnetic Resonance Imaging scan produce detailed study of the internal structure of human brain and other parts of the body. Brain tumor segmentation from brain MRI image is a very remarkable task. A large number of techniques have been proposed for the automatic brain tumor detection and segmentation from the brain MRI images and scans. In this paper, the existing brain tumor detection and segmentation techniques for brain MRI images have been discussed for the Comparative study of particle swarm optimization and ant colony optimization based clustering techniques for detection of brain tumor in MRI images. The brain tumor segmentation are detected for the KNN techniques. The Brain tumor segmentation are the different tissues for active cells and edema from normal brain tissues of White Matter, Gray Matter.MRI based brain tumor segmentation studies are attraction and attention in latest years due to non-invasive imaging and good soft tissue contrast of Magnetic Resonance Imaging (MRI) images.

Keywords: Brain MRI images, Clustering, PSO, ACO, KNN, Tumor segmentation.

1. INTRODUCTION

The segmentation of the human brain has become an coming out area of research and hence diverse creative is available in the field. For the diagnosis and treatment of the patient suffering from brain tumor, doctors take the help of MRI scans of the brain. But the diagnosis of the MRI scan is done manually by the doctor which is a time consuming task and the accuracy of the result depends on the experience of the doctor. The conclusions may vary from one doctor to another. Therefore, there is a need to overcome these problems and to automate the analytical process of brain tumor detection in MRI images. For this, biomedical image processing techniques are applied on the MRI scans [1] [2]. Tumor is an uncontrolled growth of cancer cells in any part of the body. Tumors are of different types and have different characteristics and different treatments. The brain tumors are classified as primary brain tumors and metastatic brain tumors. The former begin in the brain and tend to stay in the brain.

1.1 Tumor

Abnormal growth of cells developed inside human body is called as Tumor. Brain Tumor is an intra-cranial solid neoplasm occurs within the brain or the central spinal canal. Brain tumor is implicitly serious and life-ominous disease because brain is very fragile part of human body to treat for the Brain tumors can be malignant that is cancerous or benign that is non-cancerous.[3] Treatment of brain tumor depends on proper diagnosis and depends on the different factor like the type of tumor, location, size and state of development. MRI is technique used to measuring density of photons in tissue. Early and proper detection of tumor is the key for the proper treatment. Previously stage of tumor is used to be detected manually with the help of observation of image by doctors and sometimes it takes more time and sometimes results may inaccurate. Detection are the process of segmentation involves the of size and location of tumor. Now a day's many computer aided tool is used in medical field. These tools possess a property of quick and accurate result. The features are extracted using wavelet and quad tree transform in that the specific feature is Gray Level Co-occurrence Matrix.[4,5].

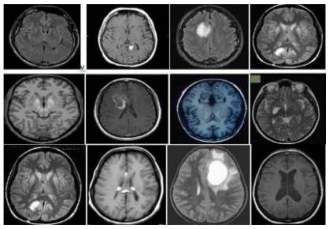


Fig 1: MRI brain Image dataset

The features extracted are used in the Knowledge Based in successful classification of unknown Images. These features are normalized in the range -1 to 1 and given as an input to support vector machine Classifier [6,7]. The Gabor filters are poor due to their lack of orthogonality that results in redundant features at different scales or channels.

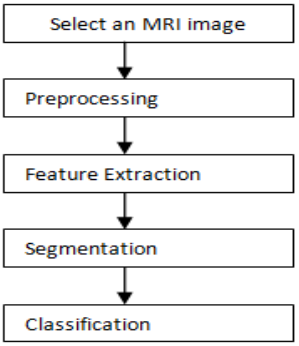


Fig 2 : Stages in Brain Tumor Detection

That are different type are according to their size, shape and location. Tumors can be classified as: -
1. Benign
2. Pre- Malignant
3. Malignant.

Benign means non-progressive. So these types of tumors cannot be spread and are non-cancerous. But these can have negative effect such some may press against nerves of blood vessels and can cause pain [8].

1.2 Swarm intelligence

Swarm intelligence are based on the population of individuals.The algorithm maintains and successive improves a collection of potential solutions until some stopping condition is met. The solutions are initialized randomly in the search space. The search information is propagated through the interaction among solutions. Based on the solutions converting and solutions are guided toward the better areas. In swarm intelligence algorithms, there are several solutions which exist at the same time. The premature convergence may happen due to the solution getting clustered together too fast.[14] The population are the different thing of measure of exploration and exploitation. Based on the population different changing measurement, the state of exploration and exploitation can be obtained. The population different definition is the first step to give an accurate observation of the search state.

PSO is a population-based stochastic algorithm mode on social behaviors observed in flocking birds. A particle flies through the search space with a velocity that is dynamically adjusted according to its own and its companion historical behaviors. Each particle's position represents a solution to the problem. Particles tend to fly toward better and better search areas over the course of the search process. Different topology structure can be utilized in PSO, which will have different strategy to share search information for every particle.

1.3 Clustering

In the Clustering technique which is most frequently used in the MRI Segmentation. Its divides pixels into classes,without having prior information [16]. It classifies the pixels having largest probability into the same class. The clustering technique, the training is done by utilizing the pixel characteristics with properties of each class of classified pixels.

(A) K-means

K-means clustering algorithm is the simplest of the existing clustering algorithms that can do clustering of pixels into numerous regions based on pixel properties. This method is called hard clustering as the clusters must be distant enough from each other and every pixel is assigned the membership function in such a way that it belongs to one particular region only.

(B) Fuzzy C-means (FCM)

FCM clustering is an unsupervised method for the analysis of given input image. The fcm clustering algorithm assigns membership functions to every pixel in an image corresponding to each cluster center based on the distance of the cluster center from that particular pixel.

(C) Hierarchical clustering

Hierarchical clustering method works by grouping data objects in an image into a tree of clusters. Hierarchical clustering does not need to specify the number of clusters in advance.

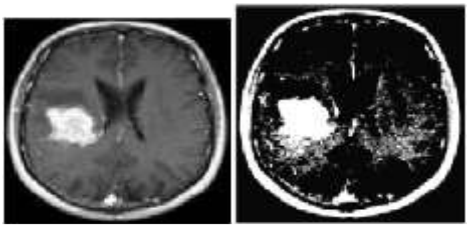

(a) (b)

Fig.3: Clustering-based segmentation: (a) Original input image; (b) Output of fuzzy c-means clustering.

The existing techniques for segmentation of brain tumor from MRI images can be broadly classified into four categories are based segmentation, edge based segmentation, region based segmentation and clustering based segmentation techniques. In threshold based segmentation techniques, the objects from the image are extracted on the basis of a particular threshold. In region based segmentation techniques, the image is divided into regions having different properties. In the case of clustering based segmentation techniques, an image is divided into a number of clusters based on the value of membership functions allotted to each pixel in the image.

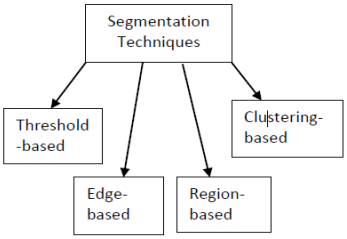


Fig.4 Segmentation techniques.

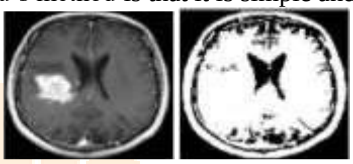
1.3.1 Thresholding

Thresholding is one of the frequently used methods for image segmentation [34]. This method is suitable for images with different intensities of pixels. Using this method, the image is partitioned directly into different regions based on these intensity values of the pixels.

(A) Global thresholding

Global thresholding method chooses only one threshold value for the entire image. Global thresholding is used for bimodal images. It is simpler and faster in computational time only if the image has uniform intensity distribution and high contrast between foreground and background.

Otsu's thresholding method depends on a discriminant analysis which divides the image into two classes based on the intensity of gray levels in the image [35]. The main advantage of Otsu's method is that it is simple and effective to implement.

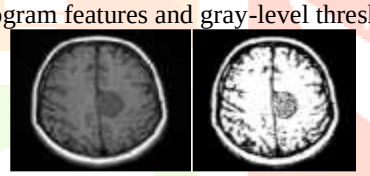


(a) **(b)**

Fig.5**:** Otsu's thresholding method: (a) original input image; (b) Output of Otsu's method.

(B) Local thresholding

Threshold values are chosen locally by dividing an image into sub-images and threshold value for each part is calculated. A local thresholding technique takes more computational time than the global thresholding. Histogram thresholding: Histogram thresholding segmentation is based upon the thresholding of histogram features and gray-level thresholding in an image.



(a) (b)

Fig.6: Histogram thresholding method: (a) original input image; (b) Output of histogram thresholding.

1.3.2 Edge Based Segmentation

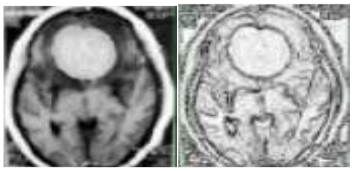
Edge based segmentation methods divide an image based on abrupt changes in the intensity of pixels near the edges [36]. The result is a binary image with edges of the objects being detected. Based on the theory, there are two basic edge based segmentation methods viz. gray histogram and gradient based methods[37].

(A) Gray Histogram Technique

The result of the technique of gray histogram mainly depends upon selection of threshold (T). The image is converted into grayscale image and after that gray-level thresholding is applied on the histogram of that image.

(B) Gradient Based Method

In the gradient based method, the difference between intensity values of neighboring pixels is taken into account [38].These methods involve applying gradient operators on the image. The basic edge detection operators used in this method are Sobel operator, Canny operator, Laplace operator, Laplacian of Gaussian (LOG) operator etc., out of which Sobel and Canny operators produce better results Edge detection methods exhibit a balance between accuracy and noise immunity. [39]If the level of detecting accurate edges is too high, then noise may produce fake edges and if the degree of noise immunity is too high, then some parts of the image containing important information might go undetected.



(a) (b)

Fig.7: Edge based method: (a) original input image; (b) Output of Sobel operator.

1.3.3 Region Based Segmentation

Region based methods divide an image into regions that are similar on the basis of a set of a particular criterion[40].

(A) Region growing

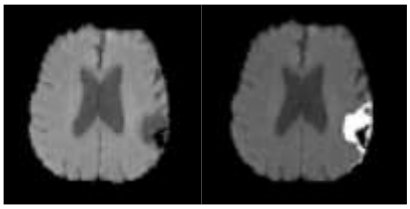
Region growing method is one of the most frequently used segmentation methods. This method initiates with a seed pixel and grows the region by incorporating the neighboring pixels based on some threshold value [41].

(B) Region splitting and merging

The image is split into a number of different regions depending on some criterion and after the splitting, it is merged. The whole image is initially considered as a single region and then the internal similarity of the image is calculated using standard deviation.[42] If the variation is very large, then the image is split into regions using some threshold value. This process is repeated until no more further splitting of the region is possible. Quad tree is a common data structure used for splitting.

(C) Watershed segmentation

Watershed segmentation algorithm can be used if the image has uniform contrast distribution and the intensity of the foreground and background is distinguishable.[43] Watershed algorithm is also used to find the weak edges in the images.



(a) (b)

Fig.8: Region-based segmentation: (a) original input image; (b) Output of region growing.

2. LITERATURE SURVEY

Bhagwat et al [17]compare a paper of K-means, FuzzyC-means and Hierarchical clustering algorithms for detection of a brain tumor.The Time required for hierarchical clustering is least and fuzzy c-means is maximum to detect the brain tumor whereas K-means algorithm produces more accurate result compared to Fuzzy c-means and hierarchical clustering. Detection of brain tumor involves various stages such as image preprocessing, feature extraction, segmentation, and classification. Pulse couple neural network uses for image smoothing, feature extraction and image segmentation, and Back Propagation Neural Network is used for classification that classifies the image whether it is normal or abnormal.

Magdi et al[18]used an intelligence Model for brain tumor diagnosis from MRI images. Preprocessing used to reduce the noise by filtration and to enhance the MRI image through adjustment and edge detection. Texture features are extracted and Principal Component Analysis (PCA) is applied to reduce the features of the image and finally, back propagation neural network (BPNN) based Pearson correlation coefficient was used to classify the brain image.The First phase is to preprocess an image for segmentation, the second phase is to segment an image using granular rough set and third phase is to separate white matter from a segmented image using fuzzy sets. This method was compared with mean shift algorithm. This method performs noise removal function, Segmentation,and morphological operations which are the basic concept of image processing.

Parveen and Amritpal Singh [19], proposed data mining methods for classification of MRI images. Classification is performed in four stages: pre-processing, segmentation, feature extraction, and classification. In the first stage, enhancement and skull stripping is performed to improve the speed and accuracy. Segmentation was done by Fuzzy C-Mean clustering.

Kailash Sinha and G.R. Sinha [20], presented a comparative study of three segmentation methods implemented for extraction of tumor in the MRI images. Proposed methods are k-means clustering with watershed segmentation algorithm, optimized k-means clustering with genetic algorithm and optimized c- means clustering with genetic algorithm. The problem of over segmentation has also been reduced. Also it is found that the optimized c-means perform better that optimized k-means method.

H. B. Nandpuru, S. S. Salankar and V. R. Bora [21], in their paper introduced classification techniques based on Support Vector Machines (SVM) and applied to brain image classification to recognize normal and abnormal MRI brain image. Proposed technique includes following stages: preprocessing, feature extraction, feature reduction, training, storing the database and testing. In this paper gray scale, symmetrical and texture features used for feature extraction from MRI Images.

Raj Kumar and G.Niranjana[22] perposed to the cellular network based segmentation of MRI brain tumor and classification of tumors using Gray level Co-occurrence matrix features and artificial neural network.After the selection of seed pixel from co-occurrence features, it is checked that whether the selected seed pixel belongs to the abnormal region or not and is checked by calculating the Run-length features.

P.Dhana lakshmi *et al,* 2013;[23] used k-means clustering for automatic brain tumor segmentation and area calculation. The proposed algorithm shows the better accuracy and reproducibility.

G.Evelin Sujji *et al,* 2013;[24]threshold based image segmentation. The outcome shows the proper detection of region of interest.

Divya Kaushik *et al*, 2014;[25] perposed genetic algorithm based segmentation. The proposed algorithm describes the extraction of brain tumor regions from the corners as well.

Swe Zin Oo *et al*, 2014;[26] present watershed segmentation and morphological operation based brain tumor segmentation.

Alan Jose *et al*, 2014; introduced K-means clustering and fuzzy c-means algorithm. The algorithm shows the exact location and detection of tumor[27].

3. PARAMETERS USED TO MEASURE PERFORMANCE

a) Random: A measure of non uniformity in the image based on the probability of co-occurrence values.
b) Energy: A measure of homogeneity.
c) Difference moment: A measure of contrast.
d) Inverse Difference Moment: A measure of local homogeneity.

e) Correlation: A measure of linear dependency of brightness.

4. SUMMARY AND CONCLUSION

In this paper, several existing brain tumor detection and segmentation techniques for brain MRI images have been discussed. The various existing segmentation techniques like thresholding-based, region-based, edge-based and clustering-based segmentation techniques have been described for the extraction of brain tumor from MRI images. The intensity-based thresholding methods provide good results but fail for the images with large intensity differences. The region-based segmentation is good for high contrast images but for low contrast images, it does not provide efficient results. Edge-based segmentation provides better results but fail for noisy images. Clustering-based segmentation is very simple, fast and provides good results but for noisy images, it produces inaccurate results. In conjunction with this different methodologies present by the researchers are considered to conclude that machine learning shows an important role in brain tumor detection and classification together with appropriate segmentation approach. This paper also describes various parameters used to measure performance. Image processing sequence includes i) Image Acquisition ii) Image Preprocessing iii) Segmentation iv) Feature Extraction and Selection and v) Classification. Many algorithms have been proposed in the literature for each image processing stage.

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