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Dynamic Brain Tumor Image Detection Using Median Filter and Genetic Algorithm

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***Abstract*- Processing of MRI image for detection of disease in human body was done manually by heath specialist. But most of machine develops automation for the same, so researchers are working in this field to improve the accuracy of detection. This paper has proposed the brain tumor detection algorithm in MRI images. Due to the dynamic nature of tumor in any part of brain sculpture genetic algorithm was used for tumor detection. Proposed tumor detection model use Teacher Learning Based Optimization genetic algorithm which classify image pixel into two regions first was tumor and other was non tumor portion of brain. So no need of training for the detection of tumor from image is required. Use of median filter increase detection accuracy with gray scal image input in fitness function. Real image brain tumor dataset was taken for testing of algorithm. Result shows that proposed model has improve the precision, recall, f-measure evaluation parameters as compare to previous approaches.**

***Keywords*- Digital Image segmentation, Brain tumor, Genetic Algorithm, Segmentation.**

I. INTRODUCTION

Clinical image examination [1] can be utilized as primer screening strategies to help health specialists. Different parts of image bifurcation features and calculations have been widely investigated for a long time in a large group of researcher. Although, the detection difficult is still present, with no broad and remarkable arrangement, because of an enormous and continually developing number of disease, huge varieties of their properties in images, diverse clinical imaging modalities, and related changes of sign homogeneity, infidelity, and disorder for each disease.

Computed Tomography and Magnetic Resonance imaging are the most generally utilized radiographic strategies in analysis, clinical examinations and treatment arranging. The thought process is to examine the issues experienced in segmentation of CT and MR images. This relative benefits and confinements of strategies at present accessible for segmentation of clinical images. With expanding utilization of CT and MR imaging for analysis, treatment arranging, clinical examinations, it has gotten practically mandatory to utilize algorithms to help radiological specialists in clinical finding, treatment arranging.

Dependable calculations are required for the outline of anatomical structures and different areas of disease. The strategies accessible for segmentation of clinical images are explicit to application, imaging methodology and sort of body part to be considered. Segmentation dependent on dim level methods, for example, thresholding, and district based are the easiest procedures and discover restricted applications. Be that as it may, their presentation can be improved by incorporating them with man-made consciousness procedures.

Methods dependent on visual features have fantastic outcomes on clinical image segmentation. The obstruction is that in specific situations it gets hard to accurately choose and mark area in an image, experiences issues in portioning complex structure with variable shape, size, and properties. A wide range of neural system based calculations are likewise accessible for surface based segmentation and grouping having great precision. But to adopt dynamic situations genetic algorithm performs well in image segmentation.

Paper is structured into few sections first was introduction than second structure elaborate various research work done by scholars in same field of image segmentation. Further in third section paper has detailed the proposed genetic based image brain tumor model detection with block diagram explanation. In fourth section compares performance of proposed model with other algorithms. Finally paper get conclude with finding of proposed model.

II. LITERATURE SURVEY

Astina minz, Prof. Chandrakant Mahobiya [1] proposed an algorithm for tumor detection in brain MRI by utilizing the Adaboost artificial calculation. The proposed framework comprises of three sections, for example, input image Preprocessing, effective feature extraction and Classification. Preprocessing has evacuated

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unwanted pixels in the input image information, it change RGB picture into grayscale, middle filter and thresholding segmentation is applied. For feature extraction by utilizing GLCM strategy 22 features were extricated from a MRI. For grouping boosting method utilized (Adaboost). It gives 89.90% exactness and result in typical brain or in Malignant or Benign kind of tumor. This work has few issues so scholar can work of quadratic and polynomial kernel function for learning. The precision of the framework will be expanded by expanding training database pictures. Additionally the framework can be executed for various sorts of classes like Glioma and Meningioma.

Garima Singh, Dr. M.A. Ansari [2] proposed a novel procedure which incorporates Normalization of Histogram and K-means Segmentation. This work starts with input image pre-processing, so as to evacuate the undesirable signals or disorder from it. Some of know filters were used for reorder the image pixels which was Median filter, Un-sharp concealing filter, Adaptive filter, Averaging filter and Gaussian filter is utilized in the MRI pictures. The histogram of the pre-prepared picture is standardized and segmentation of MRI is finished. At long last, the picture is categorized by utilizing K-means calculation so as to take out the tumor from the MRI. Productive grouping of the MRIs is finished utilizing NB Classifier and SVM in order to give precise expectation and characterization. Gullible Bayes and SVM Classifier give precision 87.23% and 91.49% separately. SVM give better order exactness. For usage MATLAB is utilized. The proposed technique has a few confinements that it couldn't discover the exact or precise limit of the tumor locale.

Zehra Karhan et al. (2015) [3] proposed a technique that is utilized for deciding if the clinical picture has a place with that class or not, utilizing textural features of the clinical pictures. The investigation was directed on the pictures in the IRMA (Image Retrieval in Medical Applications), in the worldwide database. Subsequent to playing out the pre process on clinical pictures, discrete wavelet change (DWT) was applied and afterward the discrete cosine change (DCT) was applied to the each band parts. Subsequent to extricating the features, utilizing of 1%, 3%, 5% and 7% of the acquired information were characterized. K-Nearest neighbor calculation was utilized in characterization stage. The characterization execution was around the 87 rate. One of the fundamental features of the wavelets is that they offer a concurrent limitation in time and the recurrence area.

Ketan Machhale et al. (2015) [7] proposed a scholarly grouping framework to perceive the ordinary and irregular MRI brain pictures. At present, choice and the treatment of cerebrum tumors depends on the manifestations and radiological appearance. Attractive reverberation imaging (MRI) is the significant controlled device for anatomical judgment of the tumors in cerebrum. These days, different strategies were utilized for the characterization of the cerebrum disease. Under these procedures utilized the modules like picture preprocessing, picture segmentation, picture include extraction and resulting order of cerebrum malignant growth are performed. Bolster Vector Machine (SVM), K-Nearest Neighbor (KNN) and Hybrid Classifier (SVM-KNN) are the different AI procedures are utilized.

Swarnalatha et al. (2013) [8] proposed an idea dependent on the novel fluffy methodology with bit plane FCMBP approach. The bit plane separating strategy is utilized to cut the introduced picture for grouping to discover crushed district of the introduced picture. The cut picture must be standardized with old strategies and afterward contrasted and fluffy procedure for the better characterization and the group of the ruined segment. In this way control focuses are extricated that are additionally required for remaking of the pictures. The exhibition of the fluffy methodology with bit plane strategy is assessed with the assistance of recreation and it is discovered that our methodology yields better outcomes when contrasted with other open strategies. Its disservice is only productive for most huge piece planes (MSB).

III. PROPOSED MODEL

In this section working steps of proposed methodology was explained in detail with complete block diagram shown in fig 1.

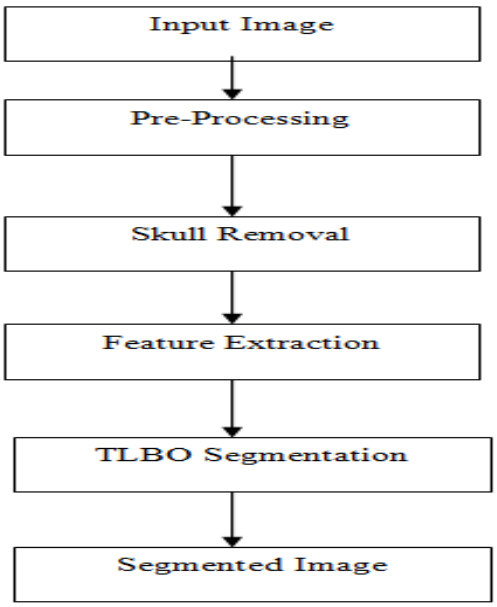


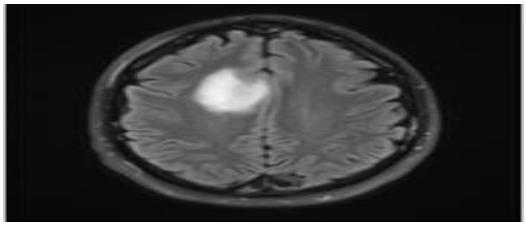
Fig 1. Proposed work block diagram.

1. Pre-Processing:
Input brin tumor image dataset is pre-process where dimension of the image were restructure as per the working environment of algorithm. So each input image is resized into fix dimension. Further work is done in gray

scale, so conversion of RGB to gray scale or HSV to Gray scale is also done in this step.

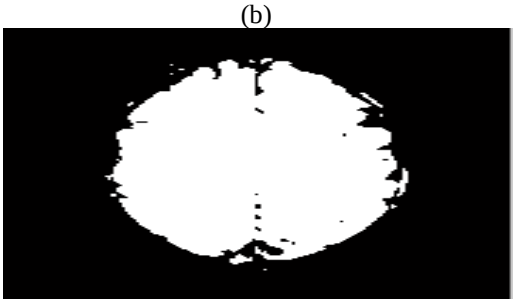
2. Median Filter:
In this step a fix size window let say a frame of 2x2 is move in image from left to right and tp to bottom. So this movement replaces image pixel value as per neighboring pixels.

3. Skull Removal:
Convert the gray scale image into binary image by Thresholding. The output binary image F has values of 1 (white) for all pixels in the input image with pixel value greater than threshold and 0 (black) for all other pixels. This image format has two classes where 1 stands for non tumor potion and 0 for tumor portion. So a pixel is represent by P than if P equal to 1 if F is greater than T otherwise P equal to 0 if F is less than T where T is threshold value while F is filter image pixel. So image was redesign by replacing original pixel value at place of 1 which is brain portion of the input brain tumor image. In other condition where 0 is presentremove original pixel value and replace this by 0.



(a)

(b)



(c)

Fig 2. (a) Image before skull removal. (b) Image after binary segmentation. (C) Image after skull removal in binary format.

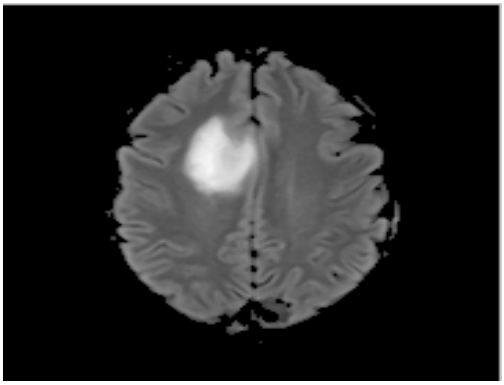


Fig 3. Image after skull removing process.

4. Feature Extraction:
Image obtained after the skull removal is in gray format, as this work take colr feature for the segmentation so no separate processing required in this step. These reduce the execution time of the model as well. Hence, as per gray scal pixel values range in 0 for black to 255 for white.

5. TLBO Algorithm:
5.1 Generate Population: Here assume some cluster set that are the combination of different pixel values. This is generating by the random function which select fix number of pixel values for the centroid. This can be understand as let the number of centroid be Cn and number of pixel values are N then one of the possible solution is {C1, C2, …..Cn}.

In the similar fashion other possible solutions are prepared which can be utilizing for creating initial population represent by ST matrix.

ST[x] ←Random (N, Cn)

5.2 Teacher Phase: The Euclidean distances d between two solutions X and Y is calculated by;

$$D = \sqrt{sum((X - Y)^2)}$$

So the matrix D contain all the values of the centriod distance from the probable solutions then find the minimum distance which will evaluate specify best possible solution.

Top possible solution after sorting will act as the teacher for other possible solutions. Now selected teacher will teach other possible solution by replacing fix number of centroid as present in teacher solution. By this all possible solution which acts as student will learn from best solution which acts as teacher. This difference modifies the existing solution according to the following expression;

X_{new}, i = X_{old}, i + Replacing Cluster value

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Where, X_{new}, i is the updated value of X_{old}, i. Accept Xnew, i if it gives better function value.

5.3 Student Phase: In this phase all possible solution after teacher phase are group for self learning from each other. This can be understand as let group contain two student then each student who is best as compare to other will teach other solution. Teaching is similar as done in teacher phase; here replacing fix number of centroid is done which is similar as in best student of the group.

- For i = 1: Pn // Pn: Number of student group
- Randomly select two learners Xi and Xj, where i is not equal to j
- If f (Xi) < f (Xj)
- X_{new}, i = X_{old}, i + ri (Xi − Xj) (for a minimization problem)
- Else
- X_{new}, i = X_{old}, i + ri (Xj − Xi)
- End If
- End For

Accept X_{new} if it gives a better function value. After completion of student module of TLBO algorithm, iteration breaking condition is check. So as per loop breaking if maximum number of rounds get complete than final best chromosome segment the image otherwise teacher module of TLBO get start.

6. Segmented Image:
This is the final step of the proposed algorithm for brain tumor image segmentation. In this step once iteration gets over than best chromosome from the updated population was extract which further divide the image into two clusters first was tumor region and second was non tumor portion. Output image show tumor in white color pixel value while non tumor region in black color pixel value.

7. Proposed Algorithm:

- I ←Pre-processing(MI)
- I←Median_filter(I)
- WSI←Skull_removal(I) // without skull Image
- ST←Generate_population(WSI)// set of chromosome
- While (!MaxGeneration)
- ST←Teacher_Phase(ST, WSI)
- ST←Student_Phase(ST, WSI)
- EndWhile
- B←best _chromosome(ST)
- SI←Segment_image(WSI, B)

IV. EXPERIMENT AND RESULTS

Comparison of proposed model is done by existing method proposed in [12]. While both model were implement on MATLAB software where machine have 4 Giga Hertz of memory to operate and I3 processor 6th generation.

1. Evaluation Parameter:
As various techniques evolve different steps of working for segmenting image into appropriate category. So it is highly required that proposed techniques or existing work need to be compare on same dataset. But cluster which are obtained as output is need to be evaluate on the function or formula. So following are some of the evaluation formula which help to judge the clustering techniques ranking.

$$\text{Precision} = \frac{\text{True_Positive}}{\text{True_Positive} + \text{False_Positive}}$$

$$\text{Recall} = \frac{\text{True_Positive}}{\text{True_Positive} + \text{False_Negative}}$$

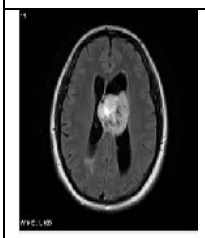
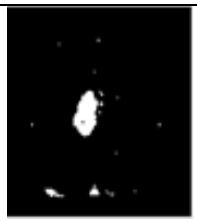
$$F_Score = \frac{2 * \text{Precision} * \text{Recall}}{\text{Precision} + \text{Recall}}$$

$$Accuracy = \frac{Correct_Classification}{Correct_Classification + Incorrect_Classification}$$

In above true positive value is obtained by the system when the classified pixel is same as in actual case or ground truth pixel. While in case of false positive value it is obtain by the system when the classified pixel is not of same case as in actual ine or ground truth pixel.

2. Results:

Table 1. Comparison of input and output of MRI image for Tumor detection.

Original Image	Previous Work Segmentation	Proposed Work Segmentation
		
		

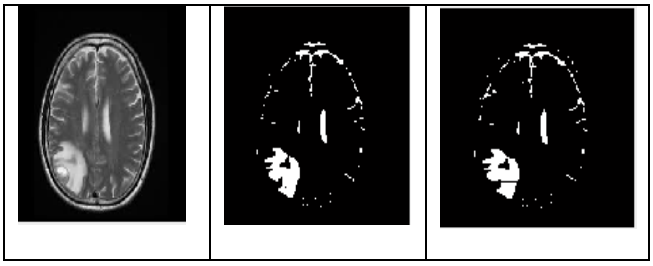


Table 2. Precision value comparison from proposed genetic approach.

Images	Precision Value Comparison	
	Previous	Proposed
Set 1	0.96965	1
Set 2	0.997754	0.99995
Set 3	0.992907	0.994622

Table 2 shows that proposed work has achieved a high precision value as the testing files are increasing. It has shown in table that TLBO genetic algorithm segmentation is more accurate as compare to self organizing mapping.

Table 3 shows that proposed work has achieved a high recall value as the testing files are increasing. It has shown in table that TLBO genetic algorithm segmentation is more accurate as compare to self organizing mapping.

Table 3. Recall value comparison from proposed genetic approach.

Dataset Percent	Recall Value Comparison	
	Previous	Proposed
Set 1	0.998783	0.998817
Set 2	0.99888	0.998817
Set 3	0.996114	0.998918

Table 4. Recall value comparison from proposed genetic approach.

Dataset Percent	F-Measure Value Comparison	
	Previous	Proposed
Set 1	0.983742	0.998814
Set 2	0.997624	0.998882
Set 3	0.994508	0.996764

Table 4 shows that proposed work has achieved a high F-measure value as the testing files are increasing. It has shown in table that TLBO genetic algorithm segmentation is more accurate as compare to self organizing mapping.

Table 5. F-Measure value comparison from proposed genetic approach.

Dataset Percent	Accuracy Value Comparison	
	Previous	Proposed
Set 1	96.9033	99.7782
Set 2	99.5756	99.7778
Set 3	98.91325	99.359

Table 5 shows that proposed work has achieved a high accuracy value as the testing files are increasing. It has shown in table that TLBO genetic algorithm segmentation is more accurate as compare to self organizing mapping.

Table 6. Execution time value comparison from proposed genetic approach.

Dataset Percent	Execution Time (second) Value Comparison	
	Previous	Proposed
Set 1	90.913	81.2947
Set 2	87.6511	75.4828
Set 3	87.2529	79.7428

Table 6 shows that proposed work has achieved a low execution time value as compare to previous work. It has shown in table that TLBO genetic algorithm segmentation is more accurate as compare to self organizing mapping.

V. CONCLUSIONS

As the tumor segmentation plays important role in brain tumor treatment. So proposed method utilize the genetic approach to segment the MRI image of brain tumor into tumor and non tumor region. Here algorithm not needs any kind of prior training for classification. It is obtained that proposed algorithm uses TLBO genetic algorithm which segments the image with high accuracy.

This work has increased the accuracy of the segmentation so the medical diagnosis gets easy and fast. Here overall precision and recall values are also good from segmentation view. In future one can adopt different genetic approach for segmenting of user MRI image as well.

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