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Research Article

DEVELOPMENT OF SEGMENTATION ALGORITHMS FOR BRAIN TUMOR DETECTION AND CLASSIFICATION USING MR IMAGES AND PERFORMANCE ANALYSIS

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A B S T R A C T

This work introduces an optimized deep learning mechanism; named Dolphin-SCA based Deep CNN, to improve the accuracy and to make effective decisions in classification. Initially, the input MR images are given to the pre-processing and then, subjected to the segmentation process. The segmentation process is carried out using a fuzzy GVF deformable hybrid model with Dolphin Echolocation based Sine Cosine algorithm (Dolphin-SCA). Then, the feature extraction process is performed based on power LBP and statistical features, like mean, variance, and skewness.

INTRODUCTION

A group of tissues that are prearranged with the creation of irregular cells is known as Brain tumor and in recent years; it acts as a major reason for the death of a large number of people. There are various kinds of cancers, among which brain tumor is the serious disease that requires immediate detection and effective treatment to save the life of the patient.

The Association of American Brain Tumor states that, brain tumor is the second leading cause of cancer-related death among children below 20 years. In addition, it acts as the second leading cause in men among age group 20-39, and fifth leading cause among female between the age 20-39 [1].

One of the most challenging and important problems associated with the medical image analysis is the segmentation of the image. Facilities and Requirements: The experimentation of proposed technique is done using a PC Windows 10 Operating System with Intel 2.16 GHz processor having 2GB RAM. Complete coding is in MATLAB.

System Architecture

Image Acquisition: image processing can be thoroughly described as the movement of recouping an image from some source. Performing picture securing in picture planning is reliably the first in the work procedure course of action considering the way that, without a picture, no taking care of is possible. In the proposed framework, MR images from brats database that contains data about the pictures and it has unique picture and ground truth of the first picture [2,9]. Magnetic resonance imaging (MRI) is a method utilized fundamentally in clinical settings to deliver top-notch images of human body's interior life structures.

Image Preprocessing: images are regularly undermined by arbitrary variety in force, brightening or have helpless differentiation and can't be utilized straightforwardly. pre-processing is never really noise and obscuring just as ringing impact so as to get the improved and much clear picture for our motivation. to expel the noise from pictures, median filter is utilized. it is a nonlinear computerized separating method, frequently utilized [2]

Segmentation: it is a procedure of dividing an advanced picture into various fragments. to change the portrayal of a picture into something that is increasingly important and simpler to investigate [2,9]. It is done utilizing active contour model or deformable model. dynamic contour depicts the article limits or some other highlights of a picture to frame a parametric bend or shape. arch of the models is resolved with different shape calculations utilizing external and internal forces applied. outside energy is characterized as the blend of the powers because of the picture which is explicitly used to control the situating of the form on to the picture. Inner energy is to control the deformable changes [3]

Feature Extraction: To extract the required features for training the classifier, Histogram of original image and ground truth image is extracted [4]

Classification: Support Vector Machine (SVM) to classify the image into tumor and non-tumor [2, 5]

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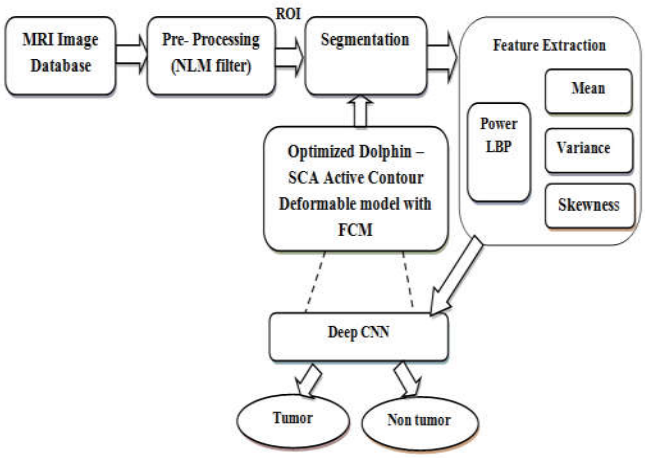


Figure 1 Block diagram of proposed work

Evaluation Metrics: Performance analysis Metrics like Accuracy, Sensitivity and specificity are used.

- As shown in the figure 1 images are taken from BRATS database which contains ground truth information is obtained by the BRATS database..
- To remove the noise from the original image, median filter is used in pre-processing
- The process of Segmentation is done active contour model or deformable model.
- Feature extraction is done through the histogram of ground truth image is extracted. To extract the required features for training the classifier.
- DCNN is used as a classifier [2] Performance analysis matrix like sensitivity, specificity and accuracy are used.

METHOD

Removal of noise from unique image by median filter: in clinical picture preparing region, the significant significance is given to acquire the best quality MR images [6-8, 10]. In any case, typically the caught MR images are increasingly helpless to drive clamor (salt and pepper commotion) [7,9]. The commotions in the clinical pictures are unavoidable however, the evacuation of those noises are required to help the visual greatness of the picture. The salt (white) and pepper (black) noise is increasingly pervasive noise in brain MR images, which are caused because of unexpected drifters during recording of image, and the mistakes happened in the signal frequencies of the clinical imaging instrument. salt and pepper noise through same probability upsets the nature of picture by arbitrarily debasing the pixels with two extraordinary qualities 0 (black) and 255 (white) additionally it corrupts the best subtleties in the clinical picture, for example, edges, textures and contours.

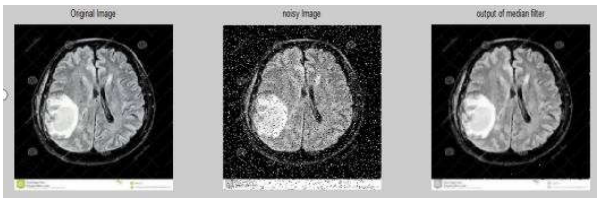


Figure 2 Output of the median filter

Thus concentration should be on the preprocessing of brain MR images. It is decayed into recognition of commotion [10,11], expulsion of noise utilizing various kinds of clamor channels. here we have utilized middle channel to evacuate the salt and pepper clamor from the boisterous picture to get unique picture as appeared in the figure 2.

Number of iterations performed using active contour model: At the 75th iteration, we got definite region, limit and example of the characterized area (tumor). The resultant picture is then morphologically shut. A proper organizing component is distinguished, its size is calibrated and a shut picture is gotten. at long last, these shut images are increased to acquire a sectioned picture as appeared in figure 3 , got outcomes were level set strategy tried in various manufactured MRI successions of various patient [7, 11]

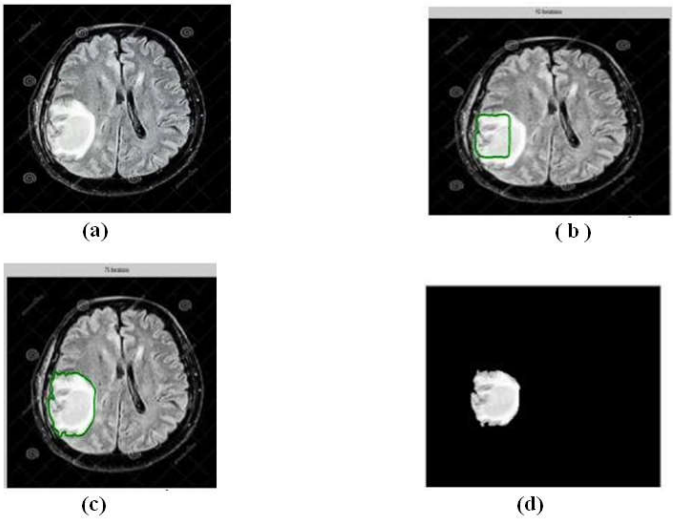


Figure 3 (a) original taken from BRATS database, (b) contour at 10^{th} iteration, (c) contour at 75^{th} iteration, (d) segmented image

Feature extraction: this is a procedure of gathering more significant level data of a picture, for example, shape, color, intensity, contrast, and so forth changing the information into the arrangement of highlights. It is identified with dimensionality decrease. It includes discovering features of the segmented image [7,9,10]. It is utilized adequately to improve the precision of analysis framework by choosing unmistakable highlights. This procedure is applied to get highlights that will be valuable in ordering and acknowledgment of pictures. Highlights characterizes the conduct of a pictures, they show its place as far as capacity taken, proficiency in classification and in time utilization [9, 10, 11]

An image histogram is a diagram that shows the dissemination of forces in an ordered or gray scale picture. The "imhist" work makes a histogram plots by characterizing n similarly divided containers, each speaking to a scope of information esteems and afterward computing the quantity of pixels inside each range. the scope of intensity values is little, we can utilize a power change work "imadjust" to spread the qualities a more extensive territory. Capacity "imread" read a picture into the workspace and show it. As appeared in the figure 4 the histogram shows a peak at around 2000, corresponding to the dark gray background in the image.

Classification: To classify the image into tumor and non-tumor brain images "SUPPORT VECTOR MACHINE (SVM)" is utilized as classifier. Besides, to improve accuracy and quality rate, we need to prepare the classifier. Significant features are extracted from every segmented tissues. train the SVM classifier utilizing "fitsvm".

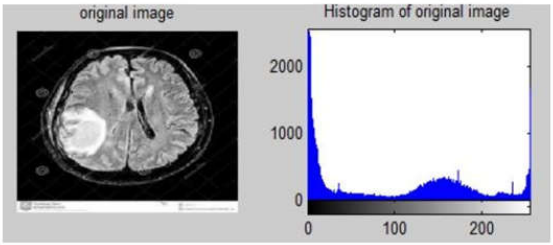


Figure 4 Histogram of original image

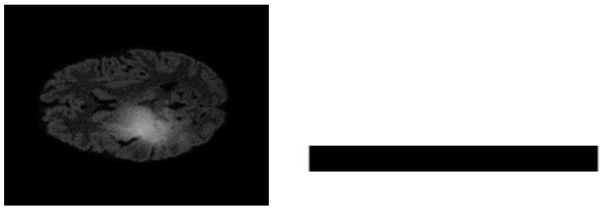


Figure 5 (a) original BRATS database, (b) classified image

RESULTS AND DISCUSSION

The proposed method has achieved accuracy of 96.51% , specificity of 94.2% and sensitivity 97.72% which shows the effectiveness technique in segmenting and classifying normal and abnormal Brain MR images

Experimental Results

The experimental results obtained by the developed classification technique are explained in this section, the results obtained at every stage of segmentation of classification using SimBRATS database are as shown here.

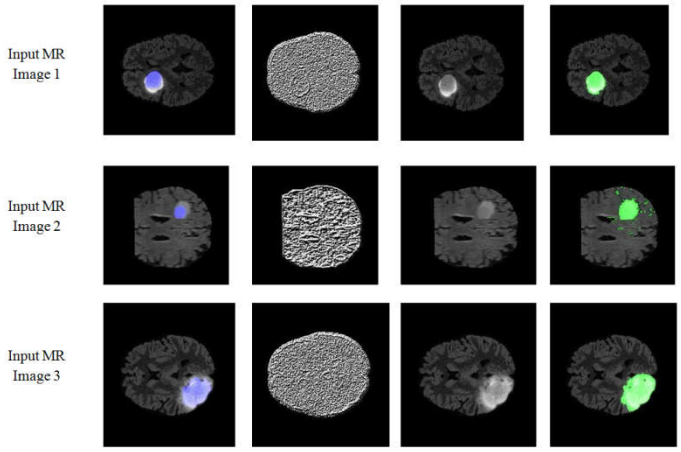
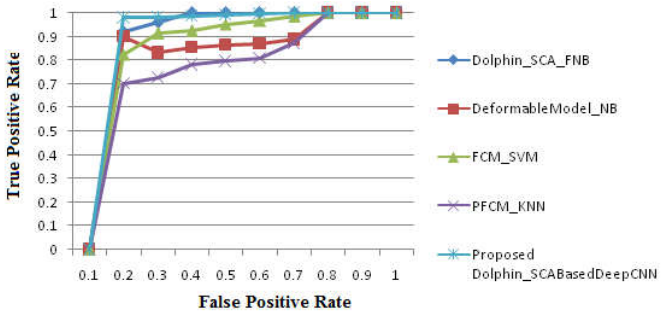


Fig 2 Experimental results of proposed Cluster deformable + NB for SimBRATS database

(a) Ground truth (b) Power LBP feature, (c) Original image, and (d) Classified output.

Analysis based on ROC

The RoC analysis of the comparative models against the proposed dolphin-SCA with FNB algorithm for SIMBRATS database is presented in Figure 5.18. For FPR = 0.2, the comparative models, such as Cluster deformable with NB, FCM with SVM, and PFCM with k-NN, dolphin-SCA with FNB have the TPR value of 0.9, 0.824, and 0.703, 0.959 respectively. Meanwhile, the proposed Dolphin-SCA with FNB algorithm provided better classification performance with the TPR value of 0.982 for the FPR = 0.2. Thus, the proposed dolphin-SCA based DeepCNN offers superior classification performance in classifying tumor and non tumor regions with the TPR value of, for the FPR = 0.2.



Figures and Tables

Comparative discussion using Proposed Dolphin-SCA based Deep CNN

Database	Comparative techniques	Evaluation metrics		
		Sensitivity	Specificity	Accuracy
BRATS database	Dolphin-SCA with FNB	0.865	0.881	0.842
	Cluster GVF Deformable model with NB	0.968	0.537	0.791
	FCM with SVM	0.933	0.6	0.734
	PFCM with k-NN	0.901	0.547	0.784
	Proposed Dolphin-SCA based Deep CNN	0.951	0.902	0.978
SimBRATS database	Dolphin-SCA with FNB	0.987	0.874	0.955
	Cluster GVF Deformable model with NB	0.987	0.607	0.848
	FCM with SVM	0.841	0.598	0.711
	PFCM with k-NN	0.958	0.812	0.918
	Proposed Dolphin-SCA based Deep CNN	0.937	0.906	0.915

Equations

1. $LBP(R_k) = \sum_{e=1}^{g} \beta\left(w_{p_e} - w_{p_x}\right) 2^{e-1}$

2. Mean $\overline{U} = \sum_{C=0}^{C=1} CP(C)$

3. Variance $V_C = \sum (C - \overline{U})^2 P(C)$

4. $Skewness = \frac{1}{V^3} \sum_{C=0}^{I-1} (C - \overline{U})^3 P(C)$

CONCLUSION

A tale strategy presents has not too bad segmentation technique that can recognize the exact character and size of the brain tumor and will have the option to comprehend and break down an absorb clinical network, the realities about the appearance, size or state of patient assessment is given by the product. Brain image is utilized in examination to show illnesses, for example, multiple sclerosis, schizophrenia, alzheimer's disease. The subsequent technique is extremely quick, vigorous and dependable for ordering tumor images for both documented and recovery purposes and it can use as a vehicle for additional clinical examinations.

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