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Skull Stripping of Human Brain in MRI Images

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***Abstract*—Magnetic resonance imaging (MRI) is a very important thing in medical treatment. The exactness of various image processing applications lies on the efficiency of skull stripping. Removal of non-brain tissues can be a challenging exercise considering the various complications of human brain, irregular parameters of Magnetic resonance (MR) scanners, personalized distinctive trait and many more. Here we considered computationally efficient and robust T1-weighted magnetic resonance brain images. In this project, we have proposed a differential evolutionary (DE) methodology with Median filter which optimizes (time and quality of image) the skull stripping for extraction of brain tissue and compared the results with the existing differential evolutionary (DE) algorithm. The exactness of various image processing applications lies on the efficiency of skull stripping. The fully automated brain extraction methods are used to extract the brain portion from T1 MRI of head scans. Here, features are extracted in order to locate regions of interest (ROI). In this project, we have proposed a differential evolutionary (DE) methodology with Median filter which optimizes (time and quality of image) the skull stripping for extraction of brain tissue in low contrast and without neglected edges of affected tissue.**

***Index Terms*— Accurate Skull Stripping, Non-brain tissue removal, Brain surface extraction,T1W MRI:Abnormal MRI head scans, Intensity Thresholding, Differential Evolutionary, Artificial Bee Colony.**

I. INTRODUCTION

MRI images of information technology and e-health care system in the medical field helps clinical experts to provide better health care to the patient. This project problems of segmentation of abnormal brain tissues and normal tissues such as Gray Matter (GM), White Matter (WM), from Magnetic Resonance (MR) images using feature extraction technique artificial bee colony algorithm, skull stripping and support of Median filter. This project of brain MR Images is helpful in brain tumor diagnosis process. Tumor and cancer are a harmful and death-defying disease for human life. This project is another effort to reveal the importance of the image classification in the world of the Biocomputing field. Image classification technique are efficiently improving the process of disease diagnosis. It is a process in which images are labeled into numerous predefined class. There are several techniques for image classification like SVM, Boltzmann, fuzzy C-mean, random forest and many others. This project proposed a model in which deep skull stripping is used for grey scaled segmentation technique and Artificial Bee Colony (ABC) for brain extraction. Combination of these two techniques (grey scaled segmentation technique and Artificial Bee Colony (ABC)) is giving better result in minimum computational time at earlier stage.

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II. Existing System

Existing system of tumor identification method is a Metaheuristic (problem independent) method. Combination of ABC and DE methods are used to extract scan images. Anisotropic diffusion filter technique is used to aiming at reducing image noise. It makes image blurred leads to edge smoothing. It means it omits edges at times. Without removing significant parts of the image content, typically edges, lines or other details those are important for the interpretation of the image.

A. Disadvantages

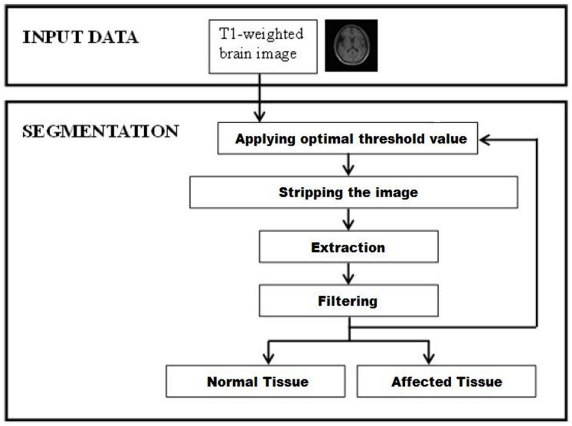
- Edges of Muted tissues are blurred while noise removal process.
- Blurring images caused to ignores some DETAILS on MR images. Long time taken to process due to anisotropic diffusion filter used.
- Complex of anisotropic filter design makes more complex programming.

III. Proposed System

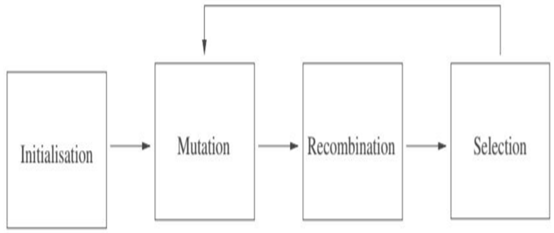
MRI image, which is considered as a best sequence of image for the analyses of brain tumour is given as input. Intensity of pixel values is changed to work with low contrast. After feature extraction is done in MRI scan, we separate out the image noise instead of removing the convincing fraction of image content. For noise removal, here we proposed Median filter, the most popular, most common and easy to design in Mat lab. Stripping method removes the skull parts in MR images without losing the tissues. To reduce noise in the extracted image we propose most popular Median filter. Because it keeps edges sharp. It doesn't make image blur. The Median filter is a non-linear filter most commonly used as a simple way to reduce noise in an image. It's claim to frame (over Gaussian for noise reduction) is that it removes noise while keeping edges relatively sharp. So, we may use DE technique with Median filter to achieve the best result as existing ABC and DE method. It reduces complexity and time constrain. The commonly affected noises in medical MRI image are Salt and Pepper, Speckle, Gaussian and Poisson noise. The medical images taken for comparison include MRI images, gray scale and RGB. The performance of these algorithm are examined for various noise types which are salt and pepper, Poisson, speckle, blurred and Gaussian Noise. The evaluation of these algorithm is done by the measures of the image file size, histogram, and clarity scale of the images. The median filter performs better for removing salt pepper noise and Poisson Noise for images in gray scale.

A. Advantages

- Blurring the edges of muted tissues is avoided Keeps muted tissue's edge sharp
- Probability of ignoring initial stage of affected cells were reduced
- The Median filter is a non-linear filter most commonly used as a simple way to reduce noise in an image
- It removes noise while keeping edge relatively sharp
- DE technique with Median filter reduces complexity and time constrain



IV. Design of Differential Evolutionary Algorithm (DE)



Many practical problems have objective functions that are non-differentiable, non-continuous, non-linear, noisy, flat, and multi-dimensional or have many local minima, constraints or stochasticity. Such problem is difficult if not Impossible to solve analytically.DE can be used to find approximate solution to such problem. Differential Evolution is a meta-heuristic technique that is used to optimize the problem by trying iteratively to improve the candidate solution corresponding to the quality. DE is considered as a NP-hard problem and uses the D-dimensional parameters.

Hence for, Xp, G, p=1, 2, 3… NP

In the minimization process for each generation (G), NP does not change.

- DE population is initialized and the vector population is calculated.
- Perturbation is generated Xr1-Xr2.
- To produce a population of NP trial vector, DE is mutated and combines with the population.
- Begin the selection process.
- The newly generated population vector is mutated with a randomly generated perturbation.
- Again selection is started

The parameter vectors have the form:

$$x_{i,G} = [x_{1,i,G}, x_{2,i,G}, \ldots x_{D,i,G}] \quad i = 1, 2, \ldots, N. \qquad (1)$$

Where G is the generation number

Define upper and lower bounds for each parameter:

$$x_j^L \le x_{j,i,1} \le x_j^U \qquad (2)$$

Randomly select the initial parameter values uniformly on the interval
$[x_j^L, x_j^U]$

Each of the N parameter vector mutation, recombination and selection Mutation expands the search space

For a given parameter vector xi, G randomly select three vectors xr1,G, xr2,G and xr3,G such that the indices r1, r2 and r3 are distinct.

Add the weighted difference of two the vectors to the third

$$v_{i,G+1} = x_{r1,G} + F(x_{r2,G} - x_{r3,G}) \qquad (3)$$

The mutation factor F a constant from [0, 2]

vi,G+1 is called the donor vector

Recombination incorporates successful solutions from the previous generation.

The trial vector ui,G+1 is developed from the element of the target vector, xi,G, and the element of the donor vector, vi,G+1

Element of the donor vector enter the trial vector with probability CR

uj,i,G= vj,i,G+1 if randj,i $\le$ CR and j =
+1 Irand
xj,i,Gif randj,i > CR and j $\neq$ Irand

i = 1, 2. . . N; j = 1, 2. . . D

randj,i ~ U[0, 1] and is a random integer from [1, 2, ..., D]

Irand ensures that vi,G+1 $\neq$ xi,G

The target vector $x_{i,G}$ is compared with the trial vector $v_{i,G+1}$ and the one with the lowest function value is admitted to the next generation

$$x_{i,G+1} = u_{i,G+1} \quad \text{if } f(u_{i,G+1}) \leq f(x_{i,G}) \quad i = 1, 2, \ldots, N$$

$$x_{i,G} \text{ otherwise}$$

Mutation, recombination and selection continue some stopping criterion is reached.

V. RESULT

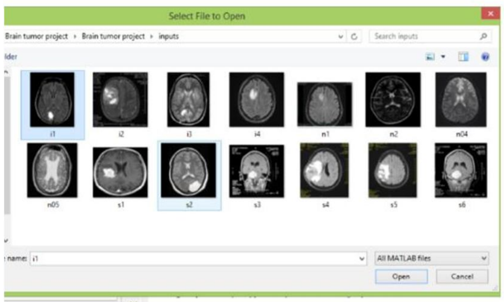


Figure 1. Normal input MR image

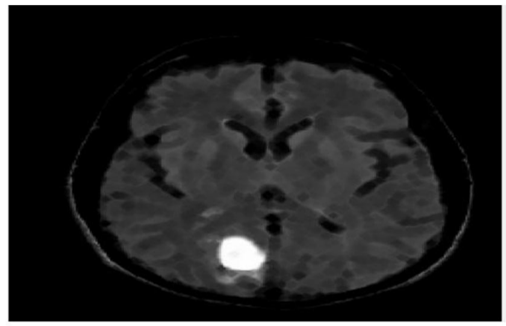


Figure 2. Skull and unwanted Details removed images

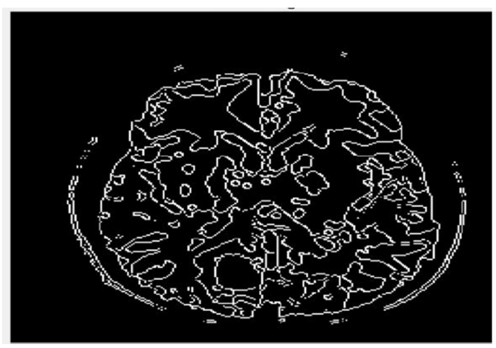


Figure 4. Intensity adjusted Grey

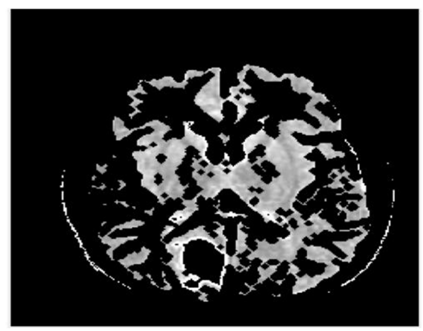


Figure 3. Extract Edge

Figure 5. Extracted White Matter

Figure 6. Segmented Tumor

TABLE I. AVERAGE VALUE OF PARAMETERS FOR 10 SAMPLED IMAGE

Image ID	Contrast	Correlation	Energy	Homogeneity	Sensitivity	Specificity	Accuracy
P1	0.0345	0.9852	0.9884	0.9994	93.7042	90.0000	97.6479
P2	0.0278	0.9781	0.9895	0.9989	94.6850	90.0000	97.1575
P3	0.0330	0.8814	0.9936	0.9994	94.1944	90.2798	97.2629
P4	0.0435	0.7894	0.9949	0.9992	94.6024	90.0000	97.1987
P5	0.0001	0.0000	1.0000	1.0000	95.4547	90.0000	97.2727
P6	0.0000	0.0000	1.0000	1.0000	93.7282	90.0000	97.6359
P7	0.0000	0.0000	1.0000	1.0000	94.8995	0.0000	0.0000
P8	0.0000	1.0000	1.0000	1.0000	94.6911	1.0000	1.0000
P9	0.2342	0.7644	0.9750	0.9958	94.2281	90.1990	97.2864
P10	0.1591	0.9128	0.9595	0.9972	93.6960	90.5678	97.3681
Average	0.0345	0.9852	0.9884	0.9994	93.7042	90.0000	97.6479

VI. CONCLUSIONS

In this dissertation an experiment has been conducted to detect the tumor from the MR images. Image filtration has been used to improve the quality of image, Skull stripping is an image segmentation method which has given better results of the image and the output of the segmentation has used as an input image to the classification process. DE algorithm with median filter used to classification of brain tumor MR image with considerably taking less time for processing. This novel approach doesn't blur the MR images which leads to process the tumor calculation can be done even on the edge of the tissues.In future, we will be trying to use this methodology for the 3-D processing of the brain tissues.

REFERENCES

[1] Alansary A., M.Ismail, A.Soliman, F.Khalifa, M.Nitzken, A. Elnakib, M.Mostapha, A. Black, K.Stinebruner, M. F. Casanova, J.M. Zurada, and A.El Baz. "Infant Brain Extraction in T1-weighted MR Images using BET and Refinement using LCDG and MGRF Models", IEEE Journal of Biomedical and Health Informatics, vol. 20, issue 3, pp. 925-935,2016.

[2] Amulya, Ch, and G. Prathibha. "MRI Brain Tumor Classification Using SURF and SIFT Features", IEEE transaction, 2016.

[3] Anshika Sharma, Shailendra Narayan Singh, Sushil Kumar"An Innovative approach based on Skull Stripping for MRI images of Human Brain", IEEE transactions on tele. Com and networks, vol.4, no.2, pp. 237-240, 2018.

[4] Arakeri, Megha P., and G. Ram Mohana Reddy. "Medical image retrieval system for diagnosis of brain tumor based on classification and content similarity", Annual IEEE India Conference (INDICON) IEEE, 2012.

[5] Ashburmer J and K.J. Friston"Voxel based morphometry: the methods", Neuro- Image, vol. 11 issue 6, pp.805–821, 2000

[6] Basri, Mohd Ariffanan Mohd, Mohd Fauzi Othman, and Abdul Rashid Husain."An approach to brain tumor MR image detection and classification using neuro fuzzy", Journal Technology 61.2,2013.

[7] Chiverton J., K. Wells."Volumetric partial volume quantification via a statistical model of 3-D voxel gradient magnitude", in: IEEE Nun. Sci. Sym. Med. Image. Conf. Rec., IEEE, Rome, Italy, 2004.

[8] Chou N., J. Wu, J. B. Bingren, A. Qiu, and K.H. Chuang. "Robust Automatic Rodent Brain Extraction Using 3-D Pulse-Coupled Neural Networks (PCNN)", IEEE Transactions on Image Processing, vol. 20, issue 9, pp. 2554-2564, [6],2018.

[9] Das, S., Siddiqui, N. N., Kriti, N., & Tamang, S. P. "Detection and area calculation of brain tumor from MRI images using MATLAB", International Journal, 2017