International Journal of Engineering Research and General Science Volume 4, Issue 1, January-February, 2016
ISSN 2091-2730

Image Segmentation using Hybrid Particle Swarm Optimization & Penalized Fuzzy C-Mean Clustering

Raminderjit Kaur, Navjot jyoti

North West Institute of Engg. &Technology Dhudike, dhillonraminder46@gmail.com, navjot_cse@northwest.ac.in

Abstract- In this work image segmentation is used to find the region of interest (ROI). In this process image is divided into different segments. The segments have to be divided on the basis of the similarity. The images used for this has to be segmented in a proper way so that hidden information from medical images can be extracted. The main problem in segmentation is that after segmentation the edges and the logical information from images get dispersed. To overcome the issue of the image segmentation the penalty based fuzzy c-mean clustering has been implement which segment the regions of the image on the basis of penalty value defined in the algorithm. For increase the performance of a particular algorithm artificial intelligence approaches have to be implement that optimize the results of the purposed algorithm by using fitness evaluation for each value of the image.

Keyword: Medical Image Segmentation, Types of segmentation, PFCM, PSO, GA, PSNR etc,.

1. INTRODUCTION

1.1 Image Segmentation: Picture division assumes an imperative part in picture investigation, showing up in numerous applications including example distinguishment, object discovery, and restorative imaging. Picture division intends to parcel a picture into important district as for a specific application and comparing to individual surfaces, articles, or characteristic parts of articles. All in all, picture division is the first stage in picture examination which looks to streamline the information into its essential part components or protests inside the scene.

1.2 Types of Image Segmentation

1.2.1 Colored Image: Shade Image Segmentation calculation The human eyes have customizability for the shine, which we can just recognized handfuls of ash scale anytime of complex picture, yet can recognize a huge number of shades. Much of the time, just use ash Level data cannot extricate the focus from foundation; we should by method for shade data. Likewise, with the quickly change of PC handling capacities, the shade picture transforming is being more concerned by individuals.

1.2.2. Gray-scale Image Segmentation: The segmentation of image raster data into connected regions of common gray-scale has long been seen as a basic operation in image analysis. In texture analysis, just this type of segmentation is possible after individual pixels in an image have been labeled with a numeric classifier.

1.2.3. Text Segmentation:: It is remarkable that content extraction, including content identification, limitation, division and distinguishment is essential for feature auto-understanding. Content division, that is to discrete content pixels from complex foundation in the sub-pictures from features. Content division in feature pictures is significantly more troublesome than that in filtering pictures..

1.3 Techniques Used

1.3.1 PFCM- Penalized Fuzzy C-Means (PFCM) algorithm for clustering gene expression data is introduced in this paper, which modified Fuzzy C-Means (FCM) algorithm to produce more meaningful fuzzy clusters. Genes are assigned a membership degree to a cluster indicating its percentage association with that cluster. The two algorithms differ in the weighting scheme used for the contribution of a gene to the mean of the cluster. FCM membership values for a gene are divided among clusters in proportion to similarity with that clusters mean. The contribution of each gene to the mean of a cluster is weighted, based on its membership grade. Membership values are adjusted iteratively until the variance of the system falls below a threshold. PFCM algorithm helps in identifying hidden pattern and providing enhanced understanding of the functional genomics in a better way.

1.3.2 Hybrid PSO: To overcome the limitations of PSO, hybrid algorithms with GA are proposed. The basis behind this is that such a hybrid approach is expected to have merits of PSO with those of GA. One advantage of PSO over GA is its algorithmic simplicity. Another clear difference between PSO and GA is the ability to control convergence. Crossover and mutation rates can subtly affect the convergence of GA, but these cannot be analogous to the level of control achieved through manipulating of the inertia weight. In fact, the decrease of inertia weight dramatically increases the swarm's convergence. The main problem with PSO is that it prematurely converges to stable point, which is not necessarily maximum. To prevent the occurrence, position update of the global best particles is changed. The position update is done through some hybrid mechanism of GA.

GA: Genetic Algorithms are a family of computational models inspired by evolution. These algorithms encode a potential solution to a specific problem on a simple chromosome-like data structure and apply recombination and mutation operators to these structures so as to preserve critical information. An implementation of a genetic algorithm begins with a population of chromosomes. One then evaluates these structures and allocates reproductive opportunities in such a way that those chromosomes which represent a better solution to the target problem are given more chances to reproduce than those chromosomes which are poorer solutions. The goodness of a solution is typically defined with respect to the current population.

2. PURPOSE OF THESIS WORK

Medical images are very difficult to process because in medical field minute details of image are also matter a lot that's why they need to be divided in such a manner so that their minute details can be easily examined. To divide the image into parts or we can say that segments the technique is called as segmentation. In this work image segmentation is used to find the region of interest (ROI). In this process image is divided into different segments. The segments have to be divided on the basis of the similarity. The images used for this has to be segmented in a proper way so that hidden information from medical images can be extracted. The main problem in segmentation is that after segmentation the edges and the logical information from images get dispersed. To overcome the issue of the image segmentation the penalty based fuzzy c-mean clustering has been implement which segment the regions of the image on the basis of penalty value defined in the algorithm. For increase the performance of a particular algorithm artificial intelligence approaches have to be implement that optimize the results of the purposed algorithm by using fitness evaluation for each value of the image.

3. OVERVIEW OF FINAL APPROACH

In proposed work the image segmentation is done to divide image into various segments to exact hidden information and logical data from the input image. In this process various approaches has been used. In this research work main motive is to use medical images for segmentation purposes. To process segmentation the different steps has been carried out. In these steps the statically histogram of the image has to be find out for extraction of intensity level of particular image at each and every pixel set. in second step the clusters has been form on the basis on histogram using k-mean clustering approach which computers neighbor pixel values and develop different pixels into different clusters. When clustering is done image has been used for segmentation process using penalized fuzzy c mean clustering (PFCM) approach for segmentation. To achieve better results of segmentation the coefficients extracted by PFCM has been optimized using Genetic Algorithm (GA). PSO is faster in finding quality solutions. It faces some difficulty in obtaining better quality solutions while exploring complex function. The drawback of PSO is that the swarm may prematurely converge. To overcome the limitations of PSO hybrid algorithms with GA are used. Advantage of PSO over GA is its algorithmic simplicity and ability to control convergence. After this parameter analysis has been done by computing PSNR and MSE from the input and segmented image.

4. RESULTS AND DISCUSSIONS

In the proposed work different medical images has been used for image segmentation process. In these MRI medical images of different body parts have been captured for image segmentation process. These are 300 images of different body parts have been available. These images are of heart, lungs, head, brain, and knee. These image have been segmented by using the Fuzzy C-mean clustering approach that use the gray lever pixel values for finding the centre value on the basis of objective function. FCM approach is much sensitive to noise. So to reduce the affect of noise the image segmentation has been done by using the PFCM approach that utilizes the penalty factor that is based on the NEM algorithm.

Fig 4.1 GUI

Fig 4.1 represents graphical user interface of the proposed work. This figure represents the graphic user interface designed for image segmentation system. In this various graphic user interface control buttons have been used for image segmentation. These buttons performs various tasks for image segmentation. In this various axes and edit boxes have been used for handling the various operations of image segmentation.

Fig. 4.2 represents the input image

Fig 4.2 represents the input image which is selected on clicking on the browse button. This figure represents the input image that has been selected for image segmentation process. This image has been preprocessed and undergoes the operation of image segmentation process.

Fig 4.3 Conversion of input image to gray scale image

Fig 4.3 represents the conversion of input image to gray scale image. Input image is of RGB form and it has to be converted into gray scale. This figure represents the image that has been converted from true color image to gray scale image. The luminance of the image has been converted by using three true colors of the image that are red, green and blue.

Fig 4.4 represents that the FCM segmentation is applied on gray scale image.

This figure represents the image segmented by using the FCM approach. This approach computes the objective function value for image segmentation process. The objective function of FCM uses the gray level pixel values intensity for image segmentation process. On the basis of the objective function and the clusters the centre values have been computed that helps for image segmentation.

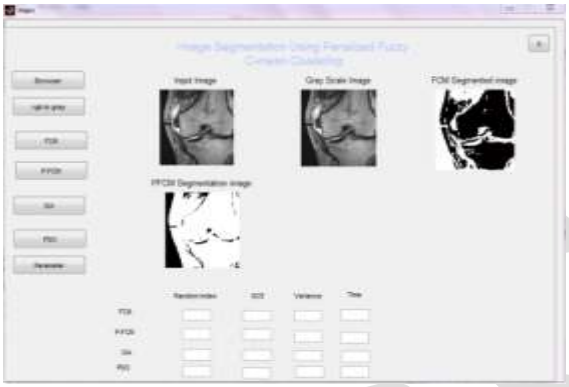


Fig 4.5 image Segmentation using PFCM approach

This figure represents the image segmentation using PFCM approach. The FCM approach is very much noise sensitive. In the PFCM approach different parameters and NEM algorithm is used for maximizing the spatial domain features. In this figure the penalty factor is computed and added to objective function of PFCM.

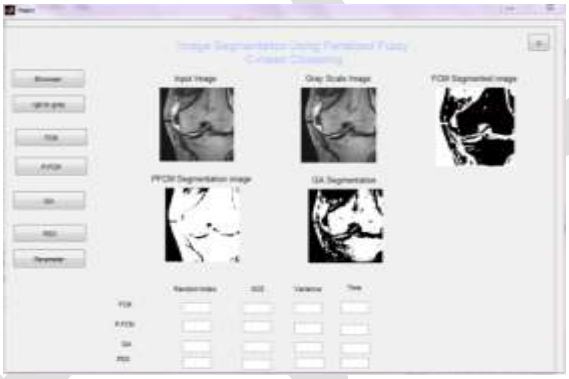


Fig 4.6 optimization of image Segmentation using hybrid PSO approach

This figure represents the image that has been segmented by using PFCM approach that has been optimized by using the different hybrid PSO approach. In the hybrid PSO approach the fitness function has been used that computes the particle best and global best for whole image. The global best value is best value for image segmentation approach

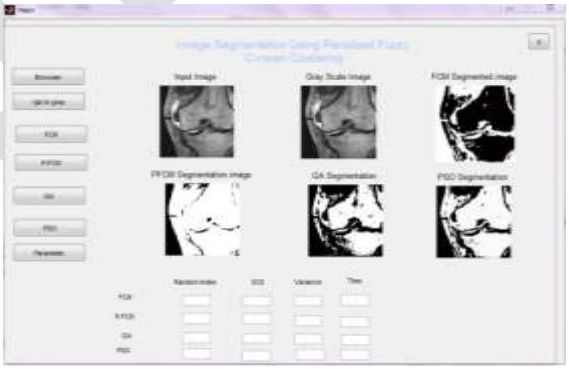
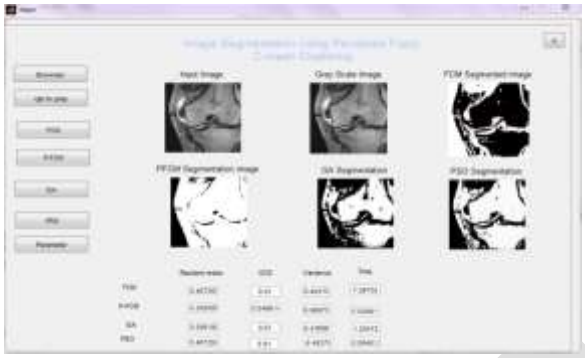


Fig 4.7 Parameter analysis for different approaches

This figure represents various parameters for image segmentation. In this image various parameters have been evaluated for performance evaluation of purposed work. The parameter random index, GCE, and variance have been computed. These parameters have been essential for image segmentation process.



5. PARAMERERS

PSNR: PSNR stands for peak signal to noise ratio. The term peak signal-to-noise ratio (PSNR) is an expression for the ratio between the maximum possible value of a signal and the power of distorting noise that affects the quality of its representation. PSNR is usually expressed in terms of the logarithmic decimal scale. PSNR is used to measure the quality of image (stego-image). The signal or input in this case is the original data, and the noise is the error introduced by compression. The PSNR is defined as:

$$\mathrm{PSNR} = 10.\log_{10}\left(\frac{\mathrm{MAX}_1^2}{\mathrm{MSE}}\right)$$

$$= 20.\log_{10}\left(\frac{\mathrm{MAX}_1}{\sqrt{\mathrm{MSE}}}\right)$$

$$= 20.\log_{10}(\mathrm{MAX}_1) - 10.\log_{10}(\mathrm{MSE})$$

Although a higher PSNR generally indicates that the good quality of image. PSNR is most easily defined via the mean squared error (MSE). Here, MAX_I is the maximum possible pixel value of the image. When the pixels are represented using 8 bits per sample, this is 255. In this expression, PSNR is inversely proportional to the MSE, if the PSNR is high then MSE is low and if the PSNR is low then MSE is high.

MEAN SQUARED ERROR: Mean squared error (MSE) of an estimator measures the average of the squares of the "errors", that is, the difference between the estimator and what is estimated. It is basically a difference between the cover image and stego image. If the value of MSE is low, then the quality of the stego image is better. In an analogy to standard deviation, taking the square root of MSE yields the root-mean-square error or root-mean-square deviation (RMSE or RMSD), which has the same units as the quantity being estimated; for an unbiased estimator.
The MSE is defined as:

$$\mathrm{MSE} = \frac{1}{\mathrm{mn}}\sum_{\mathrm{i}=0}^{\mathrm{m}-1}\sum_{\mathrm{j}=0}^{\mathrm{n}-1}[\mathrm{I}(\mathrm{i},\mathrm{j}) - \mathrm{K}(\mathrm{i},\mathrm{j})]^2$$

6. CONCLUSION

The Goal of our research is to use medical images for segmentation purposes. To process segmentation the different steps has been carried out. In these steps the statically histogram of the image has to be find out for extraction of intensity level of particular image at each and every pixel set. in second step the clusters has been form on the basis on histogram using k-mean clustering approach which computers neighbor pixel values and develop different pixels into different clusters. When clustering is done image has been used for segmentation process using penalized fuzzy c mean clustering (PFCM) approach for segmentation. To achieve better results of segmentation the coefficients extracted by PFCM has been optimized using Genetic Algorithm (GA). In GA it evaluated fitness function on the basis of chromosomes and genes. PSO is faster in finding quality solutions. It faces some difficulty in obtaining better quality solutions while exploring complex function. The drawback of PSO is that the swarm may prematurely converge. To overcome the limitations of PSO hybrid algorithms with GA are used. Advantage of PSO over GA is its algorithmic simplicity and ability to control convergence. On the basis of this we evaluate various parameters like PSNR, MSE & on the basis of these parameters it concludes our system gives us better results.

REFERENCES:

1. Abishek Gupta, Ajesh Nag, Jaten Savani "Evolutionary Approach and Spline Interpolation for Contrast Enhancement" IEEE Second International Conference on Image Information Processing, pp. 181-186,2013.
2. Peng Fengb "Enhancing retinal image by the Contourlet transform", IEEE Conf. on Counterlet transform, 2007, pp 516–522.
3. Alejandro F. Frangi "Multiscale vessel enhancement filtering", IEEE Conf. on enhancement, 1998, pp 130-137.
4. Muneer Ahmad "An Integrated Approach for Medical Image Enhancement using Wavelet Transforms and Image Filtering", IEEE Conf. on Life Science Journal, 2014, pp 6-11.
5. Alex F. de Araujo "New artificial life model for image enhancement", IEEE Conf. on image enhancement, 2013, pp 6-16.
6. Swagatam Das1, "Bacterial Foraging Optimization Algorithm: Theoretical Foundations, Analysis, and Applications", IEEE Conf. on BFOA, 2014, PP 31-40.
7. Nik Shahidah Afifi Bt Md Taujuddin " Enhancement of Medical Image Compression by using Threshold Predicting Wavelet-Based Algorithm", IEEE Conf. on Medical Imahges, 2011, pp 43-52.
8. Janani, V. ; Dinakaran, M. "Infrared image enhancement techniques- A review", in Current Trends in Engineering and Technology (ICCTET), 2014, ISBN 978-1-4799-7986-8, pp 167-173.
9. Bhattacharya, S; Gupta, S.; Subramanian, V.K. "Localized image enhancement", 2014, pp 1-6.
10. Suprijanto; Gianto ; Juliastuti, E. ; Azhari "Image contrast enhancement for film-based dental panoramic radiography", IEEE International Conference on System Engineering and Technology, 2012, pp 1-5.
11. Hasikin, K, Isa, N.A.M. "Enhancement of the Low Contrast Image Using Fuzzy Set Theory" IEEE 14th International Conference on Computer Modelling and Simulation, pp. 371-376, 2012.
12. Wang Xianghong, Yang Shi-e, Xu Xinsheng "An Effective Method to Colour Medical Image Enhancement" IEEE International Conference on Complex Medical Engineering, pp. 874-877, 2007