A Case Study on various techniques used for Medical Image Segmentation

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Abstract— 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 on the basis of the similarity. 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.

Keywords— ROI, C-mean clustering, FCM, K-FCM, P-FCM, Otsu's method, image segmentation etc.

1.INTRODUCTION

Image segmentation is the methodology of dividing a digital image into multiple segments (sets of pixels, otherwise called super pixels). The objective of segmentation is to rearrange and/or change the representation of a picture into something that is more significant and simpler to examine. Image segmentation is normally used to find articles and limits (lines, bends, and so on.) in pictures [1].
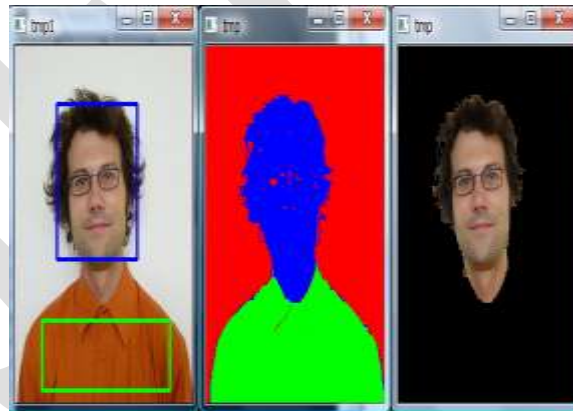

Fig 1 Image Segmentation

More precisely, Image segmentation is the method of doling out a name to every pixel in a photo such that pixels with the same imprint give certain qualities. The result of Image division is an arranged of pieces that aggregately cover the entire picture, or a game plan of shapes removed from the photo.

Each of the pixels in a region is similar concerning some trademark or enrolled property, for instance, shading, drive, or surface. Bordering regions are basically unmistakable with respect to the same Characteristic. Right when joined with a store of pictures, typical in helpful imaging, the resulting shapes after picture division can be used to make 3D propagations with the help of addition

counts like strolling 3D squares. Picture division is the division of a photo into regions or arrangements, which contrast with different dissents or parts of articles. Every pixel in a photo is distributed to one of different these classes.

A decent division is ordinarily one in which pixels in the same class have relative grayscale of multivariate values and structure a joined region, neighboring pixels which are in particular classes have novel qualities. A valid example, in the muscle picture each cross-sectional Bore could be seen as an unmistakable article and a successful division would shape an alternate social event of pixels contrasting with each field. Basically in the SAR picture, each field could be seen as an alternate class [2].

Segmentation is routinely the fundamental wander in picture examination: the time when we move from considering each pixel as a unit of observation to working with Objects in the photo, made out of various pixels. In case segmentation is done well then each and every other stage in picture examination are made simpler. At any rate, as we ought to see, accomplishment is consistently simply fragmentary when customized division estimations are used. On the other hand, manual intercession can regularly overcome these issues, and by this stage the PC ought to as of now have done most of the work.

1.1 Types of Image Segmentation

1.1.1 Colored Image

Shade Image Segmentation computation The human eyes have adaptability for the sparkle, which we can simply perceived modest bunches of powder scale at whatever time of complex picture, yet can perceive an enormous number of shades. A significant part of the time, simply utilize slag Level information can't remove the center from establishment; we ought to by system for shade information. In like manner, with the rapidly change of PC taking care of limits, the shade picture changing is in effect more concerned by people. The shade picture division is similarly comprehensively used as a piece of various intuitive media applications, for occasion; remembering the finished objective to feasibly look at unfathomable amounts of pictures and highlight data in mechanized libraries, they all should be requested index, sorting and stockpiling, the shading moreover structure are two most crucial quirks of information recuperation considering its substance in the photos and highlight. Hence, the shade and surface division every now and again used for indexing and organization of data; a substitute specimen of intuitive media applications is the dispersal of information in the framework. Today, a sweeping number of intelligent media data streams sent on the Web, However, in view of the transmission limit controls; we need to brace the data, and in this way it calls for picture and highlight division.

Fig 2 Colored Image Segmentation [8]

1.1.2 Gray-scale Image Segmentation
The division of picture raster information into joined areas of regular dim scale has long been seen as a fundamental operation in picture investigation. In composition examination, simply this sort of division is conceivable after individual pixels in a picture have been marked with a numeric classifier [3].

In arranging pictures for used as a piece of geographic information systems (GIs) this division is for the most part trailed by the formation of a vector representation for every region. The main estimation for division, become by Rosenfeld-pfaltz, portrayed a two pass 'progressive computation' for the division of combined pictures. The key trick of the Rosenfeld-pfaltz computation is that the photo is raster-checked, first the forward heading, from upper left to base right, then backward. In the midst of the forward pass, each pixel is set an area imprint, taking into account information checked through; the areas so isolated may have pixels with more than one imprint in that. In the midst of the backward pass, a fascinating imprint is designated to each pixel. Therefore this commendable computation can be depicted as a two pass figuring. In a past paper Cohen.

Fig 3.Grayscale Image Segmentation [9]

1.1.3 Text Segmentation:

It is astounding that substance extraction, including substance ID, restriction, division and recognition is crucial for highlight auto-understanding. Text Segmentation, which is to discrete substance pixels from complex establishment in the sub-pictures from components. Text Segmentation in highlight pictures is altogether more troublesome than that in separating pictures. Looking at pictures generally has clean and white establishment, while highlight pictures as often as possible have especially complex establishment without previous data about the substance shade. Though there have been a couple of productive structures of highlight substance extraction, couple of examiners remarkably focus on substance division in highlight pictures significantly. The used methods could be requested into two essential orders:

 (1) Distinction (or top-down)
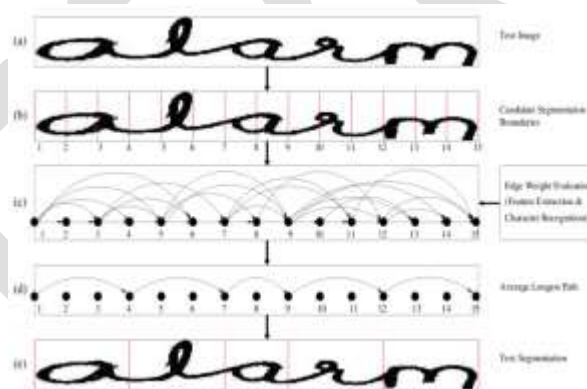 (2) Closeness based (or base up) strategies.

Fig.4. Text Segmentation [10]

1.2 METHODES OF SEGMENTATION

1.2.1 Thresholding

The minimum troublesome method for picture division is known as the thresholding framework. This strategy is in perspective of a cut level (or an edge worth) to transform a powder scale picture into a parallel picture.

The key of this system is to pick the breaking point regard (or qualities when different levels are picked). A couple of noticeable schedules are used as a piece of industry including the best entropy method, Otsu's framework (most compelling vacillation), and k-suggests grouping. As of late, methodologies have been created for thresholding prepared tomography (CT) pictures. The key believed is that, not at all like Otsu's method, the edges are gotten from the radiographs instead of the (revamped) picture [4].

1.2.2 Clustering techniques

The K-implies calculation is an iterative system that is utilized to parcel a picture into K bunches. The fundamental calculation is:
1. Pick K bunch focuses, either haphazardly or taking into account some heuristic
2. Assign every pixel in the picture to the bunch that minimizes the separation between the pixel and the group focus
3. Re-figure the bunch focuses by averaging the greater part of the pixels in the group

4. Repeat steps 2 and 3 until merging is accomplished (i.e. no pixels change groups)

For this situation, separation is the squared or outright distinction between a pixel and a group focus. The distinction is regularly in light of pixel color, force, composition, and area, or a weighted blend of these components. K can be chosen physically, haphazardly, or by a heuristic. This calculation is ensured to join, yet it may not furnish a proportional payback arrangement. The nature of the arrangement relies on upon the starting set of groups and the estimation of K.

1.2.3 Compression-based strategies

Layering based schedules suggest that the perfect division is the specific case that minimizes, over every possible division, the coding length of the data. The relationship between these two thoughts is that division tries to find outlines in a photo and any typicality in the photo can be used to pack it. The strategy depicts every one piece by its organization and utmost shape. Each of these sections is exhibited by a probability course limit and its coding length is enrolled as takes after [5]:

1. The farthest point encoding impacts the way that ranges in general pictures tend to have a smooth structure. This prior is used by Huffman coding to encode the refinement chain code of the structures in a photo. Along these lines, the smoother a breaking point is the shorter coding length it accomplishes.

2.Texture is encoded by misfortune pressing in a way like minimum delineation length (MDL) rule, however here the length of the data given the model is approximated by the amount of samples times the entropy of the model. The piece in every territory is shown by a multivariate normal scattering whose entropy has close structure translation. A charming property of this model is that the assessed entropy restricts the honest to goodness entropy of the data from above. This is in light of the fact that among all movements with a given mean and covariance, ordinary spread has the greatest entropy. Accordingly, the real coding length can't be more than what the count tries to minimize.

2.RELATED WORK

K. RajMohan et al [1] "A Dualistic Sub-Image Histogram Equalization Based Enhancement and Segmentation Techniques for Medical Images" In this work, creator propose a dualistic sub-picture histogram leveling based update and division frameworks. The proposed framework has been attempted and evaluated on a couple of restorative pictures. In this work, the helpful picture is lineated and isolated out with the objective that it can be seen solely. The results demonstrate that the proposed count is significantly compelling over different leveled assembling strategy. This is acknowledged using the execution measures, for instance, satisfaction and clearness.

M. Duraisamy et al [2] "Cell Neural Network Based Medical Image division Using Artificial Bee Colony Algorithm" In this paper, creator have presented a practical CNN based division system with lung and cerebrum MRI pictures. This technique hits the center with the assistance of the going with genuine steps, which fuses, 1) Preprocessing of the brain and lung pictures, 2) Segmentation using cell neural framework. At in the first place, the MRI picture is preprocessed to make it fit for division. Here, in the preprocessing step, picture de-noising is done using the straight smoothing channels, for instance, Gaussian Filter. By then, the preprocessed picture is partitioned by proposed system, CNN-based picture division. Finally, the particular MRI pictures (psyche and lung) are given to the proposed approach to evaluate the execution of the proposed approach in division process. The Comparative examination is finished Fuzzy Cmeans (FCM) and K-suggests course of action. From the close examination, the precision of proposed division strategy makes better results (83.7% for lung and 93% for brain pictures) than that of existing Fuzzy C-suggests (FCM) and K-infers portrayal.

Amol Bhagat etal [3]" Electronic Medical Image Retrieval System Using Fuzzy Connectedness Image Segmentation and Geometric Moments". This paper proposed fleecy connectedness picture division for therapeutic picture recuperation in Oracle using propelled imaging and exchanges as a piece of solution (DICOM) structure. Paper fuses the examination of picture recuperation techniques with the proposed cushioned connectedness picture division merged with geometric moment. Paper similarly gives the use purposes of enthusiasm of proposed estimation in Oracle.

Shihab A. Hameed et al [4] "Cross breed and Multilevel Segmentation Technique for Medical Images" Creator showed a novel, speedy, blend and bi-level division technique interestingly delivered for division of restorative pictures. Therapeutic pictures are generally depicted by different ranges, and slight edges. Exactly when territories in restorative pictures are seen as included homogeneous social occasion of intensities, it gets the chance to be all the more difficult to research in light of the way that all the time particular organs or anatomical structures may have near faint level or force representation. The complication of therapeutic imagery is fairly cooked for in this framework by starting with different thresholding, applying comparability division method, and deciding point of confinement issue with organization coordinating methodology, and a short time later a region of venture (ROI) division that incorporates finding the edges of the object of premium (OOI) finally arrange. This method can in like manner be conformed to division of nonmedical pictures.

R. Harini et al [5] "Picture Segmentation Using Nearest Neighbor Classifiers Based On Kernel Formation For Medical Images" In this paper, suggestion of their work includes course of action of bit for the restorative pictures by performing the deviation of mapped picture data inside the degree of each zone from the piecewise relentless model and in perspective of the regularization term in light of the limit of documents estimation of the locale. The handy target minimization is finished by two stages minimization in picture division using diagram cut methods, and minimization with respect to locale parameters using reliable point figuring. Nearest neighbor classifiers are familiar with the benchmarked picture data distributed fragments. Among the unmistakable frameworks in coordinated truthful case recognition, the nearest neighbor rule realizes accomplishing unrivaled without essential of the previous suppositions about the courses from which the arrangement sets are taken.

Korchiyne, R. et al [6] "Therapeutic picture surface division utilizing multifractal investigation" This paper exhibits a vigorous division approach formedical picture composition utilizing multifractal examination. The objective is to portion the pictures regarding their attributes, for example, bone and tissue sorts. In clinical circumstances where expansive quantities of information sets must be divided, customary techniques may be dull and one-sided. Consequently, we utilized a programmed picture division calculation, which wipes out the issue the established strategy shows and facilitates the procedure. In this paper, we display a calculation to dependably section medicinal imagesby utilizing multifractal examination. The outcome demonstrates that the proposed strategy has the capacity break down a wide scope of therapeutic pictures.

M.Y. Choong et al [7] "Hatchling Ultrasound Medical Image Segmentation by means of Variational Level Set Algorithm" There is a test to section the therapeutic picture which is regularly smudged and comprises of commotion. The items to be divided are continually evolving shape. Accordingly, there is a need to apply a strategy to robotized section well the articles for future examination with no suspicions about the object's topology are made. When all is said in done, when performing pregnancy ultrasound filtering, obstetrician needs to discover the best position or plot of the embryo and stop the scene. The obstetrician will click on the crown and the back end of the embryo to get the hatchling length. The division procedure connected is level situated technique. A variation level set calculation has been effectively executed in restorative picture division (X-ray picture, MRI picture and ultrasound picture). The outcomes demonstrated the level set form developed well on the low differentiation and commotion comprising therapeutic picture, particularly the ultrasound picture.

Deepak R. Chittajallu et al [8]"An Explicit Shape-Constrained MRF-Based Contour Evolution Method for 2-D Medical Image Segmentation" In this paper, an explicit shape-constrained MAP-MRF-based contour evolution method for 2-D image segmentation is presented. Specifically, the contour, explicitly as chain of control points. Then segmentation problem is casted as a contour evolution problem wherein the evolution of the contour is performed by iteratively solving a MAP-MRF labeling problem. The contour evolution is governed by three types of prior information, namely, (i) appearance prior, (ii) boundary edgeness prior, and (iii) shape prior, each of which is incorporated as clique potentials into the MAP-MRF problem. The main contribution is in the introduction of a new shape constraint into the MAP-MRF explicit contour evolution formulation of the segmentation problem.

Hesam Izakian et al [9]" Fuzzy Clustering Using Hybrid Fuzzy c-means and Fuzzy Particle Swarm Optimization" The fuzzy c-means algorithm is sensitive to initialization and is easily trapped in local optima. On the other hand the particle swarm algorithm is a global stochastic tool which could be implemented and applied easily to solve various function optimization problems, or the problems that can be transformed to function optimization problems. In this paper in order to overcome the shortcomings of the fuzzy c-means we integrate it with fuzzy particle swarm algorithm. Experimental results over six well known data sets, Iris, Glass, Cancer, Wine, CMC, and Vowel show that the proposed hybrid method is efficient and can reveal very encouraging results in term of quality of solution found.

Y. YANG*et al [10]" Fuzzy c-means clustering algorithm with a novel penalty term for image segmentation " We have presented a novel penalized fuzzy c-means (PFCM) algorithm that is able to incorporate both local spatial contextual information and feature space information into the image segmentation. The algorithm is developed by modifying the objective function of the standard FCM algorithm by a penalty term that takes into account the influence of the neighboring pixels on the centre pixels. A variety of images, including synthetic, simulated and real images were used to compare the performance of FCM and PFCM algorithms. It should be emphasized that if the algorithm performs on an image with higher contamination intensity, a larger parameter g should be set in order to provide better result.

O.A. Mohamed Jafar et al [11] "Hybrid Fuzzy Data Clustering Algorithm Using Different Distance Metrics: A Comparative Study" In this paper, an attempt is made to study the performances of K-means, FCM and K-PFCM with different distance metrics such as Euclidean, City Block and Chessboard.

Sapna Katiyar et al [12] "A Comparative Study of Genetic Algorithm and the Particle Swarm Optimization" Particle Swarm Optimization (PSO) is a relatively recent heuristic search method that is based on the idea of collaborative behavior and swarming in biological populations. GA is very helpful when the developer does not have precise domain expertise, because GAs possesses the ability to explore and learn from their domain. The objective of this research paper is to test the hypothesis that states that although

PSO and the GA on average yield the same effectiveness (solution quality), PSO is more computationally efficient (uses less number of function evaluations) than the GA.

3. APPROACHES USED

FCM: Fluffy bunching system groups pixel values with phenomenal level of precision & it is in a far-reaching way suitable for decision arranged applications like tissue portrayal & tumor area and so on. Fluffy grouping partitions the information pixels into bunches or social occasions on the premise of some likeness ideal model, such that similar pixels have a spot with same bunch.

K-FCM ALGORITHM: In this approach the portion based fluffy C mean methodology is utilized for the division of the picture. In this bit based division methodology utilized for division transform this methodology can be actualized to control the information into higher measurements of highlight vectors by utilizing the nonlinear guide. This element space division of the picture is known not the little areas of the picture that have been isolated for the usage of FCM to every single locale by giving part values. In this approach the picture is firstly de-noised by utilizing nonlinear spatial channel to improve the nature of the picture.

In this approach one point of preference is that it naturally characterizes the quantity of groups that need to create utilizing KFCM. This methodology firstly uses portion qualities and after that registers the fluffy enrollment capacities for the picture districts utilizing the reckoning mathematical statements. It discovers the focused for every sub highlight space of the picture and this procedure goes till to the best group focuses has been found for every area of the picture. This methodology is more powerful to commotion and unique grouped structures and exceptions of the picture. This methodology incorporates class of strong non-Euclidean at separation measures for unique information spaces. This methodology basic holds reckoning straightforwardness. In KFCM approach Euclidean separation between neighbor pixels has been figured on the premise of that separation different parts of the picture. This methodology gives better execution to the non-round and complex dataset that has not been given by FCM.

OTSU Thresholding Method: Otsu's thresholding technique includes iterating through all the conceivable threshold values and computing a measure of spread for the pixel levels every side of the threshold, i.e. the pixels that either falls in foreground or background. The point is to discover the threshold value where the aggregate of foreground and background spreads is at its minimum.

GENETIC ALGORITHM BASED SEGMENTATION: Genetic algorithms were ended up being the most intense optimization method in an large solution space. This clarifies the increasing popularity of Genetic algorithms applications in picture handling and different fields. They are utilized where thorough search for solution is costly as far as computation time. Applications of GAs for picture handling reach out from developing channels or distinguishing edges to settling on complex choices alternately characterizing identified highlights.

CONCLUSION

Approach Used	Advantages	Disadvantages
FCM	This approach is beneficial for the simple and spherical datasets or images. This approach identifies similar cluster using the centurions from each cluster and find neighborhood pixel values[1]	This approach does not provide better performance for non-spherical and complex data values. This approach is very noise sensitive[2]
P-FCM	Penalized fuzzy c mean approach has advantage of a term penalty for the removal of noise variation in the FCM algorithm. This approach regularizes the penalty tem which increase the segmentation performance of the algorithm[9]	This approach is mainly based on the penalty value used for the regularization of the penalty term. Is the value of particular term is higher than the centeriods values of the clusters get disrupted and degrade the performance[15]

| K-FCM | This can be efficient for the non-spherical and complex databases, robust to noise available in the image and number of clusters has been defined automatically in this approach [3] | The KFCM has main disadvantage of multiple use of kernel values for variant feature space computation used in the algorithm. These feature spaces sometimes get correlate with other feature space but the kernel value process each segment in different way[13] |
| GPU BASED IMAGE SEGMENTATION | GPUs used for general-purpose computations have a highly data parallel architecture. This process each thread of execution and these groups of functional units are called thread processors [1]. | Architecture of a GPU is complex and differs from one model and manufacturer to another [15]. |

REFERENCES:

[1] K. RajMohan, Dr.G.Thirugnanam "A Dualistic Sub-Image Histogram Equalization Based Enhancement and Segmentation Techniques for Medical Images" IEEE Second International Conference on Image Information Processing, 2013, pp. 566-569.

[2] M. Duraisamy, F. Mary Magdalene Jane "Cellular Neural Network Based Medical Image segmentation Using Artificial Bee Colony Algorithm" International Conference on Green Computing Communication and Electrical Engineering (ICGCCEE), 2014,pp. 1-6.

[3] Amol Bhagat,Mohammad Atique "Web Based Medical Image Retrieval System Using Fuzzy Connectedness Image Segmentation and Geometric Moments" International Conference on Computational Science and Computational Intelligence,2014,pp. 208-214.

[4] Shihab A. Hameed , Othman O. Khalifa , Aisha H. Abdalla "Hybrid and Multilevel Segmentation Technique for Medical Images" International Conference on Advanced Computer Science Applications and Technologies,2012,pp. 442-445.

[5] R. Harini ,Dr. C. Chandrasekar "Image Segmentation Using Nearest Neighbor Classifiers Based On Kernel Formation For Medical Images" International Conference on Pattern Recognition, Informatics and Medical Engineering,2012,pp. 21-23.

[6] Korchiyne, R, Sbihi, A, Farssi, S.M. "Medical image texture segmentation using multifractal analysis" International Conference on Multimedia Computing and Systems (ICMCS), 2012,pp. 422 – 425.

[7] M.Y. Choong, M.C. Seng, S.S. Yang, A. Kiring, K.T.K. Teo "Foetus Ultrasound Medical Image Segmentation via Variational Level Set Algorithm" Third International Conference on Intelligent Systems Modelling and Simulation, 2012, pp. 225-229.

[8] Deepak R. Chittajallu" An Explicit Shape-Constrained MRF-Based Contour Evolution Method for 2-D Medical Image Segmentation" IEEE JOURNAL OF BIOMEDICAL AND HEALTH INFORMATICS, VOL. 18, NO. 1, JANUARY 2014.

[9] Hesam Izakian, Ajith Abraham" Fuzzy Clustering Using Hybrid Fuzzy c-means and Fuzzy Particle Swarm Optimization" 978-1-4244-5612-3/09/$26.00_c 2009 IEEE .

[10] Y. YANG*, Ch. ZHENG, and P. LIN" Fuzzy c-means clustering algorithm with a novel penalty term for image segmentation" OPTO-ELECTRONICS REVIEW **13**(4), 309.315 © 2005 COSiW SEP, Warsaw.

[11] O.A. Mohamed Jafar, R. Sivakumar" Hybrid Fuzzy Data Clustering Algorithm Using Different Distance Metrics: A Comparative Study" International Journal of Soft Computing and Engineering (IJSCE) ISSN: 2231-2307, Volume-3, Issue-6, January 2014.

[12] Sapna Katiyar" A Comparative Study of Genetic Algorithm and the Particle Swarm Optimization" AKGEC INTERNATIONAL JOURNAL OF TECHNOLOGY, Vol. 2, No. 2

[13] http://tinyurl.com/ophmrkn

[14] http://tinyurl.com /q237cyb

[15] http://tinyurl.com /p85m43r