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Survey on Image Segmentation Techniques using Traditional and Soft Computing Techniques

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***Abstract*—** Digital image processing plays an important role in computer technology. DIP has a variety of applications, image segmentation is one of the important application. Segmentation is a process of segment an image into different objects or parts. At present scenario, segmentation is an active research area. The issue of image segmentation is always of great concern as it enables the optimization in the extraction of the features and characteristics of the image. This paper presents a review of Traditional image segmentation techniques along with Soft computing Techniques.

***Keywords*—** Image Segmentation, Genetic Algorithm, Soft Computing Techniques, Traditional Techniques

I. INTRODUCTION

Segmentation is to segment an image or to subdivide an image into different parts on the basis of color, intensity, features, or characteristics. Segmentation can be used in the various field such as face recognition, satellite images to locate objects, medical field to detect the tumor, robotics, pattern recognition etc. basically there are two categories of image segmentation:

Detecting discontinuity: it means to split up an image based on rapid changes in intensity [1] like edge detection algorithm.

Detecting similarity: it means to split up an image into regions on the basis of similarity[1], like Thresholding, Region Growing algorithm.

There are various methods have been informed in order to segment images. Two approaches are soft computing approach and traditional approach shown by following fig.

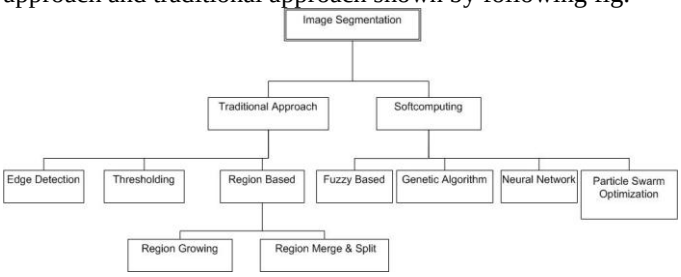

Fig.1 Segmentation Techniques

Edge detection technique: edge detection is based on discontinuity i.e to find for abrupt changes in the intensity value at the edges so this type of method is called edge or boundary based methods [2].four types of edge used to find the different shape of the image is shown by following fig.

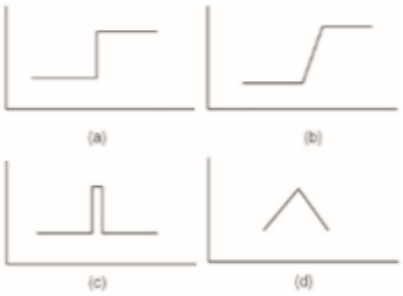

Fig.2 Types of edges (a) Stamp Edge (b) Ramp Edge (c) Line Edge (d) Roof Edge [7]

The drawback of edge detection: 1.edge detection techniques shows the contrast of gray level but it is very sensitive to noise [3].

2.Does not work ably with an image in which the edges are imprecise.

Edge detection operators are assembled into two groups as Ist order derivative

- Robert Operator
- Sobel Operator
- Previtt Operator

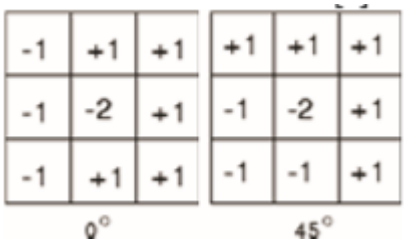

Fig.3 Previtt Operator [7]

Fig.4 Robert Operator [7]

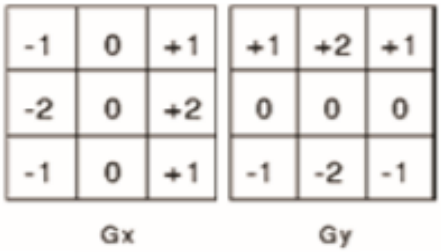

Fig.5 Sobel Operator [7]

2nd order derivative

- Laplacian: Laplacian is very sensitive to noise, and it also developed double edges so it generally not used in the original form for edge detection.
- so laplacian is merged with smoothening to detect edges via zero crossing

Thresholding: Thresholding is one of the widely used technique in image segmentation. It is used in the distinctive foreground from background. Thresholding technique can be classified into following classes.

1. Local techniques depend on the local properties of the pixel and their neighborhood.
2. Global techniques can split an image on the basis of information achieved globally (e,g by using image histogram) [5].

Pixels are classified, using range values or threshold values to the local threshold and global threshold.

1. Global Thresholding where an individual thresholding is used in the whole image. The global technique is relevant to images of higher gray level changes; if the gray level of the image changes is not obvious, then the ideal effect can rarely be reached.
2. **Local Thresholding** where a value is allocated to each pixel to decide whether it close to the foreground or background pixel using local information about the pixel.

The **drawback** of local thresholding is the size of each sub-image cannot be too tiny [5,6].

Thresholding T is selected by examine image histograms which are of the **Unimodal** histogram where one value contains more data than the other values or single-peaked distribution. The **Bimodal** histogram represents two peaks distribution and fare valley. **Multimodal** histogram where there are many valuesof T i.e mingled valleys so it is more complicated and not easy to select values of T [5….7].

Thresholding Techniques

Mean techniques take the mean value of the pixel as the threshold value.

The **P-tile** technique, one of the earliest threshold method that requires knowledge about the area or size of the objects present in the image. For example, the object occupies p% of the image area, an appropriate threshold can be chosen by partitioning the histogram.

Automatic Thresholding to make thresholding more robust, the threshold should be automatically selected by the system.

Hysteresis Thresholding if there is no clear valley in the histogram of an image, it means that there are several background pixels that have a similar gray level with object pixels and vice versa.

Histogram dependent technique based on the success of the reckoning the threshold value that distinguishes the two homogeneous regions of the object and background.

Edge maximization used when there is more than one homogeneous region.

The **visual Technique** similar to p-tile improves people's ability to accurately search for target items.

Multilevel thresholding determines more than one thresholding for the given image and segments the image into certain brightness regions which correspond to one background and several objects.

Region-based method divides an image into sub-regions.

Region growing is a renowned method that starts with an initial seed point and will go on adding the neighboring pixels of initial seed point based on similarity, to the region. Repeat the process until all pixels belong to the same region [8]. **Advantages** region growing methods can accurately split the regions that have the similar properties. **Disadvantages** the seed point should be selected suitably is more important.

Split and merge is a top-down approach. It displays with a complete image and this image will keep splitting until no more splits are possible, than merging process is used after each split which compares adjacent regions and merges them if necessary [7,9]. **Advantages** the image could be split regularly according to our applied resolution because the number 0f splitting level is determined by us**. Disadvantages** it may produce the chunky segments. The chunky segment problem could be reduced by splitting higher level, but the tradeoff is that the calculation time will arise.

II. LITERATURE REVIEW

The **clustering method** is an unsupervised image segmentation method. It divides the image into a finite number of cluster, where the number of clusters can be user

defined or can be found using an algorithm. Clustering techniques can be defined into different types like [10].

K means Clustering is to split n observation into k clusters in which each observation belongs to the cluster with the closest mean serving as a prototype of the cluster. This results in a dividing of a data space into Voronoi cells [7,10].

Fuzzy clustering is shape based image segmentation. Unlike hard clustering in fuzzy clustering, the data point can belong to two or more cluster and membership level is linked with each element [7,11].

Fuzzy c-means strategies can improve remote sensing image threshold segmentation with fewer iterations time and good stability and robustness [7,11,12]. **Disadvantages** it is very sensitive to noise. To overcome this drawback introduce another algorithm i.e general special FCM, Novel FCM, Improved Special FCM [12].

Soft computing

Due to complexity and uncertainty of machining processes, soft computing techniques are being preferred to physics based models for predicting the performance of the machining processes and optimizing them. Soft computing deals with approximate models and gives the solution to complex problems. Primary soft-computing tools are the neural network, fuzzy sets, genetic algorithm, simulated annealing, ant colony optimization and particle swarm optimization [13,14].

Fuzzy logic based Approach among various techniques of handling uncertainties, fuzzy logic has been most successful techniques almost over four decades. In 1965, Lotfi Zadeh put forward the idea of fuzzy sets, in which the element of the set can have partial membership in the set. Fuzzy logic examines human reasoning power using linguistic terms. The soft computing algorithm permits pixels to have relationships with multiple clustering with varying degree of memberships. Fig. shows the fuzzy rules for edge detection and neighborhood of the central pixel of the image [7,13,14,15].

Genetic Algorithm Approach is randomized search, that is more appropriately said to be an optimization technique based on natural selection. It based on survival of fittest idea algorithm. Derives from the evolutionary theory, consist of three major operations: selection, crossover, mutation. Genetic mostly used in pattern recognition. GA has the capability of global optimization so it combines with FCM clustering to overcome the local minimum problem that reduces the sensitivity of the FCM clustering algorithm. Fuzzy genetic algorithm fitness functions were considered. **Advantages** genetic algorithm uses a population of points at one time in contrast to the single point approach [7,16,17,18,19].

Neural network being a simplified modal of biological neuron system is a massively parallel computational modal, comprised of densely interconnection adaptive processing units. An important feature of these networks is that they learn by experience. A neural network consists of an input layer used to present data to the network, output layer to produce artificial neural network response and hidden layer in between. ANN has some aspects weight vector and activation function that are used in hidden and output layers of the network.

Advantages 1.their graceful degradation in the presence of noise has not been thoroughly investigated. 2. Highly parallel ability and fast computing capability.

Disadvantages 1. Initialization may affect the result of image segmentation.

2.Neural network should be trained by learning process that training interval may be very lengthy [7,13,17,20].

Particle Swarm Optimization is a population-based stochastic optimization technique developed by Dr. Eberhart and Dr. Kennedy in 1995, inspired by social behavior of bird flocking or fish schooling. PSO shares many similarities with evolutionary computation and genetic algorithm in the sense that both approaches are population-based and each individual has a fitness function. Potential solution of a problem is known as the particle. Velocity is constraints that change the flocking of the swarm. In PSO algorithm each particle has its position and velocity. The position of the particle in influenced by velocity.

Advantages1.PSO is based on intelligence, it can be applied to both scientific research and engineering use. 2.PSO has no overlapping and mutation calculation[21…24].

Literature survey:

Ali, Karmakar, and Dooley(2005), presents a new shape-based image segmentation algorithm namely fuzzy clustering for image segmentation using generic shape information(FISG) that incorporates generic shape information into the Gustafson-Kessel(GK) cluster framework[23].

Mrs. Deepali Kelkar and S. Gupta(2008), presents an Improved Quadtree Method (IQM) for split and merge image segmentation. IQM method has used three steps first splitting the image, second initializing neighbors list using Neighbor Naming Method (NNM) and the third step is merging the split regions. The third step again subdivided into two phases, in-phase and final merge[24].

Jianbo Shi and Jintendra Malik(2000), introduce normalized cut criteria for segmenting the graphs. This paper shows how the normalized cut is an impartial measure the disassociation among subgroups of a graph and it has a good property that minimizing normalized cuts leads directly to maximize the normalized association which is impartial measures for total association within sub groups[25].

Wenchao Cai, Juewu, and Chung (2006), introduce a hybrid segmentation algorithm which uses the shape constraints to improve the performance of the normalized cut[26].

Mantus Paulinas, Andrius Usinskar(2007), gives a brief overview of the Genetic algorithm. The survey of publication of this topic leads to a conclusion that the field of Genetic algorithms application is growing very rapidly[27].

Muthukrishnan.R and M. Radha(2011), in this paper, describe the performance of different edge detection techniques for image segmentation and also the comparison of these techniques is implemented with an experiment by using MATLAB software.

Indra SU and Ramesh AC(2011), Introduce a nonparametric and unsupervised Kohonen's Self Organisation Maps(SOM) method to identify the main features present in an image. SOM combined with the Genetic algorithm and some variant of SOM like variable structure SOM(VSSOM), Parameterless SOM(PLSOM) are compared and their performance is evaluated[19].

Deepali Aneja and Tarun Kumar Rawat(2013), presents a comparison between three namely Fuzzy based techniques, Fuzzy c-means(FCM), Intuitionistic Fuzzy c-means(IFCM) and TypeII Fuzzy c-means(T2FCM). These algorithms are executed into scenarios- both in absence and performance of noise and on two kinds of images- Bacteria and CT-scan brain image[11].

Sujata Saini and Komal Arora(2014), presents the various image segmentation techniques. In this paper, two categories are highlighted here namely Edge based and Region based segmentation[2].

Nimeesha Km, Rajaram M Gowda(2013), introduce two techniques namely K-means and Fuzzy c-means to detect a tumor. The segmentation algorithm is compared to estimate the efficiency by evaluating the execution time and accuracy of the algorithm. K-means is better than Fuzzy c-means because the number of iterations is less in K-means as compared to Fuzzy c-means so its execution time is less[29].

Brundha B, Nagendra Kumar M (2015), presents a new MR Image segmentation algorithm of a brain. This paper is to detect the exact size and stages of brain tumor using the combination of two algorithms namely K-means and Fuzzy c-means clustering for more accuracy. The algorithm has four modules: preprocessing, segmentation, features extraction and approximate reasoning[30].Nameirakpam Dhanachandra and Yambem Jina Chanu (2017), presents a survey paper on Image Segmentation methods using clustering techniques and discuss some of the recent works by researchers on these techniques[10].

III. COMPATATIVE ANALYSIS

Table 1. Comparison between image segmentation techniques

Paper Title	Merits	Demerits
Fuzzy Image Segmentation of generic shaped clustering	This method used for many different object shapes	Some clustering algorithm does not assures remain areas in the image, even if it does edges of these areas inclined to be uneven. This problem can be deal by split & merge technique.
Improved Quadtree method for split merge Image segmentation	The decomposition of phases decrease the problems involved in handling long neighbor list during join phase	The conclusion depends on the position and direction of an image, leads to chunky final segmentation and regular partition leads to over-segmentation through splitting. This problem can be overcome by the normalized cut algorithm by using reduced number of a region.
Normalised cuts and Image Segmentation	It reduces the number of regions.	In medical image due to low contrast of an image or large variation of intensity inside the object may be corrupted so it is difficult to segment the whole image. This problem solved by Shaped Based Normalized cut method
Shaped-based Image Segmentation Using Normalized cuts	It can partition the image even when a part of a boundary is missing or many noisy regions accompany the objects.	The performance and firmness of the partitioning warmly depend on the choice of the parameters that also increases the cost of computation.
Survey of Genetic algorithms Applications for Image Enhancement and Segmentation	The genetic algorithm allows performing the robust search without trapping in local extremes.	In the Genetic algorithm, the success of optimization firmly relies on the selection, crossover and mutation approaches and fitness function as well.
Edge Detection techniques for Image Segmentation	Work well for images having good contrast between regions	Less immune to noise.
Image Segmentation Using Artificial Neural Network	PLSOM is efficient and computational time was very less as	Modified PLSOM that overcome the drawback of PLSOM and computational time is also less.

and Genetic Algorithm	compared to SOM.	
Fuzzy clustering algorithms for effective medical Image Segmentation	The least percentage of misclassification error shows the best result.	T2FCM may have had presented good theoretical result, but practically not fulfill the criteria.
A Study Analysis of the different Image Segmentation techniques	Segmentation technique, essentially converts the complicated image into the simple image.	Opting a single technique would not provide the better optimized result.
Brain Tumor Segmentation using K-mans and Fuzzy c-means clustering algorithms	Number of iterations is less and maximum lossless compression	As K-means is unsupervised so not require preprocessing since, in noisy image K-means would not provide a better result so this drawback can be overcome by combining K-means and Fuzzy c-means.
MR Image Segmentation of brain to detect brain tumor and its area calculation using k-means and Fuzzy c-means	provide noiseless accurate size and stage of brain tumor.	Bigger computational requirement for Fuzzy c-means.
A Survey on Image Segmentation methods using clustering techniques	Clustering is unsupervised approach so it has less execution time.	Clustering technique has only one drawback that all the methods require a prior user initialization.

IV. CONCLUSION and Future Scope

Immense research has been complete in creating many distinct techniques and algorithms for image segmentation, but still it is merely challenging to judge and compare the performance whether an algorithm produced more accurate segmentation result than another one. The purpose of this paper is to analyse of different image segmentation techniques. In future, our idea to design more robust technique to segment an image through soft computing. Soft computing approaches are namely Fuzzy based approach, Genetic algorithm based approach, Neural Network based approach and Particle Swarm Optimization based approach would be more efficient than traditional

REFERENCES

[1] Rafael C.Gonzalae, Richard E. Woods, "Digital Image Processing", 2nd ed., Beijing: Publishing House of Electronics Industry,2007.

[2] Sujata Saini and Komal Arora, "Astral analysis of the different Image Segmentation Techniques", International Journal of Information and Computation Technology, vol.4, pp.1445-1 452, 2014

[3] Gurpreet Singh, Amandeep Kaur, Pooja Sharma, "Different Techniques of Edge Detection in Digital Image Processing", International Journal of Engineering Research and Application (IJERA), Vol.3, pp.458-461, May 2013

[4] N.Senthikumaran and R.Rajesh, "Edge Detection Techniques for Image Segmentation- A Survey of Softcomputing Approaches", International Journal of Recent Trends in Engineering INFORMATION PAPER, Vol.1, ISSUE 2, May 2009

[5] Salim Saleh AL-Amri, N.V.Kulyankar, and KamitkarS.D, "Image Segmentation by using Threshold Techniques", Journal of Computing, Vol.2, ISSUE 5[Online]

[6] Li Haitao and Li Shengpu,"An Algorithm and Implementation for Image Segmentation", International Journal of Processing, Image Processing and Pattern Recognition, Vol.9, No.3, pp.125-132, 2016

[7] Nida M. Zaitoun and Musban J. Agel, "Survey on Image Segmentation Techniques", International Conference on Communication, Management and Information Technology (ICCMIT) Procedia Computer Science 65, pp.797-806, 2015

[8] Sharma, N., Mishra, M., & Shrivastava, M. (2012). Color image segmentation techniques and issues: an approach. International Journal of Scientific & Technology Research,1(4), 9-12.

[9] Manjot Kaur, Pratibha Goyal, "A Review on Region-Based Segmentation", International Journal of Science and Research Vol.4, ISSUE4, April 2015

[10] Nameirakpam Dhanchandra and Yambem Jina Chanu, "A Survey on Image Segmentation Methods using Clustering Techniques", European Journal of Engineering Research and Science, Vol.2.no 1, Jan 2017

[11] Deepali Aneja, T. K. Rawat, "Fuzzy Clustering Algorithms for Effective Medical Image Segmentation", I. J. Intelligent Systems and Applications, pp.55-51, 2013

[12] Rajeswar Dass, Priyanka, "Image Segmentation Techniques", IJECT Vol.3, ISSUE1, ISSN:2230-7109, 2012

[13] Chandrasekaran, M., et al. "Application of soft computing techniques in machining performance prediction and optimization: a literature review." The International Journal of Advanced Manufacturing Technology 46.5-8 (2010): 445-464.

[14] Seenivasagam, V., and S. Arumugadevi. "A Survey of Image Segmentation Methods using Conventional and Soft Computing Techniques for Color Images." International Journal of Advanced Research in Computer Science and Electronics Engineering (IJARCSEE) 1.6 (2012): pp-116.

[15] Muppidi, Mohan, et al. "Image segmentation by multi-level thresholding based on fuzzy entropy and genetic algorithm in a cloud." System of Systems Engineering Conference (SoSE), 2015 10th. IEEE, 2015.

[16] Jahi, Ajuba,Nigeria, "Application of Genetic Algorithm to Image Segmentation: A Review", IJIRR, Vol.3, ISSUE 10, PP.2908-2912, Oct,2016
[17] Dwivedi, Varshika, et al. "Travelling salesman problem using genetic algorithm." IJCA Proceedings on Development of Reliable Information Systems, Techniques and Related Issues (DRISTI 2012) 1 (2012): 25.
[18] Mohanta, Raj Kumar, and Binapani Sethi. "A review of genetic algorithm application for image segmentation." Int. J. Comput. Technol. Appl 3.2 (2011): 720-723.
[19] Indira, S. U., and A. C. Ramesh. "Image segmentation using artificial neural network and genetic algorithm: a comparative analysis." Process Automation, Control and Computing (PACC), 2011 International Conference on. IEEE, 2011.
[20] Raju, N. Gopi, and PA Nageswara Rao. "Particle swarm optimization methods for image segmentation applied in mammography." Int. J. Eng. Res. Appl 3.6 (2013): 1572-1579.
[21] [21]. K. Senthil Kumar, K. Venkatalakshmi and K. Karthikeyan, "Implimentation of Particle Swarm Optimization Algorithm for Lung Image Segmentation Using Threshloding", Middle East Journal of Scientific Research 24 (7): pp.2333-2337, 2016.
[22] Mohsen, Fahd MA, Mohiy M. Hadhoud, and Khalid Amin. "A new optimization-based image segmentation method by particle swarm optimization." IJACSA) International Journal of Advanced Computer Science and Applications, Special Issue on Image Processing and Analysis (2011).
[23] Ali, Mohammed Ameer, Gour C. Karmakar, and Laurence S. Dooley. "Fuzzy image segmentation of generic shaped clusters." Image Processing, 2005. ICIP 2005. IEEE International Conference on. Vol. 2. IEEE, 2005.
[24] Kelkar, Deepali, and Surendra Gupta. "Improved quadtree method for split merge image segmentation." Emerging Trends in Engineering and Technology, 2008. ICETET'08. First International Conference on. IEEE, 2008.
[25] Shi, Jianbo, and Jitendra Malik. "Normalized cuts and image segmentation." IEEE Transactions on pattern analysis and machine intelligence 22.8 (2000): 888-905.
[26] Cai, Wenchao, Jue Wu, and Albert CS Chung. "Shape-based image segmentation using normalized cuts." Image Processing, 2006 IEEE International Conference on. IEEE, 2006.
[27] Paulinas, Mantas, and Andrius Ušinskas. "A survey of genetic algorithms applications for image enhancement and segmentation." Information Technology and control 36.3 (2007).
[28] Muthukrishnan, R., and Miyilsamy Radha. "Edge detection techniques for image segmentation." International Journal of Computer Science & Information Technology 3.6 (2011): 259.
[29] Nimeesha Km, Rajaram M Gowda, " Brain Tumor Segmentation Using K-means and Fuzzy c-means clustering algorithm", International Journal of Computer Science and Technology Research Excellence Vol.3, ISSUE 2, Mar-April 2013.
[30] Brundha, B., and M. Nagendra Kumar. "MR Image Segmentation of brain to detect brain tumor and its area calculation using K-Means clustering and Fuzzy C-Means algorithm." international journal of technological research in engineering 2.9 (2015).

