A REVIEW ON IMAGE SEGMENTATION TECHNIQUES

P. Sivakumar[1], Dr. S.Meenakshi[2]

[1]Research Scholar, Department of Computer Science, Gobi Arts & Science College, Tamilnadu, India.

[2]Associate Professor in Computer Science, Gobi Arts & Science College, Tamilnadu, India.

Abstract-

Digital image processing plays a vital role in many applications to retrieve required information from the given image in a way that it has not affect the other features of the image. Image segmentation is one of the most important tasks in image processing which is used to partition an image into several disjoint subsets such that each subset corresponds to a meaningful part of the image. The goal of image segmentation is to cluster pixels into salient image regions corresponding to individual surfaces, objects, or natural parts of objects. With the growing research on image segmentation many segmentation methods have been developed and interpreted differently towards content analysis and image understanding for different applications. Thus an organized review on image segmentation methods is essential and this paper provides a review on the various image segmentation techniques proposed in the literature.

Index Terms **- Digital image processing, image segmentation, image segmentation techniques**

I. INTRODUCTION

Digital image processing (DIP) plays a vital role in many applications to retrieve required information from the given image in a way that it has not affect the other features of the image. Images are the important medium of conveying information and by understanding images the retrieved information can be used for many tasks. A digital image is composed by finite number of elements or pixels and the acquisition of images is called as imaging. DIP is a multidisciplinary operation and it has different kinds of process such as image representation, segmentation, compression and transformation.

Image segmentation is one of the most important tasks in image processing which is used to partition an image into several disjoint subsets such that each subset corresponds to a meaningful part of the image [6]. Image segmentation is defined as a process of partitioning an image into homogenous groups such that each region is homogenous but the union of no two adjacent regions is homogenous [16]. Image segmentation is an essential component of image analysis which is used to extract information from a certain image in a clear and meaningful way to meet the demands of application. Image segmentation has been used for object recognition, boundary estimation within motion or stereo systems, image compression, image editing and image database look-up.

Image segmentation is a classical and fundamental problem in many applications such as medical image processing, bio metrics, object tracking and recognition, video and computer vision applications [8, 4]. Image segmentation has been an important and challenging issue in the field of image processing and it plays a critical role for most image analysis tasks such as object recognition, object-based image compression and content based indexing. Image segmentation has been varying different interpretation for different kinds of application towards content analysis and image understanding [20]. Many image segmentation methods have been developed, but there is still no satisfactory in level of performance measure by reason of image segments results depends on type of images.

A single segmentation method cannot be well applicable for different types of images. Thus the development of an effective image segmentation technique for partitioning all categorizes images is a challenging issue in image processing. The most widely used image segmentation techniques are Edge based, Threshold based, Region based, Fuzzy based and Artificial Neural Network based segmentation [23]. This research paper reviews the various image segmentation techniques proposed in the research literature.

The paper is organized as follows. Section II describes the concept and process of image segmentation. Section III presents the various proposed image segmentation techniques. Section IV concludes the paper.

.

II. IMAGE SEGMENTATION

Image Segmentation is the process of partitioning a digital image into multiple regions or sets of pixels [15]. The images are segmented on the basis of set of pixels in a region that are similar on the basis of the homogeneity criteria such as color, intensity or texture, which helps to locate and identify objects or boundaries in an image. The result of image segmentation is a set of regions that collectively cover the entire image, or a set of contours extracted from the image. All of the pixels in a region are similar with respect to the characteristic property such as color, intensity, or texture and adjacent regions are significantly different with respect to the same characteristics. Image segmentation is a branch of image analysis and the main idea is to distinguish different objects in the image content. The image is divided into two parts namely: background and foreground. The foreground is defined as the interesting objects and the background as the rest [19]. Image segmentation process is distinguishing and separating the two from one another.

The goal of segmentation is to simplify and/or change the representation of an image into more meaningful and easier to analysis. Image segmentation is typically used to locate objects and boundaries such as points, lines, edges and regions in images [9]. The result of image segmentation is a set of regions

ISSN: 2278 – 1323

that collectively cover the entire image, or a set of contours extracted from the image. Image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain visual characteristics.

Image segmentation is a multiple objective problem and it involves several processes such as pattern representation, feature selection, feature extraction and pattern proximity. Consideration of all these objectives is a difficult problem and thus an appropriate optimization approach is required for segmentation process. The various steps that are performed during image segmentation process as shown in Figure 1 are described as the following [18, 3]:

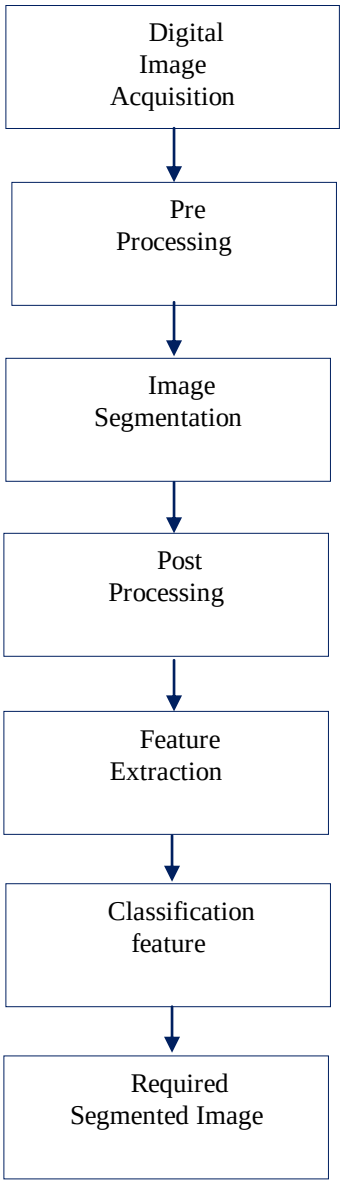

Figure 1 Image Segmentation Process

- **Image Acquisition:** In this step the given input image is read by the various devices such as sensors, tomography devices and cameras.
- **Pre-Processing:** The pre-processing step is used to determine the area of focus in the image. This process is used to enhance the contrast of the image, removal of noise, correct defects illumination and separate the objects of interest in the image.
- **Image Segmentation:** In this step the focused area of input image is segmented into its constituent parts or objects as sub-regions based on the suitable segmentation techniques**.**
- **Post Processing:** This step process the boundary of the object from the background for producing better segmented image.
- **Feature Extraction:** This step is used to extract the unique features of image such as intensity, shape and colour information. This process helps to reduce the complexity of classification problems.
- **Classification:** This step classifies the segmented image based on the extracted feature.

III. SEGMENTATION TECHNIQUES

Image quality improvement is one of the challenging issues for segmenting the image in image processing. A quality of image segmentation should provide reliability, complacence, clarity and reputability. Image segmentation is useful for isolating the boundaries of any image in the form of multiple segments based on the properties of an image includes color, intensity, and texture of that image. The various factors that make segmentation in images critical include dynamic changes of colors, shapes, texture and scale of images [11].

In general image segmentation techniques have been divided into two categories such as [16]: (i) Discontinuities based – In this category, subdivision of images is carried out on the basis of abrupt changes in the intensity of grey levels of an image. Here an image is partitioned based on abrupt changes in intensity and this includes image segmentation algorithms like edge detection. (ii) Similarities based – In this category, subdivision of images is carried out on the basis of similarities in intensity of grey levels of an image. Here an image is partitioned into regions that are similar according to a set of predefined criterion and this includes image segmentation algorithms like thresholding, region growing, region splitting and merging.

The various image segmentation techniques have been proposed based on the above specified two categories of segmentation methods as shown in Figure 2 are described as the following:

ISSN: 2278 – 1323

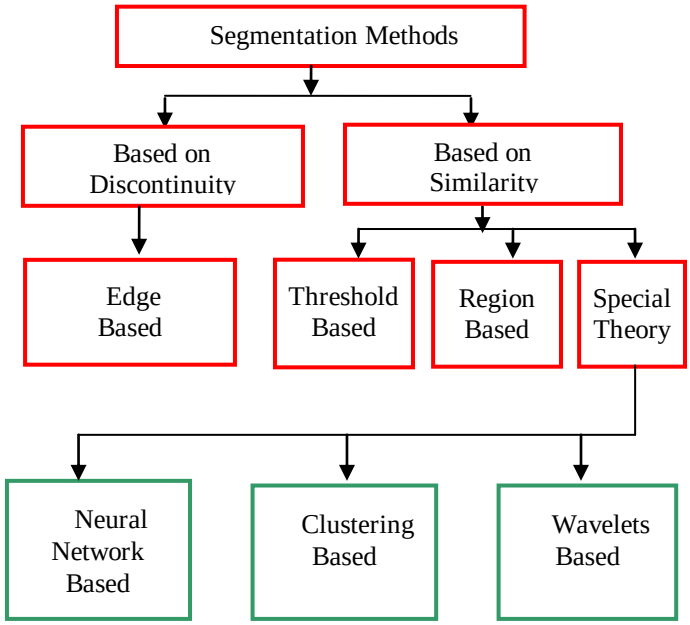

Figure 2 Categories of Segmentation Techniques

A) Edge Based Segmentation

Edge detection techniques transform images to edge images benefiting from the changes of grey tones in the images. Edge detection divides the image by observing the change in intensity or pixels of an image. Edges are the sign of lack of continuity and ending. As a result of this transformation, edge image is obtained without encountering any changes in physical qualities of the main image [21]. An edge in an image is a significant local change in the image intensity usually associated with a discontinuity in either the image intensity or the first derivative of the image intensity. An edge is a set of connected pixels that lies on the boundary between two regions that differ in grey value and thus pixels on the edge are called edge points. Edges can be distinguished by estimating the intensity gradient. An edge is a local concept and does not necessarily have to form a closed path. The three steps that are performed with edge detection are: filtering (to reduce noise), enhancement (to compute the gradient magnitude) and detection (to determine edge points).

Different techniques are used to perform edge detection and among them gradient and gray histogram based methods are the most frequently used techniques for edge detection [25]. In gray histogram method, segmentation is based on the separation of foreground from background by selecting a threshold value. Gradient based method performs image segmentation based on the abrupt change between intensities of the two regions. Several operators such as sobel operator, canny operator, Laplace operator and Laplacian of Gaussian operator are used in gradient based method for edge detection. Edge detection algorithms require a balance between the two criteria such as the accurate detection of edges and the reduction of noise level. If the level of accuracy is too high, then noise can create detection of numerous additional and fake edges. On the other hand, if the level of noise is reduced then the accuracy of the edges is low. Edge based technique is commonly useful for detecting boundaries and discontinuities in an image and it is usually suitable for images that are noise free. This method attempts to resolve image segmentation by detecting the edges or pixels between different regions that have rapid transition in intensity are extracted and linked to form closed object boundaries.

B) Threshold Based Segmentation

In threshold based image segmentation, an input image is partitioned into two or more sub-images by comparing with the predefined threshold value. In threshold based segmentation the current image is compared to the background image and a threshold value decides if the pixel differs enough to belong to the foreground. The threshold technique performs segmentation based on the pixel intensity levels. The various types of threshold methods such as local, global and adaptive are used for segmenting an image based on the various properties of an image include gray level, pixel values and neighborhood. If the threshold operation depends on gray levels, then global threshold is performed. Local threshold is performed based on both the gray level and the local properties of the image. Adaptive threshold is performed based on gray level, neighborhood and pixel coordinate's properties of the image [1].

This technique is used for segmenting images have light object on dark background or dark object on light background. The threshold algorithm should use a proper threshold value to divide image's pixels into several classes and separate objects from the background. The advantages of this technique are: assigning a background pixel to the object, assigning an object pixel to the background and combining different data sources associated to the image. The disadvantage of this technique is to find the correct threshold value.

C) Region Based Segmentation

Region-based technique partitions the image into regions. This method works on the principle of homogeneity by considering the fact that the neighboring pixels inside a region possess similar characteristics and are dissimilar to the pixels in other regions. This technique divides an image into different regions based on the pre-defined criteria include color, intensity, or object. A region is, as opposed to an edge, a global concept and is formed by a closed path. The objective of region based segmentation is to produce a homogeneous region which is bigger in size and a provision to note any considerable changes in the characteristic of the neighboring pixels. The various types of region based segmentation include region growing, region splitting and merging and graph based methods.

- **Region growing**

The region growing method segments the image based on the similarity of each pixel with its neighbor pixel by comparing the various properties of an image such as gray level, texture, color and shape. The basic idea of this method is to group a collection of pixels in an image with similar properties to form a region. In this method region grows by choosing a starting point called seed pixel. Then, the region grows by adding similar neighboring pixels according to a certain homogeneity

ISSN: 2278 – 1323

criterion, increasing step by step the size of the region. The homogeneity criterion has the function of deciding whether a pixel belongs to the growing region or not [27].

Region growing can be processed in four steps: (i) Mark the group of seed pixels in original image. (ii) Select a clustering criterion such as grey level intensity or color and set up a stopping rule. (iii) Expand the regions by connecting to each seed to the neighboring pixels that have satisfied the cluster properties similar to seed pixels. (iv) Stop region growing when no more pixels meet the criterion for inclusion in that region.

- **Region splitting and merging**

In region splitting and merging technique an image is subdivided into a set of arbitrary unconnected regions. This method attempts to divide an input image into number of smaller regions recursively. The regions split and merge method works on the basis of quad trees and main objective is to distinguish the homogeneity of the image. This method initially considers the entire image as one single region and then divides the image into four quadrants based on certain pre-defined criteria. It checks the quadrants for the same defined criteria and divides it further into four quadrants if the test result is negative and the process continues till the criteria is satisfied or no further division is possible. Instead of choosing seed points, one can divide an image into a set of impulsive unconnected regions and then merge the regions in an attempt to satisfy the conditions of reasonable image segmentation. Splitting process is a top down approach and a merging process is a bottom up approach which is used after each split which compares adjacent regions [12].

The region based segmentation method is useful when the region homogeneity criterion is easy to define. The advantage of this technique is to make the complete use of pixels relationship based on the image properties. The disadvantage of this technique is the selection of pixels based within the region since an over stringent criterion creates fragmented regions and a lenient criterion overlook blurred regions.

D) Special Theory

The segmentation based on special theory supports various algorithms that are derivatives from different fields such as, neural network based algorithms, fuzzy based algorithms, wavelet based algorithms and clustering based algorithms.

- **Neural Network**

Neural networks are systems of interconnected neurons for purpose of communicate with each other and compute values. The input values through by forward feeding or back propagate information through the network. A neural net is an artificial representation of human brain which is used to simulate the learning strategies of brain for decision making process. Neural network that simulate the human brain's learning procedures constitutes a large number of parallel nodes. Each node can perform some basic computing. The learning process can be achieved through the transferring the connections among nodes and connection weight. Neural networks have been widely used to solve the problem of medical image segmentation and it reduces the requirements of expert intervention during the image segmentation process. In neural network based image segmentation first the image is converted into energy minimization and the neural network was trained with training sample set in order to determine the connection and weights between the nodes [17].

In neural network, every neuron is corresponding to the pixel of an image and the image is mapped to the neural network. Image in the form of neural network is trained using training samples, and then connection between neurons (i.e., pixels) is found. Then the new images are segmented from the trained image. The various neural networks used for image segmentation are Hopfield, BPNN, FFNN, MLFF, MLP, SOM, and PCNN. In neural network an image is seen as a combination of segments in which image data are homogeneous and the two factors that are used to determine the image segments are: (i) Classification of all pixels that satisfy the criterion of homogeneousness. (ii) Detection of all pixels on the borders between different homogeneous areas.

Segmentation of image using neural network is performed in two steps that include pixel classification and edge detection. Neural network using edge detection organize every pixel is either part of an edge or not. All edges together form the contours of the segments and edge linking is used to get the contours closed. Edge detection filters are used to only detect edges in different directions. The pixel-based neural networks classify the image content based on the combination of texture and local shape. Neural networks have also been developed for pre and post processing steps in relation to segmentation. In this case segmentation is performed based on the various process such as delineation of contours, connecting edge pixels, identification of surfaces, deciding whether a pixel occurs inside or outside a segment, resolve the segmented image, clustering of pixels and motion segmentation.

- **Clustering**

Clustering algorithms use group of similar properties of image such as pixel, color, and boundaries for segmenting an image. In clustering based image segmentation, an input image is divided into groups based on the similar properties include distance, connectivity, and intensity values. A similarity criteria is defined between pixels and then similar pixels are grouped together to form clusters. The grouping of pixels into clusters is based on the principle of maximizing the intra class similarity and maximizing the inter class similarity. Clustering algorithms does not use training data instead they iterate between segmenting the image and characterizing the properties of each class [10].

Clustering techniques can be classified into two categories such as hard clustering and soft clustering. In hard clustering, data is divided into a number of unique clusters where each data component belongs to exactly in one cluster. One of the most popular and well used hard clustering algorithms is K-means clustering algorithm [11]. In soft clustering data elements can belong to more than one cluster with a degree of certain relationship values. Fuzzy C-Means clustering is a type of soft clustering algorithm that can be used in situations when there are no defined boundaries between different objects in an image. Fuzzy clustering divides the input pixels into cluster or groups on the basis of various similarity

ISSN: 2278 – 1323

criterions such as distance, connectivity and intensity. In recent years spectral clustering has been successfully applied in the fields of bioinformatics, information retrieval and image segmentation. Spectral clustering is an algorithm which can divide any shape based on spectral graph theory. The purpose of spectral based image segmentation is to divide the input image into some space adjacent, spectral similar homogenous regions and separate the target and background.

❖ **K-means Clustering**

K-Means algorithm is an iterative, numerical, nondeterministic and unsupervised clustering method that classifies the input data points into multiple classes based on their inherent distance from each other. K-means algorithm is based upon the index of similarity or dissimilarity between pairs of data components.

The K-means algorithm assumes to the data features form a vector space and tries to find natural clustering in them. In this method the points are clustered around the centroids that are obtained by minimizing the spaces [14]. K-means clustering is a clustering technique group n pixels of an image into K number of clusters, where K < n and K is a positive integer. Initially the centroids of the predefined clusters are initialized randomly. Clusters are formed on the basis of the similarity features as such gray level intensity of pixels and distance of pixel intensities.

In this clustering algorithm data is clustered iteratively by computing intensity for each group and segmenting the image by classifying each pixel in the class with the closest one pixel. The various steps that are to be followed for segmenting images using K-means algorithm as follows [22]:

- Takes an image as input and compute the intensity distribution.
- Initialize the centroids with k random intensities.
- Repeat the following steps until the cluster labels of the image do not change anymore.
- Cluster the points based on distance of their intensities from the centroids intensities.
- Compute the new centroids for each of the clusters.

K-means produces relatively high quality clusters with considering the low level of computation required. The k-means method aims to minimize the sum of squared distances between all points and the cluster centre. K-means perform well with many data sets, but its good performance is limited mainly to compact groups. K-Means clustering generates a specific number of disjoint flat clusters and is well suited to generate globular clusters. The disadvantages of K-means algorithm includes the determination of number of clusters, produce different results based on different initial conditions and the centers away from optimum location [7].

❖ **Fuzzy C-Means Clustering**

Fuzzy C-Means (FCM) is an unsupervised clustering algorithm that classifies the image by grouping similar data points in the feature space into clusters. This method separate the input image as regions based on their grouping of similar pixels and the pixels on an image are highly correlated and thus the spatial relationship of neighboring pixels is an important characteristic that can be of great aid in imaging segmentation The FCM algorithm assigns pixels to each category by using fuzzy memberships.

In this clustering algorithm data is clustered iteratively by grouping similar pixels and segmenting the image by classifying each pixel in the group with the pixel based on similar features. The various steps that are to be followed for segmenting images using Fuzzy C-means algorithm as follows:

- Take an input image and get the size of image.
- One of pixel is placed as constant from group of clusters.
- Identify the pixel distance and calculating given dimension of input image.
- Begins the iterations and if probable iteration is reached then stops the process and get segmenting image otherwise iteration process is continued.

The main advantage of FCM algorithm is the classification of clusters is easy to understand, since the membership functions partition the data space properly placed [13]. The disadvantage of FCM algorithm is not taken the consideration of noise in images.

❖ **Spectral clustering**

The spectral clustering is a kind of clustering method based on the similarity and graph theory and it needs to calculate the similarity between each pair of pixels in the process of image segmentation. The use of spectral clustering for image segmentation can use similar matrix feature vector which reflects the similarity between data detect the internal structure of the data and solve them with the standard linear algebra method. Compared with the traditional clustering methods such as K-means, spectral clustering can cluster any sample space in any shape. Spectral clustering algorithm is to build an undirected graph and then make a multi-channel division [26].

Image segmentation based on spectral clustering improves the quality of image segmentation and reduce computational complexity. Spectral method reduces dimensions using the Eigen values of the similarity matrix of the data and is used to group number of data points. The similarity matrix is provided as an input and consists of a quantitative evaluation related to similarity of each pair of points in the dataset. The various steps that are to be followed for segmenting images using spectral clustering algorithm as follows:

- Dividing the image into lots of small homogenous areas based on pixel level.
- Preprocess the input image and get image feature vector matrix.
- Extract the color, texture and shape feature of the image and calculate the image similarity with the extracted feature matrix.

ISSN: 2278 – 1323

- Obtain the final segmenting image based on the image features extraction.

The advantage of spectral clustering is generating good results and also reducing the computation lay out. The disadvantage of spectral clustering is when image resolution is high the spectral clustering method can lead to overlarge adjacency matrix [5].

- **Wavelets**

Wavelet transform decomposes an image by means of a series of elementary functions, created from dilations and translations of basis function known as mother wavelet. Wavelet transforms can be implemented by using pair of low-pass and high-pass filters which are represented by a sequence of coefficients. In two-dimensional wavelet decomposition the filters are applied to an image in both horizontal and vertical directions, followed by a down sampling. As wavelet coefficients in different frequency bands show variations in horizontal, vertical and diagonal directions, it has been shown that texture features can be extracted from these coefficients. Wavelets are functions generated from a single function by dilations and translations.

Image segmentation based on wavelets method has been carried out in two stages. In the first stage the input image is decomposed into blocks of pixels and a wavelet transform is applied to each block to identify homogeneous regions of the image, then assigning the entire block to a class. The initial segmentation identifies blocks with similar features, grouping them into corresponding classes. In the second stage, heterogeneous regions for instance blocks located in frontiers between different regions are detected and finally segmented images has been identified more precisely. The various steps that are required to segment an image using wavelets are [2]:

- First stage is input the image and decomposition the image such as n x n blocks.
- Blocks inside image are changing to various positions such as horizontal, vertical, diagonal.
- Feature extraction based on low and high level frequency measures.
- Identify similar regions then performs second stage of segmentation.
- In second stage pixel segmentation in heterogeneous regions and get the segmenting image as result.

Image segmentation based on wavelet transforms is useful for extracting color and texture features from the images. By using this method first, features are extracted from the wavelets coefficients from small regions of the image and then the regions are grouped into a set of classes. Finally, a pixel wise segmentation is applied to those pixels which were not segmented. By using this two-step process, it is possible to reduce the computational cost significantly since only a small number of pixels need to be segmented in the second stage that avoids the feature calculation for every pixel in the image. The advantage of wavelet transformation is an image can show at different levels of resolution and can be sequentially processed from low resolution to high resolution [24].

IV. CONCLUSION

Image segmentation is one of the most important tasks in image processing which is used to partition an image into several disjoint subsets such that each subset corresponds to a meaningful part of the image. Image segmentation is a difficult task since often the scene objects are defined by image regions with non-homogenous texture and color characteristics. In order to divide the input image into semantically meaningful regions many developed algorithms either use a priori knowledge in regard to the scene objects or employ the parameter estimation for local texture. Although a variety of image segmentation methods have been developed, there is still no general method suitable for segmenting any type of images and thus research on image segmentation method has become the key issue. Therefore, further research is required to develop an effective segmentation technique to partition an image for locating and identifying objects or boundaries in an image in a clear and meaningful way to meet the demands of advanced applications.

REFERENCES

[1] S. S. Al-amri, N. V. Kalyankar, “Image segmentation by using threshold techniques”, Journal of Computing, Vol. 2, Issue No. 5, pp.83-86, May 2010.

[2] Andrea Gavlasov´a, Aleˇs Proch´azka, Martina Mudrov”, Wavelet Based Image Segmentation”, Institute of Chemical Technology, Department of Computing and Control Engineering, In Proceedings of the 14th Annual Conference Technical Computing, Prague, pp.1-7, 2006.

[3] R.B. Aswin, J. Abdul Jaleel, Sibi Salim, “Implementation of ANN Classifier using MATLAB for Skin Cancer Detection”, International Journal of Computer Science and Mobile Computing (ICMIC13), pp. 87-94, December- 2013.

[4] Bo Peng, Lei Zhang , David Zhang, “Automatic Image Segmentation by Dynamic Region Merging”, IEEE Transactions on image processing, Vol.20, Issue No.12, December 2011.

[5] X. Cai, G. Dai, L. Yang, “Survey on Spectral Clustering Algorithms”, Computer Science, Vol. 7, Issue No. 35, pp. 14-18, 2008.

[6] H.D. Cheng, X.H. Jiang, Y. Sun, J. Wang, “Color image segmentation: advances and prospects”, Pattern Recognition, Vol.34, Issue No.12, pp. 2259-2281, 2001.

[7] Devarshi Naik, Pinal Shah, “A Review on Image Segmentation Clustering Algorithms”, International Journal of Computer Science and Information Technologies, Vol. 5, Issue No.3, pp. 3289 – 3293, 2014.

[8] Hui Zhang, Jason E. Fritts, Sally A. Goldman, " Image segmentation evaluation: a survey of unsupervised methods", Computer Vision and Image Understanding, Elsevier, pp. 260-280, 2008.

[9] K.M. Iftekharuddin, “Transformation in variant on-line target recognition”, IEEE Transactions on Neural Networks, Vol.22, pp. 906–918, 2011.

ISSN: 2278 – 1323

[10] Jain, K. Anil, M. Narasimha Murty, J. Patrick. Flynn. "Data clustering: a review." ACM computing surveys, Vol. 31, Issue No.3, pp. 264-323, 1999.

[11] Jay Acharya, Sohil Gadhiya, Kapil Raviya, "Segmentation Techniques for Image Analysis: A Review", International Journal of Computer Science and Management Research, Vol.2, Issue No.1, pp. 1218-1221, January 2013.

[12] H. G. Kaganami, Z. Beij, "Region based detection versus edge detection," IEEE Transactions on Intelligent Information Hiding and Multimedia Signal Processing, pp. 1217-1221, 2009.

[13] F .Z. Kettaf, D. BI, "A Comparison Study of Image Segmentation by Clustering Technique", In Proceedings of ICSP, pp. 1280-1282, 1996.

[14] P. Lukac et al., "Simple comparison of image segmentation algorithms based on valuation criterion", In IEEE 21st International Conference, 2011.

[15] J. Orlando, Tobias, Rui Seara, "Image Segmentation by Histogram Thresholding Using Fuzzy Sets", IEEE Transactions on Image Processing, Vol.11, Issue No.12, pp.1457-1465, 2002.

[16] N.R. Pal, S.K. Pal, "A review on image Segmentation techniques", Pattern Recognition, Vol.26, Issue No.9, pp. 1274 -1294, 1993.

[17] M.E. Petersen, D. De Ridder, H. Handels,"Image processing with neural networks - A review ", Pattern Recognition, Vol.35, Issue No. 10, pp. 2279-2301, 2002.

[18] Rajvi Parikh and Dr Hitesh shah, "A Survey on Computer Vision Based Diagnosis for Skin Lesion Detection", International Journal of Engineering Science and Innovative Technology (IJESIT) Vol.2, Issue No.2, pp. 431-437, March 2013.

[19] S. Raut, M. Raghuvanshi, R. Dharaskar, A.Raut, "Image Segmentation-A State-of-art survey for prediction", In Proceedings of the International Conference on Advanced Computer Control, pp. 420-424, 2009.

[20] Y.Rui, A.C. She, T.S. Huang, "Modified Fourier descriptors for shape representation—a practical approach", In Proceedings of the First International Workshop on Image Databases and Multi Media Search, pp. 284-295, 1996.

[21] N. Senthilkumaran, R. Rajesh, "A Study on Edge Detection Methods for Image Segmentation", In Proceedings of the International Conference on Mathematics and Computer Science (ICMCS-2009), Vol. I, Issue No. 2, pp.255-259, 2009.

[22] J. Shi, J. Malik, "Normalized cuts and image segmentation," IEEE Transaction on Pattern Analysis and Machine Intelligence, vol. 22, pp. 888-905, Aug 1997.

[23] K. K. Singh, A. Singh, "A Study of Image Segmentation Algorithms for Different Types of Images", International Journal of Computer Science Issues, Vol.7, Issue No.5, 2010.

[24] E. J. Stollnitz, T. D. Derose, D. H. Salesin, "Wavelets for Computer Graphics". Morgan KaufmannPublishers, Inc., San Francisco, CA, 1996.

[25] Waseem Khan, "Image Segmentation Techniques: A Survey ", Journal of Image and Graphics Vol. 1, Issue No. 4, pp.166-170, December 2013.

[26] Xiaohong Zhao, Yanhua Qu, Hong Zhang, "Sports Video Segmentation using Spectral Clustering", Journal of Multimedia, Vol. 9, Issue No. 7, pp.873-678, JULY 2014.

[27] S. Zhu, A. Yuille, "Region competition: Unifying snakes, region growing, and Bayes/MDL for multiband image segmentation," IEEE Transactions on Pattern Anal. Machine Intelligence, Vol. 18, Issue No. 9, pp. 884–900, Sep.1996.

Author's Profile

P. SIVAKUMAR is an M.Phil research scholar in Department of Computer Science, Gobi Arts & Science College, Gobichettipalayam. He received his M.C.A degree in the year of 2012. His area of interest is Image Processing.

Dr. S. MEENAKSHI did her M.C.A from University of Madras and M.Phil, Ph.D in Computer Science from Bharathiar University. She is an Associate Professor in Computer Science at Gobi Arts & Science College, Gobichettipalayam and has 25 years of teaching experience. She has published research papers in International Journals and her areas of interests include Object-Oriented Programming Systems, Advanced Database Systems and Data Mining.

ISSN: 2278 – 1323