ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 4, Issue 1, July 2014

A Study on the Different Image Segmentation Technique

Rozy Kumari, Narinder Sharma

Abstract:-This paper presents an overview of some well-known image segmentation techniques. The segmentation process divides a given image into different regions and objects. Image Segmentation has become popular due to its many vision applications. The main goal of this survey is to explore various algorithms of image segmentation. The short-comings of the survey on image segmentation algorithms have also been evaluated. The main focus of this paper is on the clustering based segmentation techniques. This paper concludes with certain limitations of available techniques and also the possible solutions for the same for future use.

Index terms: **Edge detection, region growing segmentation, Watershed, Clustering, Thresholding.**

I. INTRODUCTION

Image Segmentation is a vital procedure of processing and understanding an image. It is the fundamental necessity of any computer based vision application on the grounds that individuals are mostly interested just in specific parts of the picture. Essentially it is characterized as the procedure of isolating the picture into distinctive parts of homogeneity. An image might be defined as a two-dimensional function, f(x, y), where x and y are the spatial coordinates, and the amplitude of at any pair of coordinates is known as the intensity of the image at specific point. When the intensity of f and the value of x,y are finite then the image is called digital image.[1]

The objective of image segmentation is to simplify the representation of a picture into something that is more genuine and simpler to understand. It is essentially used to discover the location of objects, boundaries, lines and so on in the digital images. More precisely, image segmentation is the process of assigning a label to every pixel in the image such that pixels with the same label share certain visual characteristics or features. [2]

Essentially Image segmentation entails partitioning an image by grouping similar pixels together. Ideally these groups should represent the components that the image is comprised of. The image can then instead be interpreted using a small number of well-defined components as opposed to a large array of unrelated pixels. Wikipedia provides a nice definition: 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.

The output of image segmentation is a set of regions that together cover the entire image. The consequence of picture division is a situated of areas that together blanket the whole picture. Each of the pixels in a area are comparative regarding some property, for example, color, texture and intensity. Adjoining regions are fundamentally diverse regarding the attributes. It should be noticed that no general technique has been developed yet to segment an image precisely, so different techniques are taking floor to perform segmentation [3]. In the next section, some of the image processing methods have been explained.

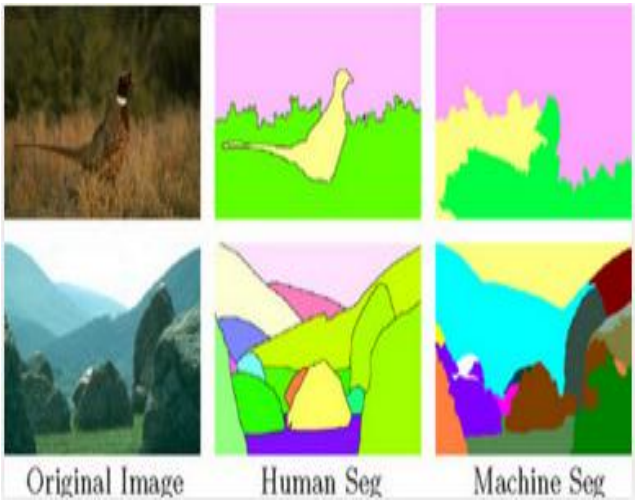

Fig 1 Segmentation results

II. IMAGE SEGMENTATION TECHNIQUES

A. Edge Detection Methods

Edge detection techniques convert's images to edge images thus having benefit from the change of grey tones in the images. 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[4][5]. Objects have various parts of different color levels. In an image with different grey levels, despite an obvious change in the grey levels of the object, the shape of the image can be distinguished in Figure 2 [5].

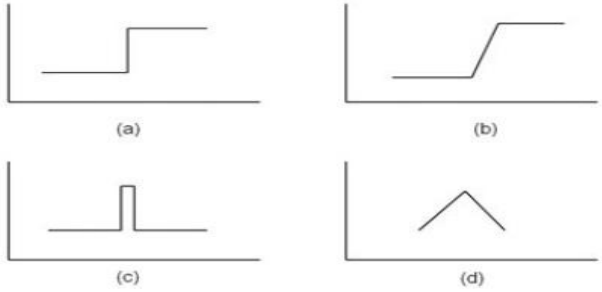

Fig 2: Type of Edges (a) Step Edge (b) Ramp Edge (c) Line Edge (d) Roof Edge

An Edge of the image is an important local change in the intensity of the image, usually related with a

ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 4, Issue 1, July 2014

discontinuity in either the first derivative of the image intensity or the image intensity. Discontinuities in the image intensity can be either Step edge, where the image intensity abruptly changes from one value on one side of the discontinuity to a different value on the opposite side, or Line Edges, where the image intensity abruptly changes value but then returns to the starting value within some short distance [6]. Though Step and Line edges are rare in real images. Due to low frequency components or the smoothing introduced by most sensing devices, sharp discontinuities do not exist in real signals. Step edges become Ramp Edges and Line Edges become Roof edges, where intensity changes are not instantaneous but occur over a finite distance [7]. Illustrations of these edge shapes are shown in Fig.2.

1. Steps in Edge Detection

Edge detection consists of three steps namely Filtering, Enhancement and Detection. The overview of the steps in edge detection are as follows.

a)Filtering: Images are regularly corrupted by arbitrary variations in intensity values, this is called noise. Salt and pepper noise, impulse noise and Gaussian noise are some of the type of noise. Salt and pepper noise holds arbitrary events of both dark and white intensity values. Notwithstanding, there is an exchange off between edge strength and noise lessening.. More filtering to reduce noise results in a loss of edge strength [8].

b) Enhancement: *To* facilitate the detection of edges, it is necessary to find changes in intensity in the neighborhood of a point. Enhancement emphasizes pixels where there is a significant change in local intensity values and is usually performed by computing the gradient magnitude [9].

c) Detection: *A* lot of points in an image have a nonzero value for the gradient, and all of these points are not edges for a particular application. Therefore, some method should be used to determine which points are edge points. Frequently, thresholding provides the criterion used for detection [10].

B. Region Based Methods

The process of segmentation is one of the very first steps in the various remote sensing image analyses. Generally the image is divided into regions which represent the relevant objects in best method in the scene. Various region properties like area, shape, statistical parameters and texture can be extracted and used for additional analysis of the data. The segmentation task can be accomplished in two ways: 1) dividing up the images into a number of homogeneous regions, each having a unique label, 2) determining boundaries between homogeneous regions of different properties and these segmentation techniques are known as region-based segmentation and edge detection, respectively [11].

The splitting and merging techniques of the region starts with splitting of an image into number of small regions and this proves continues till regions with mandatory degree of homogeneity are formed. The splitting of the phase has an impact on the overall segmentation of the image. This results in over segmentation of the image which is further followed by the merging phase. Thus region splitting and merging techniques are complex and consumes a lot of time. The main objective of region growing is to map individual pixels called seeds in input image to a set of pixels called region and region growing method starts with initial seeds and grows with neighboring homogenous elements where seed may be pixel or region [3]. The technique of the region growing is an iterative process.

1. Steps in Region Based Method

a) The entire image is segmented into pattern cells

b) Comparison of every pattern cell is done with its neighboring cells to determine whether they are similar, using a similarity measure. In case they are similar, merge the cells to form a fragment and the property used in the comparison is updated.

c) After comparison, continue growing the fragment by examining all its neighbors until no joinable regions remain. Then label the fragment as a completed region.

d) Move to the next uncompleted cell, and repeat these steps until all cells are labeled [11].

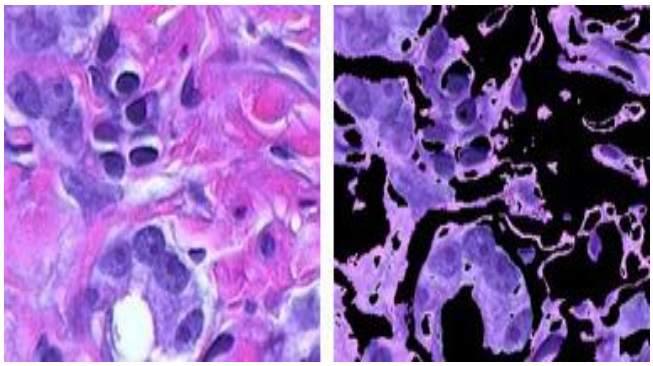

Fig 3: a) Input Image b) Segmented Image [12]

III. THRESHOLD BASED SEGMENTATION

Threshold technique is one of the most used techniques in image segmentation. This technique can be expressed as:

$$T=T[x, y, p(x, y), f(x, y]$$

Where: T is the threshold value [11] .

x, y are the coordinates of the threshold value point. p(x,y) ,f(x,y) are points the gray level image pixels.

ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 4, Issue 1, July 2014

Threshold image g(x,y) can be define [13]:

$$g(x,y)= \begin{cases} 1 & if \quad f(x,y) > T \\ 0 & if \quad f(x,y) \le T \end{cases}$$

1. Some of threshold techniques

a) Mean Technique

This procedure utilized the mean estimation of the pixels as the threshold value and works well in strict instances of the images that have roughly half to the pixels having a place with the objects and the other half to background. This strategy case seldom happens.

b) P-Tile Technique

The p-tile technique uses knowledge about the area size of the desired object to the threshold an image. And this method is one of the earliest threshold methods based on the gray level histogram [13]. This technique supposes that the objects in an image are brighter than the background, and occupy a particular percentage of the picture area. This fixed percentage of picture area is known as P%. The threshold is defined as the gray level that mostly corresponds to mapping at least fixed percentage of picture area of the gray level into the object.

Let n be the maximum gray level value, H (i) be the histogram of image (i = 0. n), and P be the object area ratio. The algorithm of the P-tile method is as follows:

S=sum (H(i)) …… (3)

Let f=s

For k=1 to n

f=f-H(k-1)

If (f/t) <p then stop

T=k

Where: S total area of image

f is the initialize all area as object area

T is the final threshold value [13]

This method is simple and suitable for all sizes of objects. It yields good anti-noise capabilities; however, it is obviously not applicable if the object area ratio is unknown or varies from picture to picture [14].

c) Histogram Dependent Technique (HDT)

These are dependent on the success to estimate the threshold value that separate the two homogonous region of the object and background of an image. The HDT is right for image having large homogonous and will split regions where all area of the objects and background are homogonous apart from the area in between the objects and background.

This technique [14] can be expressed as :

C (T) =P1 (T)σ1 2(T) +P2(T)σ2 2(T) (4)

Where:

C (T) is the within-group variance.

P1 (T) is the probability for group with values less than T.

P2(T) is the probability for group with values greater than T.

σ1 (T) is the variance of group of pixels with values less than or equal

T.σ2 (T) is the variance of group of pixels with values greater than T.

d)EMT Technique

The threshold image by using this technique is used when there are extra homogenous region in image or when there is a change on illumination in the object and its background.

e) Visual Technique

These techniques enhance people's ability to exactly search for target items. These techniques are similar to P-Tile technique as they all uses the component segments of original images in new ways to improve visual search performance but is dissimilar from p-tile.

C. Clustering Based Segmentation

Clustering method is a procedure in which a data set or say pixels are exchanged by cluster, pixels may belong together because of the same color, texture etc. There are two types of clustering that is hierarchical clustering and partional clustering [16].

1. Some of the Clustering methods

a) K- means clustering method

This is an iterative technique used to partition an image into lot of clusters in which there is option of k cluster centers; randomly each pixel in the image is assign to the every cluster. The cluster centers is again computed by taking mean of all the pixels in the centre. The quality of explanation obtained from this method depends upon the initial set of clusters and the value of k.

b) C-means clustering method

It is fuzzy clustering method where each point has a degree of belonging of clustering as in fuzzy logic, rather than belongs to just one cluster. In this, centroid of a cluster is the mean of all points, weighted by then degree of belonging to the cluster. It is also called soft k-means clustering method.

c) FELICM

ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 4, Issue 1, July 2014

It is abbreviation of Fuzzy C-Means with Edge and Local Information, which introduces the pixel's weights within local neighbor windows to decrease the edge degradation. Mainly this method has somehow used to overcome the isolated distribution of pixels inside segments of image.

d) Mean Shift

This is an advanced technique for clustering based segmentation and is a non parametric iterative algorithm. It is implemented through kernel density estimation which is a non parametric way to approximate the density of a random variable. It is a popular method for estimating probability. For every data point, mean shift defines a window around it and computes the mean of data point

IV. LITERATURE SURVEY

Nan Li et al. (2013) [17] have proposed an image clustering method called fuzzy C-means with edge and local information(FELICM), which decreases the edge degradation by adding the weights of pixels within local neighbor windows. They had used the canny edge detection for edge extraction, adaptive threshold values. It had been shown that the proposed method could be directly applied without using the filters. This approach has delivered the better results with respect to fuzzy c means clustering method and mean shift approach. The experiments show that the proposed FELICM method is insensitive to the isolated regions and more accurate edges than FLICM.

Monika Xess et al.(2013) [18] This paper presented an overall search over the topic clustering based color image segmentation and novel approaches to FCM algorithm. This paper described two techniques namely K-means clustering and fuzzy c-means (FCM) clustering for better segmentation results. The benefits of Spatial Fuzzy C-means (SFCM) which overcomes the limitation of conventional FCM towards noisy image have been discussed. Thresholding by Fuzzy C-means (THFCM) approach solves the problem of existing method to determine a threshold for excellent segmentation. Navneet Kaur et al.(2013) [16] This paper had presented the use of image segmentation in lesion segmentation which is needed for monitoring and quantifying lesion. It had also illustered the k-means clustering method which is an iterative technique that is used to partition an image into clusters in which there is choice of k clusters along with the types of clustering that is hierarchical clustering and partitioned clustering. It has also given the description over the region growing segmentation which is partitioning of an image into homogeneous connected pixels. Each pixel in the region is similar due to some property such as color and texture.

Amrita Mohanty et al.(2013) [19] This paper had described the analysis of color images using cluster based segmentation techniques. It has discussed the various segmentation techniques like thresholding, edge-based detection, region based detection and clustering. The main illustration is based upon the color image segmentation using k-means, fuzzy c-means and clustering and corresponding results have been compared. R.Ravindraih et al. (2013) [20] This is a survey paper which as represented the various image segmentation algorithms based on fuzzy clustering. It had described the use of image segmentation with the medical image processing. It had covered different types of fuzzy c-means algorithms like fcm, improved fcm, bias corrected fuzzy c-means and their corresponding use to the image segmentation.

Hamed Shamsi et al (2012) [21] this paper illustrated that the traditional way to segment the MR images is the fuzzy c-means (fcm) clustering algorithm. This method basically sensitive to noise. So to overcome the traditional method a new modified fuzzy c-means clustering with spatial information for image segmentation was proposed. The proposed method used the spatial information for the better results as compared to fcm. The results proved that the proposed method was more robust to noise than the standard fcm algorithm. Santanu Bhowmik et al(2012) [2] This paper basically represented the survey on clustering based image segmentation. It described the various clustering techniques to achieve image segmentation. Clustering is done based on different attributes of an image such as size, color, texture etc. This paper covered the types of clustering such as log-based clustering, hierarchical clustering. It had described the segmentation in relevant to various image processing techniques. S. Krinidis et al. (2010) [23] had proposed algorithm named fuzzy local information C-means (FLICM) which can remove the shortcomings of the already known fuzzy c-means algorithms. It used fuzzy local information like spatial and gray level which guarantee noise sensitiveness and robustness to noisy images.

Y. Tarabalka et al (2009) [24] had introduced a new spectral-spatial classification scheme for the hype spectral images which combines the results obtained by the pixel wise support vector machine classification and the segmentation map obtained by partitional clustering. The proposed schemes perform well for the recognition of images having large spatial structures. Li et al.(2012)[25]has suggested new approach to lessen over-segmentation using both pre and post processing for watershed segmentation. A new watershed segmentation process that combines pre-processing of the image and post-processing of image objects to produce the final segmentation results. In the initial stage of the watershed transform, this not only generates a gradient image from

ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 4, Issue 1, July 2014

the original image. It also presents the texture gradient. The texture gradient can be obtained by a gray-level co-occurrence matrix.

Ghoshale et al. (2013) [28] has described the several edge sharpening filters and to discover the effect on the output image using watershed algorithm. A spatial sharpening filter on the performance of the segmented images and mathematical morphology plays a very important role. Morphology is the special type of filtering and structuring elements used for shape smoothing and elimination of small holes. Rahman et al. (2013)[29] present, a novel image segmentation process based on adaptive threshold and masking operation with watershed algorithm. Whose objective is to overcome over-segmentation problem of the traditional watershed algorithm.

V. GAPS IN LITERATURE

Following are the various gaps in earlier work on image segmentation techniques.

1. *Isolated regions:* Most of the existing techniques have focused on the complex regions. Not much work done for the images with mixed regions.
2. *Principal region extraction:* The effect of the regions on the segmentation has been neglected by many researchers.
3. *Effect of color:* The effect of the color on the segmentation results has also been neglected by many researchers.
4. *Accuracy and complexity:* The results [base paper] has shown that the FELICM has shown better results when the window size 11*11. But 11*11 mask will result in high computational time complexity. Also result for standard mask size i.e. 3*3 it has shown poor results than mean shift algorithm.

VI. CONCLUSION AND FUTURE SCOPE

Image Segmentation is a process of image processing and understanding. It is defined as the process of dividing the image into parts based on homogeneity. The purpose of image segmentation is to make the representation of an image simpler into something that is more meaningful and easier to understand. The process in which a data set or say pixels are replaced by cluster, pixels may belong together because of the same color, texture etc is known as Clustering based method. The survey has shown that of the existing techniques, main focus is on complex regions. Therefore not much work has been done for the images with mixed regions. The effect of the regions on the segmentation has been neglected by many researchers. The effect that colors have on segmentation results has also been neglected.

So in near future we will propose a new integrated Edge preserving smoothing, region growing and FELICM based image segmentation algorithm to improve the accuracy of the segmentation procedure further. The motivation behind the proposed approach is simple and effective. First of all edge preserving smoothing will filter the objects available in digital image so that the complex objects can also be easily detected. However, the use of HSV has the ability to segment the color images in efficient manner. The actual segmentation is done by using the integrated region growing and FELICM based image segmentation algorithm.

REFERENCES

[1] P. S. Liao, T.-S. Chen and P.-C. Chung, "A fast algorithm for multilevel thresholding," J. Inf. Sci. Eng., vol. 17, no. 5, pp. 713–727, Sep. 2001.

[2] Santanu Bhowmik, Viki Datta," A Survey On Clustering Based Image Segmentation", International Journal Of Advanced Research In Computer Engineering & Technology Volume 1, Issue 5, July 2012.

[3] Verma, Om Prakash, Madasu Hanmandlu, Seba Susan, Muralidhar Kulkarni, and Puneet Kumar Jain. "A simple single seeded region growing algorithm for color image segmentation using adaptive thresholding" IEEE International Conference on Communication Systems and Network Technologies (CSNT), pp. 500-503., June, 2011.

[4] Ibrahiem M. M. El Emary, "On the Application of Artificial Neural Networks in Analyzing and Classifying the Human Chromosomes", Journal of Computer Science, vol.2 (1), 2006, pp.72-75.

[5] N. Senthilkumaran and R. Rajesh, "A Study on Edge Detection Methods for Image Segmentation", Proceedings of the International Conference on Mathematics and Computer Science (ICMCS-2009), 2009, Vol.I, pp.255-259.

[6] M. Abdulghafour,"Image segmentation using Fuzzy logic and genetic algorithms", Journal of WSCG, vol. 11, no.1, 2003.

[7] Metin Kaya,"Image Clustering and Compression Using an Annealed Fuzzy Hopfield Neural Network", International Journal of Signal Processing,2005, pp.80-88.

[8] N. Senthilkumaran and R. Rajesh, "A Study on Split and Merge for Region based Image Segmentation", Proceedings of UGC Sponsored National Conference Network Security (NCNS-08) , 2008, pp.57-61.

[9] Xian Bin Wen, Hua Zhang and Ze Tao Jiang, "Multiscale Unsupervised Segmentation of SAR Imagery Using the Genetic Algorithm", Sensors, vol.8, 2008, pp.1704-1711.

[10] Mantas Paulinas and Andrius Usinskas, "A Survey of Genetic Algorithms Applications for Image Enhancement and Segmentation", Information Technology and Control, Vol.36, No.3, 2007, pp.278-284.

ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 4, Issue 1, July 2014

[11] Bins, L. Sant'anna, Leila M. Garcia Fonseca, Guaraci José Erthal, and F. Mitsuo Ii. "Satellite imagery segmentation: a region growing approach" Simpósio Brasileiro de Sensoriamento Remoto, pp. 677-680, April 1996.

[12] http://www.mathworks.in/discovery/image-segmentation.html

[13] Du Gen-yuan,Miao Fang,Tian Sheng-li,Guo Xi-rong.,"Remote Sensing Image Sequence Segmentation Based on the Modified Fuzzy C-means", Journal of Software, Vol. 5, No. 1, PP.28-35, 2009.

[14] A.S. Abutaleb, "Automatic Thresholding of Gray-Level Pictures Using Two Dimensional Entropy", Computer Vision, Graphics, and Image Processing, Vol.47, PP.22-32, 1989.

[15] Salem Saleh Al-amri1, N.V. Kalyankar2 and Khamitkar S.D, "Image Segmentation by Using Threshold Techniques", JOURNAL OF COMPUTING, VOLUME 2, ISSUE 5, MAY 2010.

[16] Navneet Kaur, Gagan Jindal "A Survey Of K Means Clustering With Modified Gradient Magnitude Region Growing Technique For Lesion Segmentation", International Journal Of Innovations In Engineering And Technology, April 2013.

[17] Nan li, Hong huo, Yu-ming zhao, Xi chen, and Tao fang," A Spatial Clustering Method with Edge weighting for Image segmentation", IEEE Geoscience And Remote Sensing Letters, Vol. 10, No. 5, September 2013.

[18] Monika Xess, S. Akila Agnes" Survey On Clustering Based Color Image Segmentation And Novel Approaches To Fcm Algorithm", International Journal Of Research In Engineering And Technology, Vol. Issue: 2013.

[19] Amrita Mohanty, S Rajkumar, Zameer Muzaffar Mir And Puja Bardhan,"Analysis Of Color Images Using Cluster Based Segmentation Techniques", International Journal Of Computer Applications, October 2013.

[20] R.Ravindraiah, K.Tejaswini,"A Survey Of Image Segmentation Algorithms Based On Fuzzy Clustering", International Journal Of Computer Science And Mobile Computing "'July 2013.

[21] Hamed Shamsi And Hadi Seyedarabi, "A Modified Fuzzy C-Means Clustering With Spatial Information For Image Segmentation", International Journal Of Computer Theory And Engineering, Vol. 4, No. 5, October 2012.

[22] S. Krinidis And V. Chatzis, "A Robust Fuzzy Local Information C-Meansclustering Algorithm," Ieee Trans. Image Process., Vol. 19, No. 5,Pp. 1328–1337, May 2010.

[23] Y. Tarabalka, J. A. Benediktsson, and J. Chanussot, "Spectral–Spatial Classification of Hyper spectral Imagery Based on Partitional Clustering techniques," Ieee Trans. Geosci. Remote Sens., Vol. 47, No. 8, Pp. 2973–2987, Aug. 2009.

[24] Z.Xiangrong, L.Jiao, F.Liu, L.Bo and M.Gong"'Spectral Clustering Ensemble Applied to SAR Image Segmentation"IEEE Trans, Geosci. Remote Sens, Vol.46, no.7 Jul 2008.

[25] Boren Li, Mao Pan, and Zixing Wu, "An improved segmentation of high spatial resolution remote sensing image using Marker-based Watershed Algorithm," 20th IEEE International Conference on Geoinformatics, Year 2012, pp.1-5.

[26] Farheen K. Siddiqui and Vineet Richhariya, "An Efficient Image Segmentation Approach through Enhanced Watershed Algorithm," Computer Engineering and Intelligent Systems, Vol.4, No.6, pp 1-7, 2013.

[27] P.P. Acharjya, A. Sinha, S. Sarkar, S. Dey and S. Ghosh,"A New Approach Of Watershed Algorithm Using Distance Transform Applied To Image Segmenttion,"International Journal of Innovative Research in Computer and Communication Engineering, Vol.1,No.2, pp 185-189, April 2013.

[28] Dibyendu Ghoshal and Pinaki Pratim Acharjya,"Effect of Various Spatial Sharpening Filters on the Performance of the Segmented Images using Watershed Approach based on Image Gradient Magnitude and Direction," International Journal of Computer Applications, Vol. 82, No.6, pp 19-25, November 2013.

[29] Md. Habibur Rahman and Md.RafiqualIslam, "Segmentation of color image using adaptive thresholding and masking with watershed algorithm,"IEEE International Conference on Informatics, Electronics & Vision (ICIEV), Year 2013, pp.1-6.

AUTHOR BIOGRAPHY

Rozy Kumari, Pursuing M.tech in Electronics and communication engineering from Amritsar college of Engineering and technology, Amritsar, Punjab, India

Narinder Sharma, H.O.D of Electrical and Electronics Engineering in Amritsar college of Engineering and technology, Amritsar, Punjab, India.