Image Segmentation: A Short Survey

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ABSTRACT

Images are segmented by marking pixel as object pixels or back-ground pixel this helps us in highlighting the area that is to be used for analysis more clearly .There are various techniques by which this can be achieved for both grayscale images and coloured images. The accuracy and efficiency of the segmentation depends on the precision by which all the variables are incorporated .A lot of research has been done in developing such methods of segmentation or partitioning of images .In present paper a survey of various methods of Image segmentation models has been discussed.

KEYWORDS

Image segmentation, survey on image segmentation, methods of image segmentation.

1. INTRODUCTION

The image segmentation techniques deals with segmenting or partitioning the image into different parts .The basis on which partitioning is done varies according to the need for example – colour,texture,intensity gradation. Images can be segmented on the basis of any if these features. This paper provides an overview of the work that has been done in this direction.

2. PREVIOUS WORK

It started in 1972 when Bacusmber, James W., Gose and Earl E. gave a Leukocyte Pattern Recognition concept of automated classification of the peripheral blood leukocytes into eight categories .An eight-dimensional multivariate Gaussian classifier was used. The features were extracted from a 50 Ã—50 point digital image[1]. Region extraction for real image based on fuzzy reasoning in 1992 by Miyajima, K.; Lab. for Int. Fuzzy Eng. Res., Yokohama, Japan and Norita, T. was based on fuzzy nature of images it was an approach to extracting regions of a natural object by binarization using fuzzy reasoning . An advantage of this approach was that the threshold was obtained by fuzzy reasoning based on the shapes instead of the user having to determine the threshold by trial and error. Its drawback was that the approach was more effective than statistical methods for extracting objects whose shape is almost known[2]. Then in 1992 Vinod, V.V.; Dept. of Comput. Sci. & Eng., Indian Inst. of Technol., Kharagpur, India, Chaudhury, S., Mukherjee, J. and Ghose, S. presented a connectionist clustering strategy for segmenting color images. First the local peaks in the 3-D red, green, blue histogram were located. Then using these as the prototypes other patterns were classified into one of them. The prototype selection method employed only neuronal dynamics and therefore was faster than existing clustering neural networks. The classification network took into account the distribution of the data and hence was less prone to misclassifications. Experimental results obtained by applying the network for segmenting sone color image were presented[3]. Bartneck, N., Res. Inst. for Inf. Technol., Daimler-Benz AG, Ulm, Germany; Ritter, W. in 1992 presented Colour segmentation with polynomial classification . An important step for image analysis was the reduction of colour levels to a small number of significant levels. This was considered as a classification task. Furthermore polynomial classification as a method for colour segmentation with supervised learning was introduced. Finally results were shown coming from the application fields of traffic sign recognition and postal automation[4].

Graph-theoretical approach to colour picture segmentation and contour classification by Vlachos, T.; Dept. of Electr. & Electron. Eng., Imperial Coll. of Sci. Technol. & Med., London, UK; Constantinides, A.G. was presented in 1993. The procedure aimed at identifying, extracting and classifying visually important features on the image plane, such as regions of homogeneous colour and chromatic transitions. Well established principles of colour theory and graph theory were combined to obtain a unified representation of a colour picture. The picture was represented by means of a weighted graph, constructed so as to reflect the specification of the colour space employed as well as important relationships between picture elements. A spanning tree of the graph was obtained by iteratively minimising a specific picture distortion measure. Each partition comprised disjoint regions containing elements with similar attributes. Region contours defined by such partitions forms a hierarchy. It was shown that, when texture is combined with colour as joint similarity attributes of regions, an improved hierarchical description of contours is possible[5]. Hue-based segmentation of color images Crevier, D.; Dept. of Electr. Eng., Ecole de Technol. Superieure, Montreal, Que., Canada in 1993 relied on the mean and variance of their brightnesses or colors. The paper addressed the problem of using to this end the mean and variance of the hue of a population of pixels. It was based on recursive formulas for calculating the means and variances of hue distributions in an object-dependent coordinate system. At the cost of a slight numerical overhead, these computations generated results in agreement with the authors intuitive understanding of colors in split peak situations, and reduce to the standard definitions in well-behaved histograms.[6]. Labelling images with a neural network by Mackeown, W.P.J.; Bristol Univ., UK; Greenway, P.; Thomas, B.T.; Wright, W.A. in 1993 Showed that a neural network with a multilayer perceptron architecture is capable of automatically labelling the visible objects in colour images of outdoor road scenes. The two problems of segmentation and recognition were separated by using `ideal' segmentations, allowing the performance of the recognition method to be studied independently of the effects of using an imperfect real segmentation process. The authors argued that they have sufficient training data to constrain the degrees of freedom in the network. A label clustering transformation was proposed which resulted in a significant increase in the expected classification accuracy of the network. They demonstrated the importance of the contextual features with a control experiment in which the loss of the contextual features was shown to degrade the performance of the re-trained network [7].

A fuzzy technique for image segmentation of color images was introduced in 1994 by Moghaddamzadeh, A.; Dept. of Electron. Eng., Binghamton Univ., NY, USA; Bourbakis, N. according to this the largest area of an image can be easily segmented (crisp clusters), the association of most of the pixels to different clusters determined. It was the pixels between crisp clusters whose belongingness to adjacent clusters was not so clear. A pixel can belong to the closest cluster or in association with the neighboring pixels generated a new cluster .Fuzzy technique for segmentation were applied in this paper [8].Color image segmentation and understanding through connected components by Wanzhen Wang; Dept. of Electr. Eng., Taiyuan Heavy Machine Inst., China; Chengyi Sun; Hongxing Chao in 1997 proposed a new definition of connected components for color images, called (r,δ) connected components . This definition has developed the connected components theory. The new definition was applied to the segmentation and understanding of color images. Experiment shows that the segmentation through (r,δ)-connected components can give meaningful, reasonable and effective partition of color images. The (r,δ)-connected components analysis of color images was shown to be a good tool for the segmentation and understanding of color images[9]. In 1998

Jones, T.N.; Dept. of Comput. & Inf. Sci., Pennsylvania Univ., Philadelphia, PA, USA; Metaxas, D.N. presented paper on Image segmentation based on the integration of pixel affinity and deformable models this paper described a general- purpose method developed for automatically segmenting objects of an unknown number and unknown locations in images. This method integrated deformable models and statistics of image cues including intensity, gradient, color and texture. By using a combination of image features rather than a single feature such as gradient this method is more robust to noise and sparse data. To allow for the automated segmentation of an unkown number and locations of objects, simultaneous segmentation of objects were initialized at uniformly distributed points in the image. A method was developed to automatically merge models corresponding to the same object. Results of the method were presented for several examples, including greyscale, color and noisy images[10].

Color segmentation and figure-ground segregation of natural images by Swee-Seong Wong; Sch. of Comput., Nat. Univ. of Singapore, Singapore; Wee Kheng Leow in 2000 presented a way to recognize the objects in an image and to understand the image content, a computer system first separated the foreground objects from the background. Image segmentation and figure-ground segregation were, therefore, essential for computer image understanding. This paper described a system called OLAG (Object-LAyer Grouping) for image segmentation and figure-ground segregation. OLAG consisted of several incremental refinement steps which use colour and other visual cues such as size and compactness for grouping the image pixels. It produced, as an end result, a set of layers each containing an object or object part. Figure and ground relationships among the objects were inferred, giving their relative depths. It was shown that interesting and useful segmentation results can be obtained from the system[11]. Dooley, L.S.; Gippsland Sch. of Comput. & Inf. Technol., Monash Univ., Clayton, Vic., Australia; Karmakar, G.C.; Murshed, M. in 2003 presented paper on fuzzy rule-based colour image segmentation algorithm till then most fuzzy rule- based image segmentation techniques to date were primarily developed for gray level images. In this paper, a new algorithm called fuzzy rule-based colour image segmentation (FRCIS) was proposed by extending the generic fuzzy rule- based image segmentation (GFFUS) algorithm G.C. Karmakar, L.S. Dooley [2002] and integrating a novel algorithm for averaging hue angles. Qualitative and quantitative analysis of the performance of FRCIS was examined and contrasted with the popular fuzzy c-means

(FCM) and possibilistic c-means (PCM) algorithms for both the hue-saturation-value (HSV) and RGB colour models. Overall, FRCIS provided considerable improvement for many different image types[12].

Color image segmentation using fuzzy min-max neural networks in 2005 by Estevez, P.A.; Dept. of Electr. Eng., Chile Univ., Santiago, Chile; Flores, R.J.; Perez, C.A. .In this work, a new color image segmentation method, based on fuzzy min-max neural networks was presented. The proposed method was called FMMIS (fuzzy min-max neural network for image segmentation). The FMMIS method grows boxes from a set of seed pixels, to find the minimum bounded rectangle (MBR) for each object present in the images. The algorithm was tested on wood images of 10 defect categories and with images of frontal faces taken from the FERET database. The FMMIS algorithm outperformed alternative methods in terms of object detection rate, false positive detection rate, average execution time and the RUMA index. The proposed method was very fast and it may be applied to real-time image segmentation tasks[13]. Color image segmentation by scale-space image analysis in 2007 by Zhi- Qiang Wei; China Ocean Univ., Qingdao; Miao Yang An image analysis method was proposed to segment color images. The method was capable of segmenting color images based on watershed transform and scale-space analysis of the images. Analysis of hierarchical, geometric properties and the hue uniformity measure of the tree of scale-space and showed the experimental results for several biological and medical images. The experimental results showed that the proposed method provided effective segmentation. Moreover, this approach preserves the object contour, an important feature because of the performance of measure and other chemical processes are greatly influenced by their morphological character[14].

Using Fuzzy C-means Cluster for Histogram-Based Color Image Segmentation in 2009 by Zhi-Kai Huang; Dept. of Machinery & Dynamic Eng., Nanchang Inst. of Technol., Nanchang, China; Yun-Ming Xie; De-Hui Liu; Ling-Ying Hou proposed a fuzzy c-means (FCM) cluster based adaptive thresholding segmentation algorithm for color image. The main advantage of this method was that, it did not require a priori knowledge about number of objects in the image. It calculated the threshold values automatically with the help of merging process. The first step of the method was that to construct the histograms for each color channel. With this aim, information based histogram of the color intensities were obtained. In the second step of the method, Fuzzy 2-partition was used on each of the three histograms in R(red), G(green) and B(blue) dimensions, color image segmentation was obtained for the performance of the FCM cluster for each color channel. Experiment results showed that this method can determine automatically the number of the thresholds levels and achieves good results for color images[15].

A color image segmentation algorithm based on region growing in 2010 by Jun Tang; Sch. of Electron. Eng., Xi''an Shiyou Univ., Xi''an, China According to this Color image segmentation methods can be seen as an extension of the gray image segmentation method in the color images, but many of the original gray image segmentation methods can not be directly applied to color images. This requires to improve the method of original gray image segmentation method according to the color image which have the feature of rich information or research a new image segmentation method it specially used in color image segmentation. This article proposed a color image segmentation method of automatic seed region growing on basis of the region with the combination of the watershed algorithm with seed region growing algorithm which were based on the traditional seed region growing algorithm[16]. In 2011 Evolving fuzzy image segmentation was proposed by Othman, A.A.; Syst. Design Eng. Dept., Univ. of Waterloo, Waterloo, ON, Canada; Tizhoosh, H.R. according to which Image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label are connected and meaningful, and share certain visual characteristics. Pixels in a region are similar with respect to some features or property, such as color, intensity, or texture. Adjacent regions may be significantly different with respect to the same characteristics. Therefore, it was difficult for a static (non-learning) segmentation technique to accurately segment different images with different characteristics. In this paper, an evolving fuzzy system was used to segment medical images. The system used some training images to build an initial fuzzy system which then evolves online as new images are encountered. Each new image is segmented using the evolved fuzzy system and may contribute to updating the system. This process provided better segmentation results for new images compared to static paradigms. The average of segmentation accuracy for test images was calculated by comparing every segmented image with its gold standard image prepared manually by an expert[17].

Image segmentation using rough-fuzzy K-medoid algorithm in 2012 it was derived by gained increasing attention of image segmentation based on rough set and fuzzy set. In this article, a rough-fuzzy K-medoid algorithm was proposed for color image segmentation. The main objective of this algorithm was to provide an efficient method which uses color information (R, G, B values) along with neighborhood relationships. In this method K-medoid algorithm was modified using reduct formation rule of rough set theory while membership values of the features were obtained using fuzzy sets. This method used spatial segmentation where an image was divided into different parts with similar properties. Choice of initial cluster centers affected the performance of K-medoid algorithm, even if it was a simple and effective one. In this article, a modified K-medoid algorithm was proposed having two parts- in the first part, the initial cluster centers were optimized by rough set theory and in the second part the optimal cluster centers were used to execute K-medoid algorithm. The proposed scheme did not require any prior information about the number of segments. Results were compared with five different state of the art image segmentation algorithms and are found to be encouraging[18].

3. CONCLUSION

This paper provides a brief survey of the available solution for the choice of Image segmentation methods that have been evolved in past years. It is observed that in recent years fuzzy logic have gained special attention due to its precision and efficiency and is indeed of great help in developing efficient models for this purpose.

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4. REFERENCES

[1] Bacusmber, James W.; Gose, Earl E. "Leukocyte Pattern Recognition " Systems, Man and Cybernetics, IEEE Transactions on (Volume:SMC-2, Issue: 4), pp.513 - 526

[2] Miyajima, K.; Lab. for Int. Fuzzy Eng. Res., Yokohama, Japan; Norita, T. "Region extraction for real image based on fuzzy reasoning " Fuzzy Systems, 1992., IEEE International Conference, pp.229 - 236

[3] Vinod, V.V.; Dept. of Comput. Sci. & Eng., Indian Inst. of Technol., Kharagpur, India; Chaudhury, S.; Mukherjee, J.; Ghose, S. "A connectionist approach for color image segmentation" Systems, Man and Cybernetics, 1992., IEEE International Conference, pp.100 - 104 vol.1

[4] Bartneck, N.; Res. Inst. for Inf. Technol., Daimler-Benz AG, Ulm, Germany; Ritter, W. "Colour segmentation with polynomial classification " Pattern Recognition, 1992. Vol.II. Conference B: Pattern Recognition Methodology and Systems, Proceedings., 11th IAPR International Conference on, pp.635 - 638

[5] Vlachos, T.; Dept. of Electr. & Electron. Eng., Imperial Coll. of Sci. Technol. & Med., London, UK; Constantinides, A.G. "Graph- theoretical approach to colour picture segmentation and contour classification" Communications, Speech and Vision, IEE Proceedings I,pp.36 - 45

[6] Crevier, D.; Dept. of Electr. Eng., Ecole de Technol. Superieure, Montreal, Que., Canada "Hue-based segmentation of color images" Electrical and Computer Engineering, 1993. Canadian Conference, pp.1250-1253 vol.2

[7] Mackeown, W.P.J.; Bristol Univ., UK; Greenway, P.; Thomas, B.T.; Wright, W.A. "Labelling images with a neural network" Artificial Neural Networks, 1993., Third International Conference, p.16 - 20

[8] Moghaddamzadeh, A.; Dept. of Electron. Eng., Binghamton Univ., NY, USA; Bourbakis, N. "A fuzzy technique for image segmentation of color images " Fuzzy Systems, 1994. IEEE World Congress on Computational Intelligence., Proceedings of the Third IEEE Conference, pp.83 - 88 vol.1

[9] Wang; Dept. of Electr. Eng., Taiyuan Heavy Machine Inst., China; Chengyi Sun; Hongxing Chao "Color image segmentation and understanding through connected components" Systems, Man, and Cybernetics, 1997. Computational Cybernetics and Simulation., 1997 IEEE International Conference, pp.1089 -1093 vol.2

[10] Jones, T.N.; Dept. of Comput. & Inf. Sci., Pennsylvania Univ., Philadelphia, PA, USA; Metaxas, D.N. "Image segmentation based on the integration of pixel affinity and deformable models" Computer Vision and Pattern Recognition, 1998. Proceedings. 1998 IEEE Computer Society Conference, pp.330 - 337

[11] Swee-Seong Wong; Sch. of Comput., Nat. Univ. of Singapore, Singapore; Wee Kheng Leow "Color segmentation and figure- ground segregation of natural images " Image Processing, 2000. Proceedings. 2000 International Conference,pp.120 - 123 vol.2

[12] Dooley, L.S.; Gippsland Sch. of Comput. & Inf. Technol., Monash Univ., Clayton, Vic., Australia; Karmakar, G.C.; Murshed, M. "A fuzzy rule-based colour image segmentation algorithm" Image Processing, 2003. ICIP 2003. Proceedings. 2003 International Conference,pp.977-80 vol.1

[13] Estevez, P.A.; Dept. of Electr. Eng., Chile Univ., Santiago, Chile; Flores, R.J.; Perez, C.A. "Color image segmentation using fuzzy min-max neural networks " Color image segmentation using fuzzy min-max neural networks,pp.3052-3057 vol. 5

[14] Halder, A.; Dept. of CSE, St. Thomas' Coll. of Eng. & Technol., Kolkata, India; Dasgupta, A.; Ghosh, S. "Image segmentation using rough-fuzzy K-medoid algorithm " Communications, Devices and Intelligent Systems (CODIS), 2012 International Conference pp.105 - 108

[15] Zhi-Kai Huang; Dept. of Machinery & Dynamic Eng., Nanchang Inst. of Technol., Nanchang, China; Yun-Ming Xie; De- Hui Liu; Ling-Ying Hou "Using Fuzzy C-means Cluster for Histogram-Based Color Image Segmentation " Information Technology and Computer Science, 2009. ITCS 2009. International Conference, pp.597 - 600

[16] Jun Tang; Sch. of Electron. Eng., Xi"an Shiyou Univ., Xi"an, China "A color image segmentation algorithm based on region growing " Computer Engineering and Technology (ICCET), 2010 2nd International Conference, pp.V6-634 - V6-637

[17] Othman, A.A.; Syst. Design Eng. Dept., Univ. of Waterloo, Waterloo, ON, Canada; Tizhoosh, H.R. "Evolving fuzzy image segmentation " Fuzzy Systems (FUZZ), 2011 IEEE International Conference, pp.1603 - 1609

[18] Halder, A.; Dept. of CSE, St. Thomas' Coll. of Eng. & Technol., Kolkata, India; Dasgupta, A.; Ghosh, S. "Image segmentation using rough-fuzzy K-medoid algorithm " Communications, Devices and Intelligent Systems (CODIS), 2012 International Conference, pp.105-108