Ant Colony based Metaheuristic Technique for Color Image Segmentation

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ABSTRACT

Image Segmentation is an essential procedure of image processing as well as knowing it. Mainly it's known due to the method of splitting the image into various elements of homogeneity. The goal of image segmentation is to make simpler presentation of an image into incredible which is meaningful as well as easy to understand. It is mainly utilized to know the location of objects, boundaries, lines etc in the digital images. Clustering technique is a method which shows the data set or pixels are replaced by cluster, pixels might be together because of the same color, texture etc. This paper represents the effect of mixed regions on image segmentation and color images contain maximum information for efficient image segmentation.

Keywords

Image Processing,Image Segmentation Techniques, FELICM, Ant Colony Optimization.

1. INTRODUCTION

Image processing is handling of images applying mathematical procedures by several type of signal processing for that put in a graphic, in the type of picture or video frame; the result of image processing might be graphic as well as several features and metrics associated with given picture. Mostly image processing methods include the image as a two dimensional signal and apply normal signal-processing methods to it. An image is a two dimensional function like S (a, b) where a and b are coordinates of plan. When the values of a, b and the amplitude values of are all finite and discrete quantities, that image is known as digital image. Image processing usually describes digital image processing, but optical and analog image processing is also possible as well.

1.1 Applications of the Image Processing

Some applications of digital image processing are as follow

1.1.1 X-Ray Imaging

X-Ray is one of the oldest ways to obtain EM rays used for imaging. X-Ray is employed in medical diagnostics. The utilization of X-Ray in medical imaging is computerized axial to zoography.

1.1.2 Imaging in ultra violet Band

Ultra violet can be utilized in fluorescence microscopy.

1.1.3 Digital camera images

Digital cameras model have digital image handling pieces which are being used to improve row data from image sensor into color corrected picture within an ordinary image file extendable. The pictures gathered from video cameras are further procedures to advance the feature.

1.1.4 Intelligent Transportation System

Digital image handling has wide ro1e in vehicles system like number plate recognition.

1.1.5 Electron Microscopy

It runs on the microscope that able to increase every little detai1s with very extreme resolving power.

1.1.6 Ultra sound

It is employed for medical values where extreme rate of recurrence breed bead sound waves are delivered by tissue.

1.1.7 Gamma Ray Imaging

It can be employed for complete several scan obtained by using gamma ray imaging but whereas these images are chosen by utilizing gamma ray detectors, then every time noise are approved due to error detectors. With this detection of error bones is complicated to progress this trouble. In such a difficulty we may use image processing to determine the problems.

2. IMAGE SEGMENTATION TECHNIQUES

Image segmentation is the procedure of splitting a digital image into multiple sections (units of pixels, also called as super pixels). The purpose of segmentation is always to simplify as well as alter the illustration of graphic into incredible that's more significant as well as more simple to understand. It is essential for the fundamental tasks in image controlling and computer perspective. It makes essential beginning step for following object recognition and interpretation. The main aim is to divide the confirmed image into regions that contains distinct objects. The most frequent kind of segmentation is based on the theory that different objects within image have different and around constant colors. This is done by image segmentation is a position of segments that cover the complete image.

2.1 Edge Detection Methods

Edge detection process is to change images to edge images which take advantage of the change in image's grey tones. Edges are representation of insufficient continuity or ending, transformation result with this method is acquired not including any conversions in physical qualities of the key image. Image has different parts of various color levels. The design of the objects is differentiate in Figure 1.
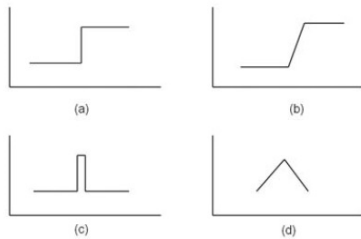
Fig 1: (a) Step Edge (b) Ramp Edge (c) Line Edge (d) Roof Edge

2.2 Region Based Methods

In remote sensing image analysis, the segmentation procedure is very initial steps. In the scene, relevant objects of image are representing when it divided into regions. The segmentation process can take place in two ways:

2.2.1. Region-based segmentation

In which, images are dividing into a number of homogeneous regions with distinctive label each.

2.2.3. Edge detection

In which, boundaries are determining between homogeneous regions of different properties.

3. FELICM

Fuzzy C-Means that advantage and Local data is recognized as FELICM, it presents the pixels' weights inside local neighbor windows to reduce the edge degradation. This type of process can be utilized to conquer the isolated allocation of pixels within sections of image.

3.1 Mean Shift

It's a way of clustering segmentation which is a non parametric iterative algorithm. It's applied during kernel thickness estimation. For every data point, mean transfer shows a window approximately as well as computes the mean of data point.

4. ANT COLONY OPTIMIZATION

This ACO algorithm is depending on meta-heuristic looking algorithm. This reflection is scrounging actions from ant varieties motivated and ant colony optimization approach improvement of random direct seek approach. Example, ants discover nearest course relating to the ant colony as well as a meals source by means of swapping specifics of your option that you should adopted. If the ants go through grub origin, they give secretions and incapacitated; such secretion chase can be applied near ants for convey collectively. Ant's probability would choose to adopt some sort of way relative to the amount from secretion. Applying straightforward responsive agencies permits the conversion through the natural for unreal auld like settlement. These factors interact personally through swapping data by means of surrounding alterations. It can be unreal pismire speak circuitously by means of unreal secretion chase. This offered near works on the particular list of ants acting forward to a picture determined through the local picture strength valuations edition. This kind of variance ensures a secretion matrix, while using like sizing picture, while in turn acts the particular boundary data and every picture place. Referable for big graphic sizing in order to cut calculation clip, the particular ant colony optimization approach depicted under was severally used upon non overlapping 128*128 graphic windows. Ant Colony Optimization is a loop approach.

5. RELATED WORK

Islam, Mohammed et al. [1] developed a method utilizing edge-based image segmentation methods forquality inspection that satisfies the professional requirements in pharmaceutical applications. The evaluation of an image with this might require complicated image processing techniques. Artan, Yusuf et al. [2] introduced a semi-supervised image segmentation method using machine learning techniques and super pixels. The proposed method yielded superior segmentation results over several semi-supervised methods including the popular random walker algorithm. Huilin, Gao et al. [3] presented a technique of CT image segmentation based on region growing method, and the application form of effective segmentation of the lung tissue to chest CT images. Weighed against any other segmentation methods, the outcome showed that the segmentation method that has been proposed in this paper does better in CT image segmentation. The outcomes obtained have the significance in clinical applications and auxiliary diagnosis. Zhu, Shaohua, and Zhaohua Wu [4], chosen chip mechanism as study thing, completing the conversion of the color space on the basis of the theory of Graphic and Image processing and achieving the conversion from the non-uniform RGB color space to HSV space for human eyes observation in the shape of MATLAB. Khanna, Anita, [5] presented an automatic segmentation method based on unsupervised segmentation done on Ultrasound (US) images received from radiologist. Here they presented three unsupervised methods namely thresholding, K-means clustering and expectation maximization and evaluate their results. Chebbout, Samira, [6] compared the effectiveness of three clustering methods involving RGB, HSV and CIE L*a*b* color spaces and a variety of real color images. The strategies were K-means clustering algorithm. R. Samet. [7] Proposed Fuzzy Rule-Based Image Segmentation technique to segment rock thin section images. The obtained outcomes of proposed Fuzzy Rule-Based Image Segmentation and Fuzzy C-Means techniques were compared. Implementation results revealed that proposed image segmentation technique has better accuracy than known ones. Vij, Sugandhi et al. [8] discussed quantitative evaluation measures for color image segmentation predicated on these techniques. Color image segmentation can be considered as an extension of gray level image segmentation. Quantitative measures like discrete entropy, root mean square error, and visible color difference were proposed for color images. Rincon-Montes, V. et al. [9] described a quantitative evaluation method for the accuracy of two different segmentation techniques for the therapy planning of Magnetic Resonance guided High Intensity Focused Ultrasound (MRGHIFU). Jiang,Ching-Fen, and Ka-Pei Tsai. [10] Proposed a cell segmentation method combining double-thresholding and disk-based reconstruction to solve the difficulties arising from shape deformation and uneven illumination during cell culture. The qualitative and quantitative comparisons show that the proposed segmentation method increases accuracy in detection the cell centroid.

6. GAPS IN LITERATURE

These are the gaps in existing research on image enhancement methods.

1. The effect of mixed regions on image segmentation has ignored in the most of the existing techniques.

2. The color images contains maximum information for efficient image segmentation but majority of researchers has ignored it during image segmentation

3. The use of the ant colony based edge detector has also ignored in the majority of existing research on image segmentation.

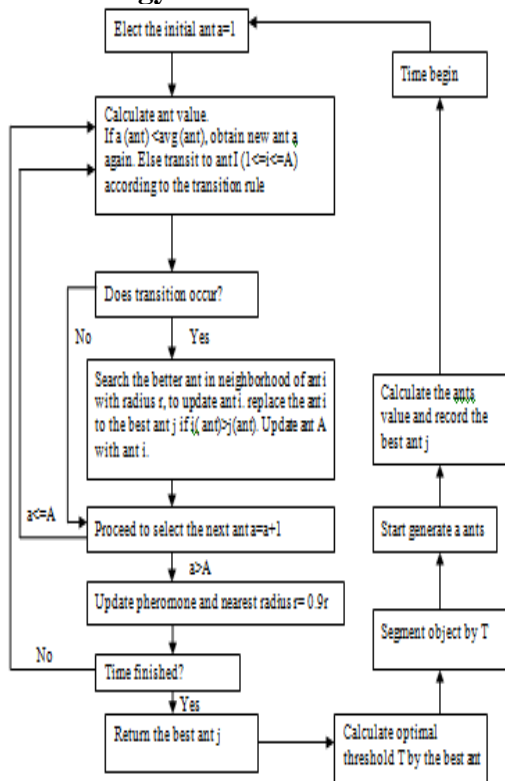# 7. METHODOLOGY AND RESULTS

7.1. Methodology

Fig.2.Methodology used for purposed algorithm

7.2 Experimentation And Results

For experimentation and implementation the proposed technique is evaluated using MATLAB tool u2013a. Here we will compare the Gray Stretch Based algorithm for image segmentation and Principal Component Analysis based gray stretch algorithm on the basis of various image quality evaluation parameters like PSNR and BER. The existing methodology give good results in enhancing the image but it neglects certain regions in image such as mixed region and also effect of color is not taken into consideration. The proposed approach gives efficient results in improving the contrast of image and it uses Principal Component Analysis based on Grey Stretch Algorithm. The tabular and graphical comparison has been done between existing and proposed methodology on the basis of parameters like Mean Square Error, Peak Signal to noise Ratio.

The segmented image with proposed method:-

Fig 3 a) original Image   b) segmented Image

7.2.1. Mean Square Error (MSE)

The calculated values of Mean Square Error for image 1 and image 2 in proposed method are 0.0087 and 0.0031 respectively.

$$MSE = \frac{1}{mn} \sum_{i=1}^{m} \sum_{j=1}^{n} (A_{ij} - B_{ij})^2$$
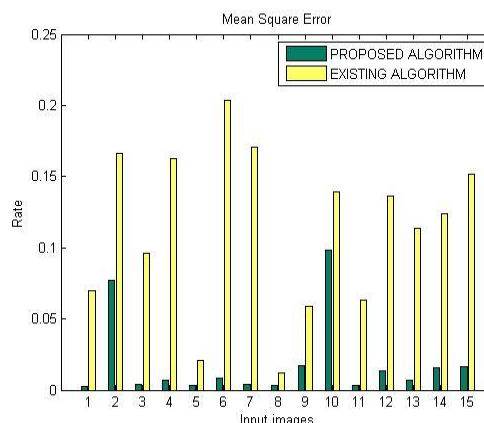
Fig 4. MSE Analysis

Table 1 has shown the quantized analysis of the mean square error. The proposed algorithm is less as compared to existing method.

Table1 MSE Analysis

Image	Existing Results	Proposed Results
1	0.0695	0.0026
2	0.1665	0.0770
3	0.0963	0.0039
4	0.1628	0.0067
5	0.0208	0.0039
6	0.2034	0.0087
7	0.1709	0.0043
8	0.0118	0.0035
9	0.0585	0.0171
10	0.1392	0.0983

11	0.0634	0.0031
12	0.1361	0.0138
13	0.1136	0.0069
14	0.1242	0.0155
15	0.1519	0.0167

7.2.2   *Peak Signal Noise Ratio (PSNR)*
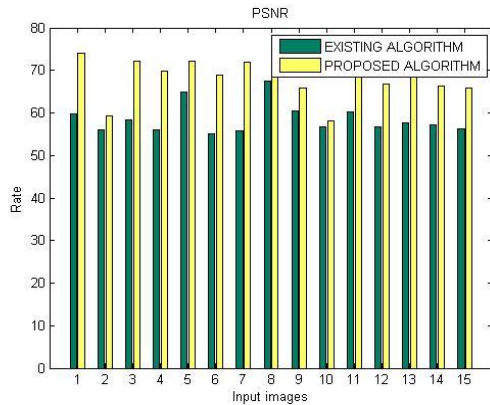The calculated values are 68.7873 and 73.1916 for image 1 and image 2 respectively.

Fig 5. PSNR Analysis

Table 2 has clearly shown that the PSNR is maximum in the case of the proposed algorithm therefore proposed algorithm is providing better results over the existing methods.

Table 2. PSNR Analysis

Image	Existing Results	Proposed Results
1	59.7477	74.0062
2	55.9519	59.3013
3	58.3301	72.2465
4	56.0488	69.8982
5	64.9820	72.2701
6	55.0810	68.7873
7	55.8363	71.8747
8	67.4394	72.7843
9	60.4939	65.8304
10	56.7276	58.2377
11	60.1463	73.1916
12	56.8256	66.7797
13	57.6113	69.7793
14	57.2238	66.2708
15	56.3505	65.9447

8.   CONCLUSION
The aim of image segmentation is to simplify the representation of an image into something that is more meaningful and easier to understand. Clustering technique is a method in this data set or say pixels are replaced by cluster, pixels which together because of the same color, texture etc. In this paper we have implemented ant colony based edge detector to differentiate the mixed regions and the results of the have shown significant improvement. The implemented an ACO based metaheuristic for color image segmentation is done using parameters like mean square error and peak signal noise ratio. Implemented an ACO based metaheuristic for color image segmentation outperforms the existing technique FELICM.

9.   REFERENCES
[1] Islam, Mohammed J., Saleh Basalamah, Majid Ahmadi, and Maher A. Sid-Ahmed. "Capsule image segmentation in pharmaceutical applications using edge-based techniques." In Electro/Information Technology (EIT), 2011 IEEE International Conference on, pp. 1-5. IEEE, 2011.

[2] Artan, Yusuf. "Interactive image segmentation using machine learning techniques." In Computer and Robot Vision (CRV), 2011 Canadian Conference on, pp. 264-269. IEEE, 2011.

[3] Huilin, Gao, Dou Lihua, Chen Wenjie, and Xie Gang. "The applications of image segmentation techniques in medical CT images." In Control Conference (CCC), 2011 30th Chinese, pp. 3296-3299. IEEE, 2011.

[4] Zhu, Shaohua, and Zhaohua Wu. "Study on solder joint image segmentation techniques based on Matlab." In Electronic Packaging Technology and High Density Packaging (ICEPT-HDP), 2011 12th International Conference on, pp. 1-3. IEEE, 2011.

[5] Khanna, Anita, and Manish Shrivastava. "Unsupervised techniques of segmentation on texture images: A comparison." In Signal Processing, Computing and Control (ISPCC), 2012 IEEE International Conference on, pp. 1-6. IEEE, 2012.

[6] Chebbout, Samira, and Hayet Farida Merouani. "Comparative Study of Clustering Based Colour Image Segmentation Techniques." In Signal Image Technology and Internet Based Systems (SITIS), 2012 Eighth International Conference on, pp. 839-844. IEEE, 2012.

[7] Samet, R., S. E. Amrahov, and A. H. Ziroglu. "Fuzzy Rule-Based Image Segmentation technique for rock thin section images." In Image Processing Theory, Tools and Applications (IPTA), 2012 3rd International Conference on, pp. 402-406. IEEE, 2012.

[8] Vij, Sugandhi, Sandeep Sharma, and Chetan Marwaha. "Performance evaluation of color image segmentation using K means clustering and watershed technique." In 2013 Fourth International Conference on Computing, Communications and Networking Technologies (ICCCNT), pp. 1-4. IEEE, 2013.

[9] Rincon-Montes, V., A. Vargas-Olivares, Samuel Pichardo, Laura Curiel, and J. E. Chong-Quero. "Quantitative evaluation method of image segmentation techniques for Magnetic Resonance guided High Intensity Focused Ultrasound therapy." In Electrical

Engineering, Computing Science and Automatic Control (CCE), 2013 10th International Conference on, pp. 110-115. IEEE, 2013.

[10] Jiang, Ching-Fen, and Ka-Pei Tsai. "Image segmentation techniques for stem cell tracking." In Acoustics, Speech and Signal Processing (ICASSP), 2013 IEEE International Conference on, pp. 1109-1112. IEEE, 2013.

[11] Ji, Hongwei, Jiangping He, Xin Yang, Rudi Deklerck, and Jan Cornelis. "ACM-based automatic liver segmentation from 3-D CT images by combining multiple atlases and improved mean-shift techniques." IEEE journal of biomedical and health informatics 17, no. 3 (2013): 690-698.

[12] Mohan, K. Raj, and G. Thirugnanam. "A dualistic sub-image histogram equalization based enhancement and segmentation techniques for medical images." In Image Information Processing (ICIIP), 2013 IEEE Second International Conference on, pp. 566-569. IEEE, 2013.

[13] Jabar, Farah HA, Waidah Ismail, Rosalina Abdul Salam, and Rosaline Hassan. "Image Segmentation Using an Adaptive Clustering Technique for the Detection of Acute Leukemia Blood Cells Images." In Advanced Computer Science Applications and Technologies (ACSAT), 2013 International Conference on, pp. 373-378. IEEE, 2013.

[14] Weingart, Mircea, and Orest Vascan. "Image segmentation processing-some techniques and experimental results A comparative study of the concepts of some segmentation techniques." In Electrical and Electronics Engineering (ISEEE), 2013 4th International Symposium on, pp. 1-6. IEEE, 2013.

[15] Li, Nan, 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 10 (2013): 1124-1128.

[16] Gandhi, Nupur J., Vandana J. Shah, and Ravindra Kshirsagar. "Mean shift technique for image segmentation and Modified Canny Edge Detection Algorithm for circle detection." In Communications and Signal Processing (ICCSP), 2014 International Conference on, pp. 246-250. IEEE, 2014.

[17] Saranya, R., Jackson Daniel, A. Abudhahir, and N. Chermakani. "Comparison of segmentation techniques for detection of defects in non-destructive testing images." In Electronics and Communication Systems (ICECS), 2014 International Conference on, pp. 1-6. IEEE, 2014.

[18] Krishnan, P. Hari, V. Karthickeyan, and P. Ramamoorthy. "A novel method for measurement of fetal volume from US images using segmentation techniques." In Green Computing Communication and Electrical Engineering (ICGCCEE), 2014 International Conference on, pp. 1-6. IEEE, 2014.