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An Image Segmentation using Improved Ant Colony Optimization and Hybrid K-means Clustering Method

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Abstract: Image segmentation may be the approach in which a graphic into significant parts. It plays an essential position in the image analysis and pc version. GA algorithm are major in nature therefore, it proved to be really time intensive .The genetic algorithm assures the local optimization but doesn't guarantees world wide optimization .the over all effect is dependent upon the choice of bad population may brings for poor segmentation. Therefore, to overcome the restriction of the GA on the basis of the multilevel thresholding in this paper ant colony optimization centered multilevel thresholding segmentation algorithm is proposed.

Keywords: Image segmentation, Image segmentation Techniques, K-Means clustering algorithm, Ant Colony Optimization

I. INTRODUCTION

Image segmentation is the method of dividing an electric digital image into numerous pieces (sets of pixels, also called tremendous pixels). The prospective of segmentation is definitely to simplify and/or change the illustration of a graphic into something that's more important and better to analyze. Caused by image segmentation is some pieces that collectively cover the whole image, or some curves removed from the image. All the pixels in a place are similar regarding some characteristic or computed property, such as for instance as an example colour, strength, or texture. Adjacent regions are somewhat various regarding the identical characteristics.

II. TECHNIQUES FOR IMAGE SEGMENTATION

Many general-purpose methods and practices have already been developed for image segmentation. To be of good use, these methods should generally be along with a domain's certain information to be able to successfully resolve the domain's segmentation problems. A great number of segmentation methods has been proposed in the past decades, and some categorization is necessary presenting the methods properly here.

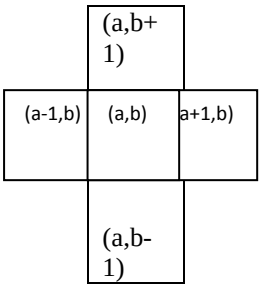
A. Non-contextual thresholding

Thresholding is one of the most important and effective method for image segmentation. This method based on the a threshold value to turn coloured image to the binary image . Due to the advantage of smaller storage space, fast processing speed and ease in manipulation. Thresholding is a well-researched field, there exist many algorithms for determining an optimal threshold of the image. Thresholding techniques for separating objects from back ground image or discriminating objects from objects that have distinct gray-levels has led to the development of new efficient methods for segmenting different types of images . The main element of this technique is to choose the threshold. A few common strategies are used in industry including the utmost entropy approach, Otsu's method (maximum variance), and k-means clustering.

B. Contextual segmentation: Region growing

Non-contextual thresholding groups pixels without account of their relative locations in the image plane. Contextual segmentation may be more successful in separating individual objects because it accounts for closeness of pixels that fit in with someone object. Two basic approaches to contextual segmentation are derived from signal discontinuity or similarity Discontinuity-based techniques attempt to locate complete boundaries enclosing relatively uniform regions assuming abrupt signal changes across each boundary. Similarity-based techniques try to directly create these uniform regions by grouping together connected pixels that satisfy certain similarity criteria. Both the approaches mirror each other, in the sense that a complete boundary splits one region into two.

i) Pixel Connectivity Pixel connectivity is defined in terms of pixel neighbourhoods. A normal rectangular sampling pattern making a finite arithmetic lattice (a.b): a = 0, 1, ..., a−1; b= 0, 1, ..., b−1 supporting digital images allows us to define two types of neighbourhood surrounding a pixel. A **4-neighbourhood** (a−1,b), (a,b+1), (a+1,b), (a,b−1) contains only the pixels above, below, to the left and to the proper of the central pixel (a,b). An **8-neighbourhood** enhances the 4-neighbourhood four diagonal neighbours: (a−1,b−1),(a−1,b), (a−1,b+1), (a,b+1), (a+1,b+1), (a+1,b), (a+1,b−1), (a,b−1).



(a-1b+1,)	(a,b+1)	(a+1,b+1)
(a-1,b)	(a,b)	(a+1,b)
(a-1,b-1)	(a,b-1)	(a+1,b-1)

Figure 1. Pixel Enhancement

ii) Region Similarity: The uniformity or non-uniformity of pixels to create an linked place is represented by a **uniformity predicate**, i.e. a rational statement, or problem being true if pixels in the regions are similar regarding some property (colour, grey level, edge strength, etc). A standard predicate restricts signal variations over a neighbourhood: the predicate P(G), where G denotes an attached region, is TRUE if $|g(a,b) - g(a+\xi,b+\eta)| \leq \Delta$ and FALSE otherwise (here, (a,b) and (a+ξ,b+η) will be the coordinates of neighbouring pixels in region R.This predicate does not restrict the grey level variation inside a region because small changes in signal values can accumulate over the region.

iii) Region Growing: The bottom-up location growing algorithm begins from some seed pixels explained by the consumer and sequentially brings a pixel to an area as long as the pixel hasn't been assigned to any location, is just a neighbour with this location, and its addition preserves uniformity of the growing region. This kind of segmentation is easy but unstable. It is very painful and sensitive to a opted for uniformity predicate, i.e. little improvements of the uniformity ceiling may possibly end up in large improvements of the regions found. Also, very different segmentation maps are purchased below different avenues of checking a visual, different ways of exhausting neighbours of every location, different vegetables, and several types of pixel connectivity.

C. Edge detection for image segmentation

Edge detection methods change pictures to side pictures benefiting from the changes of grey shades in the images. Ends could be the indication of not enough continuity, and ending. Therefore of the change, side image is obtained without encountering any changes in physical characteristics of the key image. The result is really a binary image .Based on theory there are two principal side based segmentation methods- dull histogram and gradient based method.

i) Gray Histogram Technique: The consequence of edge detection technique depends primarily on range of ceiling T, and it is really difficult to get maximum and minimal gray level intensity because gray histogram is unpredictable for the impact of noise, ergo we around alternative the designs of product and history with two conic Gaussian designs whose junction could be the area of histogram. Patience T could be the gray value of junction place of the valley.

ii) Gradient Based Method: Gradient is the first derivative for picture S(a, b), if you find abrupt change in intensity near edge and there is little picture noise, gradient based process works well .This process requires convolving gradient operators with the image. High value of the gradient magnitude is possible number to quick transition between two different regions. They are edge pixels, they have to be connected to variety closed boundaries of the regions. Popular edge detection operators employed in gradient based process are sobel operator, canny operator log operator so on. Edge detection method takes a stability between sensing reliability and noise immunity.

D. Clustering Methods

Clustering may be the collection of items or group of items in this way that items in exactly the same party which is often named as bunch are related together than to these in different clusters. Clustering can be viewed as the main unsupervised understanding issue; therefore, as every different issue of this type, it handles locating a design in an accumulation unlabeled data. A free meaning of clustering could possibly be “the method of arranging items in to organizations whose customers are related in a few way&rdquo ;.A bunch is thus an accumulation items which are defined internally, but obviously dissimilar to the items owned by different clusters. Segmentation of a picture entails the section or divorce of the picture in to parts of related attribute. The absolute most fundamental feature for segmentation of a picture is their luminance amplitude for a monochrome picture and color parts for a shade image. Clustering is one of the techniques useful for segmentation. In this instance we quickly recognize the 3 clusters into which the information may be divided; the likeness qualification is distance: two or more items participate in the same chaos if they're “close” in accordance with confirmed distance (in that case geometrical distance). That is called distance-based clustering, here we are likely to deal with is distance-based clustering. Yet another kind of clustering is conceptual clustering: two or more items participate in the same chaos if that one identifies a principle popular to all that objects. In other words, items are grouped according to their match to descriptive ideas, perhaps not in accordance with simple likeness measures.

Clustering methods may be labeled as shown below

- Smooth clustering (Creates a couple of clusters without the direct framework that could
- connect clusters to one another; It is also called exclusive clustering)
- Hierarchical clustering (Creates a hierarchy of clusters)
- Hard clustering (Assigns each document/object as a member of precisely one cluster)
- Soft clustering (Distribute the document/object total clusters)

III. K-MEANS CLUSTERING ALGORITHM

K-Means algorithm can be an unsupervised clustering algorithm that classifies the input knowledge details in to numerous courses based on the inherent range from each other. The algorithm considers that the information features kind a vector space and attempts to get organic clustering in them. The details are clustered around centroids $\mu_a = 1 : : : k$ which are acquired by minimizing the objective.

$$F = \sum_{a=1}^{k} \sum_{x_b \in X_a} (X_a - \mu_a)^2 \quad (1)$$

wherever there are k clusters Xa, a = 1; 2; : : : ; k and is the centroid or suggest stage of all of the factors $x_b \epsilon$ Xa

An iterative version of the algorithm is implemented. The algorithm takes a 2 dimensional picture as input. Numerous steps in the algorithm are the following:

1. Compute the intensity distribution(also named the histogram) of the intensities.
2. Initialize the centroids with e arbitrary intensities.
3. Repeat the next steps before bunch labels of the picture doesn't change anymore.
4. Group the factors based on distance of these intensities from the centroid intensities.
5. Compute the newest centroid for all the clusters.

wherever e is a parameter of the algorithm (the quantity of clusters to be found), a iterates over the all the intensities, n iterates over all the centroids and μa will be the centroid intensities.

IV. ANT COLONY OPTIMISATION ALGORITHM

The concept behind ant formulas is always to change and use their sign style which has been which might be so great in character, instead of truly mimic the behaviour of correct ants. Synthetic insects will then be observed and referred to as interacting brokers discussing some faculties of the true insects, but additionally introducing various faculties which is why there is number similar in character, (Solimanpur et al, 2004). The typical faculties are what makes them match to repair issues, if not optimally, at least by finding excellent solutions. A genuine foraging ant uses all their life planning between their home and some food source. It doesn't then come as a surprise that the first matter resolved with an ant algorithm, called Ant Method (AS), was the Travelling Jeweler Concern (TSP), a well-known combinatorial matter, wherever the tiniest class (path) that trips properly after each and every town of a given pair of cities, beginning and ending at the same town, is usually to be found. Although in most cases ACO calculations achieve positive results, there are cases when an hybridization with different heuristics or metaheuristics, reveals to be necessary. Therefore, in the previous a long period experts allow us mix calculations between ACO and Regional Research (Pour and Nosraty, 2006), Simulated Annealing (Bouhafs et al, 2006), Report Handling Techniques (Crawford and Castro, 2006), and despite having Genetic Algorithms as might be the event of (Altiparmak and Karaoglan, 2007). That allowed ant calculations to attain even better benefits in issues also difficult to be resolved by way of an easy heuristic method. In the next section we will discover, at length, the first ant algorithm, that was called the Ant System. Afterward, we review a few of the big amount of fascinating works that have been made actually since. We stress our interest typically in works which have shown modifications and extensions to the so-called prevents of ACO algorithms. That's created using the objective of presenting alternative techniques, that worked effectively with distinctive optimization issues, and so the audience who's establishing an ACO algorithm can certainly realize their energy and how to modify it for the issue at hand.

4.1 Ant Colony Axioms

Ant Colony Optimization concepts are on the basis of the natural behaviour of ants. Inside their daily living, one of many jobs bugs want to do is to get food, in your community of those nest. While strolling in this quest, the bugs deposit a substance substance called *pheromone* in the ground. This is conducted with two objectives. On the main one give, it allows bugs to obtain their long ago to the house, such as like Hansel and Gretel in the fairytale. And on yet another give, it allows different bugs to understand how they took, which means that your others can follow them. The awareness is that, because thousands or even a large quantity of bugs have that behaviour, if you could begin to see the pheromone place in the bottom as some sort of delicate, the bottom will be a large system with numerous the arcs light set alongside the others. Within the paths manufactured by these arcs might definitely function as the quickest way between the home and the foodstuff source. That behaviour is seen as some sort of transmission involving the ants. If the road features a large understanding of pheromone, that's probably because faster length that allowed bugs to travel faster, producing a bigger level of trips through the road therefore with far more bugs depositing pheromone on it. Moreover, with time the pheromone disappears and thus their understanding reduces. The more hours it takes for the ant to travel from the home to the foodstuff resource and rear to the home, the more hours the pheromones have to evaporate. That strategy is thus centered equally on the good feedback, i.e. depositing of pheromone draws different bugs to utilize the same manner that will enhance the pheromone volume, and on bad feedback, i.e. dissipating of the pheromone through evaporation benefits in decrease degrees of pheromone thus discouraging different ants.

Algorithm 1 Pseudo-code for Ant Colony Optimization.

1: Initialize parameters
2: Initialize pheromone trails
3: Produce bugs

4: while Ending standards is not reached do
5: Let all bugs create their alternative
6: Upgrade pheromone trails
7: conclusion while

V. LITERATURE SURVEY

Bhattacharyya, et al[1] planned the neural network based picture segmentation techniques generally concentrate on the option of proper thresholding factors in the picture feature position and range of versatile thresholding methods to multilevel service functions. In addition, it treated the present a bi-directional self-organizing neural network (BDSONN) structure suited to multilevel picture segmentation.

Gupta, et al[2] proposed a unclear partition and maximum entropy centered multilevel thresholding approach. The main target of multilevel thresholding is always to separate your lives a photo into many classes. This was targeted on obtaining the suitable prices of multiple thresholds in a way that entropy of uncertain partitions in a photo is likely to be maximized. For the reason why that GSA, ABC, PSO and GA are exploited to maximise entropy predicated on unclear partition method to locate great multilevel thresholds. Their new benefits revealed

that GSA works better than various three meta heuristic methods when it comes to entropy, computation time and stability.

Zhang, Xiaoyan et al[3]planned a better watershed image segmentation solution to over come the shortcomings of traditional watershed segmentation. For the reason that the morphological opening/closing reconstruction filter was placed on eliminate the image noise. The tests unearthed that the strategy can not just effortlessly eliminated the around segmentation of watershed, but furthermore held the roles of regional contours.

Sapna Varshney, et al[4] presented a comparative study of the essential picture segmentation methods i.e, Edge-Based, KMeans Clustering, Thresholding and Region-Based methods, applying numerous check images. The items eliminated following picture enhancement and picture segmentation as collection along side the items preferred, possibly the area limits are closed or disconnected and the Recommend Weighted Range way of measuring the segmented items regarding the initial picture form the conditions to do the comparative study.

Yun-Chia Liang et al[5] planned a cross optimization process predicated on an ant colony optimization algorithm with the Otsu method to supply the appropriate thresholding approach right and effective. The properties of discriminate evaluation in Otsu's technique are to analyze the separability one of many dull degrees in the image. The ACO-Otsu algorithm, a non-parametric and unsupervised technique, could be the first-known plan of ACO to automatic ceiling range for picture segmentation. The fresh benefits reveal that the ACO-Otsu effortlessly accelerate the Otsu's approach to a great amount at multi-level thresholding, and that such technique will offer higher effectiveness at population size of 20 for several presented picture types at multi-level thresholding for the reason that study.

NajmeZehraNaqvi, et al[6] mentioned that Ant colony optimization (ACO) is a meta-heuristic method of undertake difficult combinatorial optimization problems. The essential part of ACO is a option structure process, which simulates the decision-making procedures of ant colonies because they forage for food and find essentially the most successful paths from their nests to food sources. an assessment record on ant colony optimization using its supplements in chronological order and Car redirecting problem (one of the applying of ACO).Following this, there is a fast discharge of Estimation-based ACO. They examine strategy of ACO algorithm implementation and all its versions. That ACO strategy is put on undoubtedly among its applications VRP, and its versions (CVRP, VRPTW, TD-VRPTW, VRPPD, DVRP).they applied the present best performing ACO algorithm pACS+1-shift as a beginning point.they exposed that the use of their state oftheart iterative development algorithm 2.5-opt-EEais enables pACS to acquire an amazing development in the perfect solution is cost. To produce a complete estimation-based ACS, they applied an estimation-based strategy to gauge the perfect solution is costs.

Xumin Liu et al[7] They presented that the basic ant colony algorithm has some negatives, such as for example extended exploring time, big levels of calculation, and rough image segmentation results. They proposes a better ant colony algorithm. Applying different move rules and pheromone upgrade methods to different parts of an image, including background, target, side and noise, he build a highly adaptive image segmentation process with large side detection accuracy and large algorithm implementation efficiency. In the original stage of image segmentation, they apply the idea of fuzzy clustering, which helps ants to collect quickly to the side in the backdrop and the mark part of the image. In the later stage of image segmentation, he introduce a benefit research technique in the side area.

S Gnanapriya et al [8] Proposed that ACO can be defined because the flexible heuristic research algorithm premised on the major some ideas of organic conduct of ants. ACO can be used to initialize the KM clustering algorithm. This will aid in greater clustering effect with reduced problem rates. From the fresh effects, it's observed that the utilization of ACO effects in greater clustering effect when comparing to active techniques (KM). To lessen the problem rate, they dedicated to applying ACO. The purpose of applying ACO is its capability of convergence and it follows the conduct of ant. The fresh evaluation system was applied to supply a standard foundation of efficiency review and comparison with other methods. Ultimately, when you compare the fresh results of KM, GAIK and KM with ACO it's observed clearly that KM with ACO is preferable to the straightforward genetic algorithm. As revealed by the outcome on all datasets KM with ACO is preparing to obtain large clustering precision if compared to other algorithms.

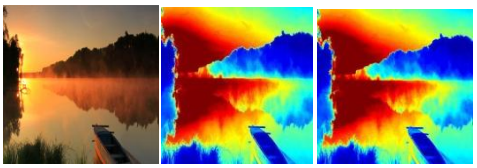
Dibya Jyoti Bora et al[9] In laptop perspective, image segmentation is always selected as a significant study topic by researchers. Because of its crucial principle in image control, there generally arises the need of a better image segmentation method. Clustering is definitely an unsupervised study using its demand in virtually every field of study

and engineering. Several experts used clustering in image segmentation process. But nonetheless there requires improvement of such approaches. In this report, a tale strategy for clustering centered image segmentation is proposed. Here, we give significance on color space and pick l*a*b* because of this task. The popular difficult clustering algorithm K-means can be utilized, but as its efficiency is inspired by picking a correct range assess, thus, we pick "cosine" range measure. Then the segmented image is clogged with sobel filter. The clogged image is examined with weapon watershed algorithm to have the supreme segmented results of our distinctive image. The MSE and PSNR values are believed to observe the performance.

Vahidsolemani et al[10] The enhanced ant colony algorithm was achieved through increasing tendency of ant to relocate one-of-a-kind course in probabilistic choice rule. The algorithm indicated a balance between the ant's way and circulation of pheromone. The location found because the tumor was more specific, obvious and without any additional margin, that was on average introduced via irritation

Ina Singh et al[11]proposed a totally computerized liver segmentation process meaning that the process identified the desired Area of Interest itself. The performance of k-means and stage collection, and planned hybrid k-means and stage collection was evaluated on numerous CT photos to segment the liver region. The segmentation requires prior anatomical understanding of the abdominal CT image to differentiate between various organs of the individual body. Equally quantitative and qualitative analyses were in favor of hybrid k-means (k-means with ACO). The analyses triggered large F-measure charge and tenderness in every screening data. The process was furthered applied to other modalities with various diseases, which will be beneficial in surgeries. Also shaded photos may be used and implementation can be carried out in 3-D. The performance of the planned algorithm was determined by the decision of preliminary centroids in addition to on proper collection of a architectural element.

VI. RESULTS AND DISCUSSION

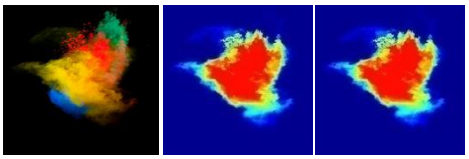


(a) (b) (c)

Figure 2 Original image and the segmentation results

(a) (b) (c)

Figure 3 Original image and the segmentation results



(a) (b) (c)

Figure 4 Original image and the segmentation results

VII. PROBLEM ANALYSIS

This part provides the cross validation between existing and Proposed techniques. Some well-known picture performance variables for electronic photos have been picked to prove that the performance of the algorithm is quite better than the existing methods.

1. Mean Sq Problem Evaluation

Table1 is showing the quantized analysis of the mean square error. As mean square mistake needs to be reduced therefore the algorithm is showing the better benefits compared to the available techniques as mean square mistake is less in every case.

Table 1: This MSE table shows the values of proposed method and existing one .

Input images	**Existing results**	**Proposed results**
In1	45.6989	14.4111
In2	62.3400	07.6911

In3	14.0705	07.4667
In4	20.6814	18.0800
In5	42.3934	11.1156
In6	34.8541	10.9467
In7	37.5149	04.1633
In8	71.1535	02.6178
In9	37.1958	19.5567
In10	35.1566	07.7889
In11	39.9015	08.7911
In12	46.6007	06.8000
In13	27.0921	10.3422
In14	13.5418	02.6833
In15	66.5590	12.8522

Figure5 from the plot and bar graph we can easily observe there is decrease in MSE value of images with the use of enhanced method over other methods. This decrease represents improvement in the objective quality of the image.

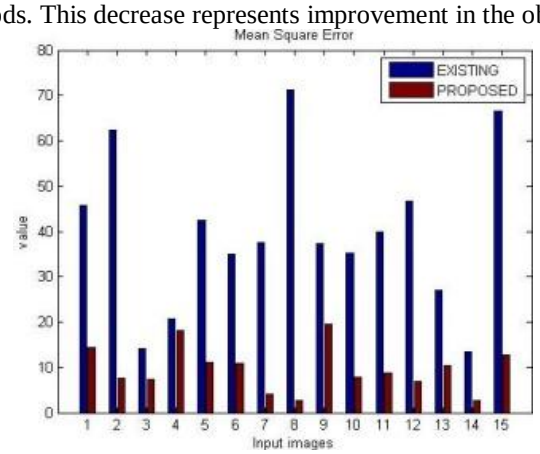


Figure 5 Bar graph of MSE evaluation

2. Peak Signal to Noise Ratio Evaluation

Table2 is showing the comparative analysis of the Peak Signal to Noise Ratio (PSNR). As PSNR need to be maximized; so the main goal is to increase the PSNR as much as possible. It has clearly shown that the PSNR is maximum in the case of the proposed algorithm therefore algorithm is providing better results than the available methods.

Table 2: This PSNR table shows the values of proposed method and existing one .

Input images	**Existing results**	**Proposed results**
In1	31.5657	36.5778
In2	30.2171	39.3049
In3	36.6817	39.4335
In4	35.0090	35.6828
In5	37.8918	37.7055
In6	32.7423	37.7720
In7	32.4225	41.9704
In8	29.6428	43.9855
In9	32.4599	35.2519
In10	32.7047	39.2500
In11	32.1549	38.7491
In12	31.4809	39.8397
In13	33.8564	38.0187
In14	36.8480	43.9781
In15	29.9327	37.0750

Figure6 the plot there is increase in PSNR value of images with the use of hybrid ACO over GA . This increase represents improvement in the objective quality of the image.

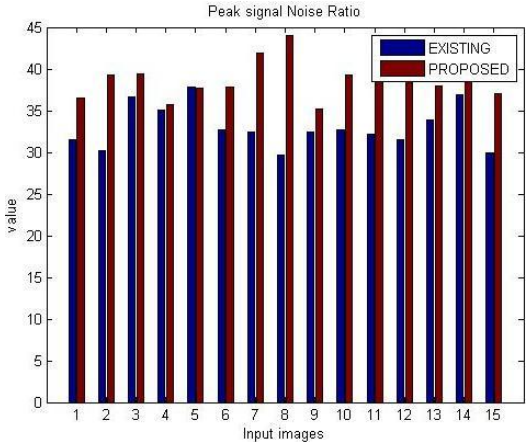


Figure 6 Bar graph of PSNR evaluation

3. Bit Error Rate

It provide the rate at which the errors occur in. This can be directly translated into the number of errors that occur in a string of a stated number of bits.

Table 3: This BER table shows the values of proposed method and existing one .

Input images	Existing results	Proposed results
In1	0.0315	0.0273
In2	0.0334	0.0254
In3	0.0273	0.0254
In4	0.0286	0.0281
In5	0.0314	0.0265
In6	0.0305	0.0265
In7	0.0309	0.0238
In8	0.0337	0.0227
In9	0.0308	0.0284
In10	0.0306	0.0255
In11	0.0311	0.0258
In12	0.0320	0.0251
In13	0.0296	0.0263
In14	0.0271	0.0228
In15	0.0337	0.0270

Figure7 from the plot and bar graph we can easily observe there is decrease in BER value of images with the use of enhanced method over other methods. This decrease represents improvement in the objective quality of the image.

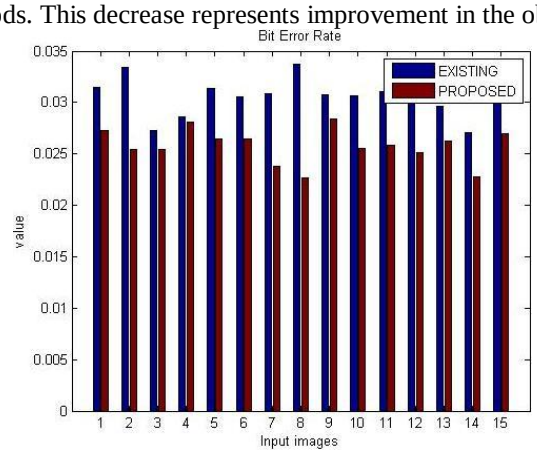


Figure7 Bar graph of BER evaluation

VIII. CONCLUSION

This paper indicates that current segmentation methods suffer from numerous issues. The general aim is to reduce the full time complexity of the genetic based segmentation. Because utilization of genetic algorithm doesn't promise the world wide optimization therefore may add bad results. Therefore the usage of ant colony optimization will increase the

segmentation results further. Most of the increased simulation outcomes of planned method ACO are revealed by parameters such as for instance mean square error, peak signal to noise ratio and bit error rate.

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Er. Harmanjit Kaur was born in Amritsar, India, in 1989. She obtained the B.Tech from LPU and M.Tech. levels in Computer Technology from the Punjab technical College, in 2013. Her interest includes remote sensingl Picture Processing, Neural Network and Delicate Computing Techniques.

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