Hybrid Bio-Inspired Technique for Edge Detection in Image Processing

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Abstract- Image processing is any form of signal processing for which the input is an image, such as a photograph or video frame; the output of image processing may be either an image or a set of characteristics or parameters related to the image. In the existing papers, technique is applied which is based on the Hough transformation for the edge detection. The compared paper applies Hough transformation algorithm, in the threshold pixels intensity for the edge detection is user defined due to which efficiency of improved Hough transformation algorithm is more as compare to existing Hough transformation algorithms. In this research work, bee colony algorithm will be applied to define threshold intensity of the pixels. The proposed improvement is implemented in MATLAB and evaluation parameter results are better compared to exiting techniques in terms of PSNR, MSE and execution time.

Keywords- ACO, PSO, Hough Tranformation, Edge Detection

I. INTRODUCTION

Image processing in modern digital technology plays as essential role. An image formed with the square pixels combined in the form of columns and row. It is based on the principal of converting an image into digital form as it is an array or matrix form. Useful information can be taken from an image or in order to get enhanced version of that image [1]. One can convert image by applying following operations such as signal dispensation in this operation input is taken it can be anything a photo or a video and obtained result may be enhanced image or its features. In image processing already set signal processing methods are applying in an image having two dimensional signals. Today's world image processing has many fundamental uses as it is used widely in the field of research and computer science [2]. Image processing is a technique which converts an image into useful characteristics which can be used for various applications. In this operation an image is taken as input such as a photo or video to convert into useful information which is used in various applications. In image processing already set signal processing methods are applying in an image having two dimensional signals. Various techniques have been developed so far these techniques applied on the images obtained from space, satellite, spacecrafts etc for enhancing image and get useful data [3]. It is referred to process two dimensional images by a computer. Nowadays, Image processing systems has gain popularity due to main advantages like it has large storage memory devices, graphical representation and powerful capacity. An image is a real entity with two variables like a, x and y. where a can be any factor with two positions x and y. this technology has made this possible to change a multi-dimensional signal into advanced system [4]. An image is formed with combination of pixels contains sub-images which sometimes referred as region of images. It also informs that an image is a collection of objects which form a region of images. Therefore it is possible to apply specific operations on specific points by processing one part of an image to improve its color rendition by suppressing other part of an image. Sequence of an image processing in an image is done on the available image that is in digital form of array pr pixels with finite length of binary words. In digital processing, discrete image is taken as a sample in which each pixel of an image is quantized with finite number of bits [5]. In this two dimensional picture is processed by a digital computer. In this process an image first converted into digital form using devices like scanner then processing starts. To display the result of digital image it is firstly converted into analog signal. The main advantages of Digital Image Processing are they are versatile in nature can use in repetition and it preserve the original data with accuracy. Therefore before processing any image it is necessary to convert that image into a digital form [6]. This method includes sampling of image and quantization of sampled values. Processing is performed after converting image into useful information. These processing techniques are Image enhancement, Image reconstruction, and Image compression. An edge is the set of connected pixels that forms a boundary between two disjoints regions. It is a fundamental tool for the detections of features and extraction of features from an image. The main function of this is to find out the points or pixels in an image where brightness changes sharply [7]. In this process it identifies the gray level of distribution and provides them values in accordance of received gray scales. In order to indicate the edges of an object it provides output a binary image. Optimization techniques based on Natural Phenomenon provide the good results and purely based on the natural phenomenon. In order to solve large computational problems and to remove complexity this method is feasible. In short it provides best solution to every problem. Bee Colony Optimization is a natural technique and

based on meta-heuristic techniques. These techniques are also known as meta-heuristic techniques based on swarm intelligence [8]. It has no central controller i.e. it is decentralized where no one control whole program. For determining the best suitable path to reach the solution of problem this optimization technique is used. Complexity can be easily solved as it uses bottom-up approach. Ant Colony Optimization is a probabilistic and meta-heuristic technique. It is also natural insipid technique which is meta-heuristic in nature and used to solve complex combinatorial problems. It uses the previous results to find out the present optimal paths.

II. LITERATURE REVIEW

Prathusha, et.al [9] proposed Enhanced Sobel operator, Enhanced Prewitt operator and Enhanced Robert operator by using morphological operations and masking. The novelty of the proposed approach was that it gave thick edges to the crab images and removed spurious edges with help of m-connectivity. Parameters which measured the accuracy of the results were employed to compare the existing edge detection operators with proposed edge detection operators. This approach showed better results than existing edge detection operators.

Hien, et.al [10] proposed a new approach to MRI edge detection issue. The proposed method included three stages. Firstly, the Semi Translation Invariant Contourlet Transform (STICT) was used to improve quality of the original MRI. Secondly, the result of first stage was subjected to image segmentation by using Fuzzy C Means (FCM) clustering method. Finally, canny edge detection method was applied to detect the fine edges. The proposed method was better than the other recent methods based on compared results.

Ganesan, et.al [11] performed a comprehensive study of edge detection methods for image processing applications to analyze the various edge detectors and the latest trends in edge detection. The principal objective of the edge detection was to identify and classify the discontinuities in an image. The performance evaluation of various edge detection methods was carried out for different images using Matlab. The merits and demerits of edge detection methods were tabulated. Among the standard edge detection methods, the canny edge detector produced very good results especially under noisy conditions. As far as accuracy concerned, Wavelets based methods were more accurate and outperformed other methods.

Sharma, et.al [12] conducted experiments and compared two methods in which edge detection of satellite images was performed on Hadoop. Since, edge detection was one of the prime steps in the field of image processing and was being used for object detection in the image; this technique targeted this basic algorithm of image processing for the experiments. In proposed research experiments, distributed processing of Hadoop was learned by logically splitting the file on HDFS and performing edge detection in distributed manner. The experiments were performed on Amazon AWS Elastic MapReduce (EMR) cluster using different satellite images varying from 10MB-200MB. The paper described the comparison of the two approaches.

Gao, et.al [13] applied a scaled multi-gradient edge detection algorithm to infrared criminal investigation images to extract the edge of the targets. It used eight orientation detection templates to process the original image, which could reduce the lack of the edge details and improve the accuracy of edge extraction. Then edge images were obtained. Proved by the experiments, the algorithm could achieve the decrease in the edge deletion for the edges whose gray scale changes were not fierce, and a great advance in the continuity and smoothness of edges. Not only the algorithm was simulated, but also the effect of edge extraction was quantitatively analyzed.

Shrivakshan and Chandrasekar, [14] explained various edge detection techniques of Gradient based and Laplacian based techniques. Shark type image was considered for all the identification. Gradient based algorithms were sensitive to noise. Kernel filter and its coefficient were static in nature and could not be adapted easily for the given image. Author proposed various observations which mainly deal with Shark Fish Classification. They were links with image processing with the help of varied filters which were mainly gradient based Roberts, Sobel and Prewitt edge detection operators, Laplacian based edge detector and Canny edge detector. In this paper author provided all the advantages and disadvantages of these filters which provided useful results or solution.

III. RESEARCH METHODOLOGY

In order to solve the optimization problems, a meta-heuristic algorithm that is introduced by researches is Hough transformation. Researchers used the ant system as a base to generate this algorithm. The actual behavior of ants is considered as a base in this algorithm. A local data related problem is considered here in which the parallel search is made over various constructive computational threads. The quality of previously obtained results is presented on the basis of information gathered from dynamic memory structures [7]. The combinational optimization (CO) problems have been effectively solved using collective behavior. The various search threads interact with each other and that is when variorums such issues arise. So, in case of static and dynamic combinatorial optimization problems a current application of Hough transformation algorithms has been used.

As a function to be provided within the artificial pheromone trails, the probabilistic decisions are generated within this algorithm. On the basis of heuristic information, the problems

of input data are resolved here. Within various combinatorial optimization issues, the traditional construction heuristics are extended within this algorithm.

There are mainly four steps involved in the proposed technique [15]. They are the initialization process in which bees are randomly placed over the image and the pheromone values along with the heuristic information is computed, the construction process of node transition rule which bees are chosen and the selected bees are moved from the certain positions. The movements of the bee decide the final threshold for the computation through ABC, and heuristic value and the termination criterion which specifies after these many iteration the algorithm will come up with the result. Below is the process followed using these steps:

Initialization process: Within an image *i*, *m* numbers of ants are randomly distributed over the image I which has a size of *M*×*N* where *M* is the height and *N* is the width of the image In such that at most one ant can be present at any pixel. The pheromone value at all the pixels or nodes is considered to be 0.0001 which is initialised in T_{init}. Here node and pixel can be used interchangeably. The heuristic information will be computed offline for all the pixels.

Construction process of node transition rule: A stochastic approach is utilized to select *k*th ant from the *m* artificial bee in the *n*th construction step. Within an image *i*,there is a continuous mobility of this bee from node (r,s)towards its neighboring node(i,j). The node transition rule is followed here and the equation generated is:

$$P^{\eta}_{(r,s),(i,j)} = \begin{cases} \dfrac{(\tau^{(n-1)}_{(i,j)})^{a}(\eta_{(i,j)})^{\beta}}{\sum_{(i,j)\epsilon\Omega(r,s)}\left(\tau^{(n-1)}_{(i,j)}\right)^{\alpha}(\eta_{(i,j)})^{\beta}} & if\ (i,j)\epsilon\ \Omega(r,s) \\ 0 & Otherwise, \end{cases} \quad \text{- (1)}$$

Here, for node(i,j),$\tau^{(n-1)}_{(i,j)}$ and $\eta_{(i,j)}$ are the pheromone and heuristic information values respectively.

The heuristic information for all the pixels will be calculated offline and the region size taken is 5×5. The heuristic information is a very parameter to be considered because it will act as an indicator for the ant that in it's vicinity where it has to move. Heuristic information is quite similar to finding out the gradient of image. The diagram below shows the region. The various colors present in the diagram have no meaning by themselves, they just refer that we will check the difference between the intensity values of same colored pixels.

Calculation of threshold Value: - The threshold value is calculated in this phase to update pheromone value. The bee colony algorithm is applied to calculate threshold value.

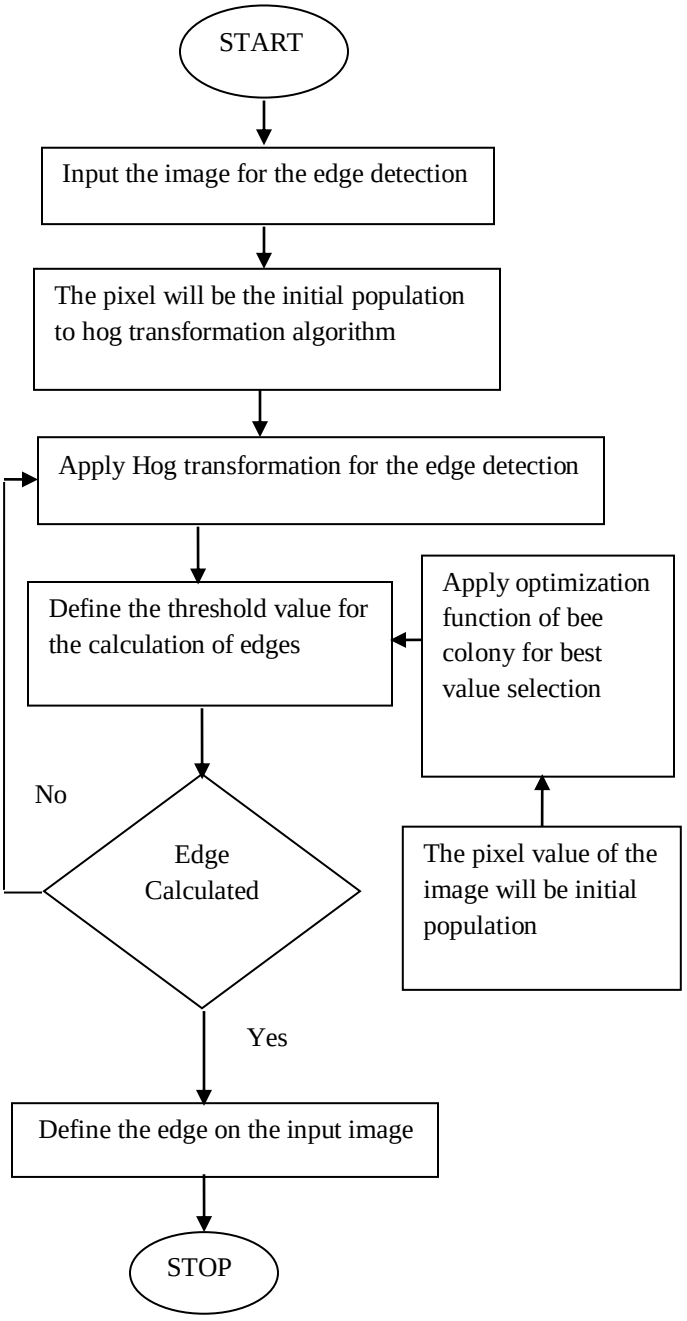

Fig.1: Proposed Flowchart

IV. EXPERIMENTAL RESULTS

The proposed research is implemented in MATLAB and the results are evaluated by comparing proposed and existing techniques in terms of various parameters.

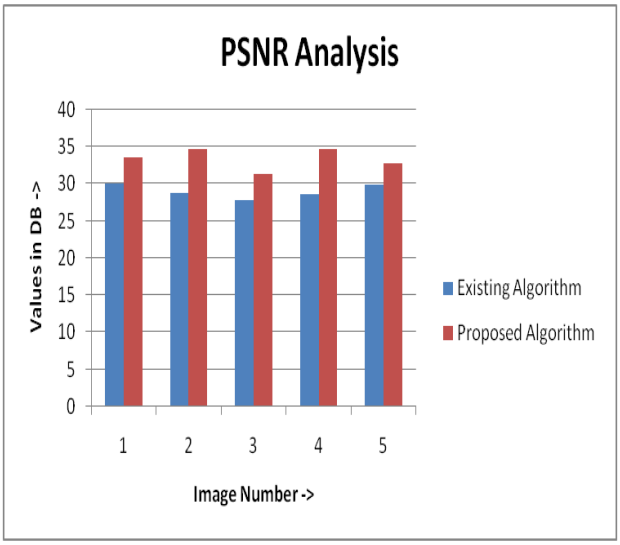

Fig.2: PSNR Analysis

As shown in figure 2 the existing and proposed algorithms for the edge detection are compared in terms of PSNR value. The proposed algorithm has high PSNR value which shows efficiency of proposed algorithm.

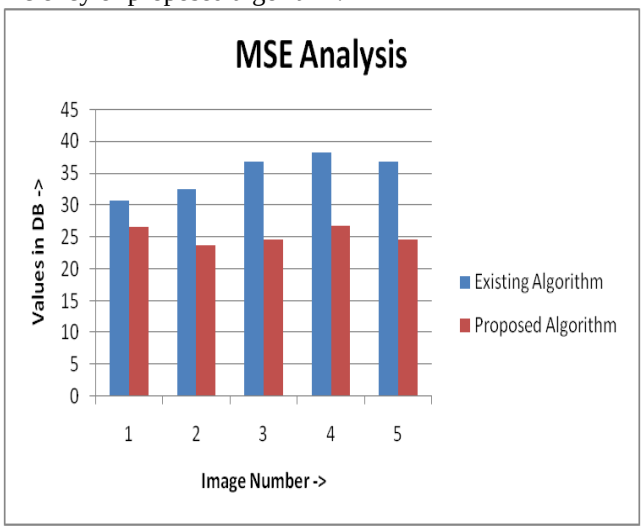

Fig.3: MSE Analysis

As shown in figure 3 the existing and proposed algorithms for the edge detection are compared in terms of MSE value. The proposed algorithm has low MSE value which shows efficiency of proposed algorithm.

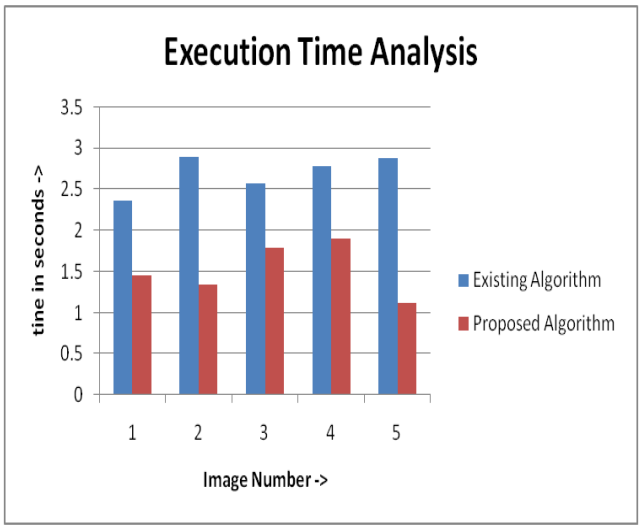

Fig.4: Execution Time Analysis

As shown in figure 4 the existing and proposed algorithms for the edge detection are compared in terms of execution time value. The proposed algorithm has low execution time value which shows efficiency of proposed algorithm

V. CONCLUSION

Image processing is defined as process in which an image is firstly converted into digital format further various numbers of operations are performed on it. This technique is used to get useful information from an image. In image processing already set signal processing methods are applying in an image having two dimensional signals. This process performs in various areas like in engineering, scientific research and computers science. Proposed the method edge detection technique in which all the points are extracted from an image to form a steady state of an image. The performance of proposed technique is tested in terms of PSNR,MSE and Execution time . It has been analyzed that proposed technique performs well as compared hog transformation techniques. It is analyzed that proposed algorithm performs well in terms of all parameters as compared to hog transformation technique.

VI. REFERENCES

[1]. Megha Kulshrestha,V. K. Banga,Sanjeev Kumar, Finger Print Recognition: Survey of Minutiae and Gabor Filtering Approach, International Journal of Computer Applications, Volume 50 – No.4, July 2012,17-21

[2]. Monika Sharma, Fingerprint Biometric System: A Survey, International Journal of Computer Science & Engineering Technology (IJCSET), Vol. 5 No. 07 Jul 2014,743-747

[3]. Hongyan Li, Jianrong Cao, Wenting Tan, Caiyun Liu, “Overview of image segmentation techniques,” Journal of Shandong Jianzhu University, 2010, (01): 85-89, 93.

[4]. Min Zheng, Youxi Wang, Dongdong Sheng, “Edge detection method based on Sobel operator with low noise and low contrast

image," Shihezi University Journal (Natural Science Edition), 2008, (01): 117-119.
[5]. Shuang Song, Honge Ren, Jun Guan, "Multi-threshold Real-time Edge Detection Method Based on Sobel Gradient Template," Computer Engineering and Applications, 2015, (23): 199-202 + 265.
[6]. Tongying Guo, Ce Chen, "Study on edge detection algorithm based on Sobel operator," Technology Square, 2015, (02): 17-20.
[7]. Fei Gao, Qihong Huang, Weidong Cheng, Dan Li, "Improvement of Sobel Edge Detection Operator," Chinese Journal of Digital Technology and Applications, 2016, (01): 143-145.
[8]. Lixun Tan, Jiejie Liu, Chunyan Li, "Improvement of Sobel Operators in Real-time Image Processing," Journal of Projectiles, Rockets and Guidance, 2006, (S1) 291-293.
[9]. P. Prathusha ; S. Jyothi ; D. M. Mamatha, "Enhanced Image Edge Detection Methods for Crab Species Identification", 2018 International Conference on Soft-computing and Network Security (ICSNS)
[10]. Nguyen Mong Hien ; Nguyen Thanh Binh ; Ngo Quoc Viet, "Edge detection based on Fuzzy C Means in medical image processing system", 2017 International Conference on System Science and Engineering (ICSSE)
[11]. P Ganesan, G. Sajiv, "A comprehensive study of edge detection for image processing applications", 2017 International Conference on Innovations in Information, Embedded and Communication Systems (ICIIECS)
[12]. Tapan Sharma ; Vinod Shokeen ; Sunil Mathur, "Comparison of Approaches ofDistributed Satellite Image Edge Detection on Hadoop", 2018 3rd International Conference On Internet of Things: Smart Innovation and Usages (IoT-SIU)
[13]. Qiang Gao ; XinXin Lv ; Xiao Yu, "A scaled multi gradient edge detection algorithm for infrared image detection", 2017 IEEE International Conference on Mechatronics and Automation (ICMA)
[14]. G.T. Shrivakshan and Dr.C. Chandrasekar, "A Comparison of various Edge Detection Techniques used in Image Processing", IJCSI International Journal of Computer Science Issues, Vol. 9, Issue 5, No 1, September 2012