



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

# IJRSET

International Journal of Innovative Research in  
**SCIENCE | ENGINEERING | TECHNOLOGY**

# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 11, Issue 2, February 2022

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA

Impact Factor: 7.569

9940 572 462

6381 907 438

[ijirset@gmail.com](mailto:ijirset@gmail.com)

[www.ijirset.com](http://www.ijirset.com)



# Content Based Image Retrieval System Using Improved GSA Algorithm

Priyanka Srivastava<sup>1</sup>, Prof. Ashish Gupta<sup>2</sup>, Prof. Manisha Pathak<sup>3</sup>

M. E. Student, Dept. of CSE, Nagaji Institute of Technology & Management, Gwalior (M.P.), India<sup>1</sup>

Associate Professor, Dept. of CSE, Nagaji Institute of Technology & Management, Gwalior (M.P.), India<sup>2</sup>

Assistant Professor, Dept. of CSE, Nagaji Institute of Technology & Management, Gwalior (M.P.), India<sup>3</sup>

**ABSTRACT:** CBIR image retrieval system is to solve problem of pattern recognition. And GSA algorithm based on heuristic search technique to used mostly pattern recognition with help of optimization. Image quality is important part of image processing with edge detection technique. But various techniques not quality improved with human image. And gravitational search algorithm is provide better quality parameter for improve image segmentation on human image.

This research methodology based on Improved GSA algorithm (I-GSA) with using adaptive threshold function on compared to SOBEL edge detection technique provide better result . Also calculated better SSIM Value for human image with compared to SOBEL edge detection technique. This research work implemented in MATLAB R2015a Tools.

Also less memory space in retrieved large images with related data. Results confirm the efficiency and throughput of GSA to increase the accuracy of CBIR based systems.

**KEYWORDS:** CBIR, I-GSA, Adaptive Threshold Function, SOBEL, SSIM Value etc.

## I. INTRODUCTION

CBIR is the most important technique for display the all contents of image from large data based according to user's mind [1]. The main part of content are refers to image colors, image shape, image textures and many information that hide in image (Fig.1). The second name of CBIR technique is query by image content (QBIC) is the application of computer vision techniques to the image retrieval problem [2][5].

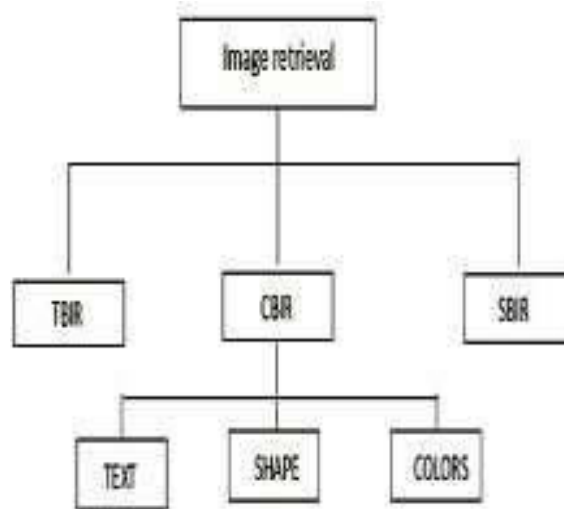


Fig.1 Block diagram of image retrieval

In this CBIR system performs with retrieval and indexing process using features selected and computed from images as according to the whole images [1]. These features are selected with numerical values and computed some image



processing algorithms and captured visual image described and save them in feature vectors [2] [5]. These systems provide whole image retrieve application with using computer vision and multimedia based heuristic algorithm [1]. Some basic application is following types:

Medical diagnosis Education and training Digital Libraries Home entertainment  
Architectural and engineering design

Our proposed paper CBIR system based edge detection technique with help of new research based heuristic algorithm for gravitational search algorithm with comparisons of PSNR (peak signal to noise ratio) and SSIM (structured similarity index major) parameter [4] [7]. Gravitational search algorithm described according to proposed paper is following.

## II. LITERATURE SURVEY

In their seminal work, **Manju Bala, Krishan K. Saluja & Sarika Jindal** [1] described latest review based CBIR feature selection with GSA algorithm also provide some feature selection concept on data mining ,machine learning and heuristic search algorithm.

**Pooja devi & Mahesh parmar** [2] also review based described CBIR VISUAL content and technique with common feature for generating image retrieval types, these paper used learning algorithm also important for concept using on our proposed work.

**Zhang Jin-Yu [3] et.al** described edge detection of image based on improved SOBEL operator and genetic algorithm not show better quality of images for directly used key feature with threshold because our research work used edge detection of images in feature selection with comparisons PSNR and SSIM parameter on developed GSA algorithm. These works solve critical justification on images for edge detection technique.

**Amitava Podder, Pramit Brata Chanda**[4] described on Comparative Performance Study and Analysis on Different Edge based Image Segmentation Techniques of Thermal Images. Authors have used different thermal images for the edge based analysis of image segmentation. Authors have given studies regarding different edge operators like SOBEL, Prewitt, LOG, and Canny Edge Detection operators for segmentation purposes and analyze their performance. Our Research paper helpful in this paper is main review for developing human image quality improvement with comparative parameter of SSIM with developing I-GSA algorithm. This review paper works only improve thermal image but our research paper improve SSIM Value with human image than compare SOBEL edge detection technique.

**J.P.papa et al. [6]** proposed a feature selection through GSA with combine the optimization behavior of GSA together with the speed of optimum path forest (OPF) and other analysis but this paper used data set not generate less difference. But our proposed work with GSA algorithm used parameter in edge detection technique provided best quality difference in image analysis. But this existence paper provided complete GSA algorithm concept with feature selection.

**Alain Horé and Djemel Ziou [7]** In this paper we find out the quality of image with the help of two major parameter of image quality that is PSNR and SSIM. And explain the simple mathematical relationship between these. A series of tests realized on images extracted from the Kodak database gives a better understanding of the similarity and difference between the PSNR and SSIM.

Our research paper we calculate the mathematical relationship between the SOBEL and GSA. And explain the better result of image quality by GSA with respect to SOBEL. So that SSIM used structured similarity for proposed research and these paper describe SSIM greatest form.

**Esmat Rashedi and other [11]** in this research paper the researcher are collection of masses, and their interactions are based on the Newton laws of gravity and motion. In this article, a binary version of the algorithm is introduced. To evaluate the performances of the proposed algorithm, several experiments are performed. The experimental results confirm the efficiency of the BGSA in solving various nonlinear benchmark functions.

The BGSA has some parameter to be tuned such as  $G_0$  and  $k_{best}$ . To examine the effect of different values of these parameters on the performance of BGSA in detail, a set of experiments have been carried out on BGSA using different values of  $G_0$  and  $k_{best}$ .

Our research work also study some related previous review paper in developing best quality of research work on CBIR system with edge detection using GSA algorithm and using parameter.

Our proposed work based on adaptive threshold, SOBEL Operator and GSA Algorithm. So we have this term used



mass, acceleration and gravity. But in this paper deeply focus these terms. Our proposed research work based on GSA algorithm with SOBEL operator and adaptive threshold function. And this exiting paper describe GSA algorithm deeply with step-by-step process description. In this research paper used following review papers with comparative result and task for better provide edge detection technique based image result. Also include CBIR system with some components parameter changes with improving retrieval system in latest used SOBEL operator and adaptive thresholds function concept in GSA Algorithms.

### III. PROPOSED RESEARCH METHODOLOGY

In our work of historical document with complex images binaries, using adaptive threshold function is compare on the basis of SOBEL operator and gravity concept in contrast of image with developed proposed Improved GSA (I-GSA) algorithm [6] [10] [11]. First two terms analyses well known objective image quality metrics, such as PSNR as well as SSIM and later term adaptive threshold function used of degraded document images is still an unsolved problem due to the high inter/intra-variation between the text stroke and the document Background across different document images. SOBEL operator fined the edge detection in some cases using images with Compared of proposed Improved GSA (I-GSA) algorithm [3][4][8].

These terms describe with proposed research based methodology is given:

1. **Peak-Signal-to-Noise Ratio (PSNR):** This ratio term used for the finding ratio between the maximum possible power of a signal and the power of corrupting noise that affects the fidelity of its image representation. Because many signal have a very wide dynamic range, PSNR is usually expressed in terms of the logarithmic decibel scale.[5]
2. **Structural Similarity Index Measure (SSIM):** In this term used three forms SSIM Index, SSIM Map and Mean SSIM. Firstly SSIM used to improve on traditional method such as PSNR and MSE (Mean Squared Error). SSIM Index is a method for predicting the perceived quality of digital images. It can be viewed as a quality measure of one of the images being compared provided the other image regarded as a perfect quality. The SSIM is also known as quality metric used to measure the similarity between two images. It was developed By Wang et al. The SSIM show better image quality according to PSNR in image format. [5]
3. **Adaptive Threshold Function:** It takes a color image as input and in the simplex implementation, outputs a binary image representing the segmentation for each pixel in the image, a threshold has to be calculated. And adaptive threshold is the method where the threshold value is calculated for smaller regions and therefore, there will be different threshold value for different region [6][10].
4. **Prewitt Operator:** Prewitt operator edge detection masks are the one of the oldest and best understood methods of detecting edges in images. The Prewitt edge detector uses the following mask to approximate digitally the first derivatives Gx and Gy[12].
5. **SOBEL Operator:** It performs the 2-d spatial gradient measurement on an image and so emphasize region of high spatial frequency that correspond toedge. The operator consists of a 3\*3 convolution matrix as shown in figure. One matrix is simply the other rotated by 90<sup>0</sup>. This is similar to the Roberts cross operator [4] [12].

-1	0	+1
-2	0	+2
-1	0	+1

G<sub>x</sub>

+1	+2	+1
0	0	0
-1	-2	-1

G<sub>y</sub>

**Fig.2 SOBEL convolution matrix** These matrixes are designed to respond maximally to edge running vertically and horizontally relative to the pixel grid, one matrix for each of two perpendicular orientations. This matrix can be apply to each input image, to produced the separate gradient component in each orientation. G<sub>x</sub> and G<sub>y</sub> The gradient magnitude is given by:

$$|G| = \sqrt{G_x^2 + G_y^2}$$



Typically, an approximate magnitude is computed using:

$$|G| = |G_x| + |G_y|$$

#### IV. PROPOSED ALGORITHM

**Improved Gravitational Search Algorithm (I-GSA):** According to this algorithm searcher agents are collected of masses and their interactions are based on the Newton gravity law and motion. GSA is inspired by the Newton theory that says: "Every particle in the universe attracts every other particle with a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between them". Gravity is a force, pulling together all matter [4] [6] [10].

In this algorithm generate SSIM parameter and later PSNR with CBIR system based feature selected on edge detection technique.

The real version of GSA was designed for search spaces of original real valued vectors. However, many optimization problems are set in binary discrete space. But our proposed algorithm is improved with used SSIM parameter and later PSNR to find images with less resolution by using SOBEL and show real images clarity of human images [4].

Modify Improved GSA Algorithm completed by following step:

- 1. Input image:** In this step selected by any two images also compared. And applying SSIM index formula with default value used  $K = [0.01 \text{ to } 0.03]$ .
- 2. Preprocessing:** In this step used local window for statistics. Default window is Gaussian given by window = f special ('Gaussian', 11, 1.5). This step also used filtering parts.
- 3. Optimization technique (I-GSA):** A new optimization algorithm with GSA based on the law of gravity and mass interactions is introduced. In the proposed algorithm, the searcher agents are a collection of masses which interact with each other based on the Newtonian gravity and the laws of motion [4].
- 4. EDGE detection:** In this step used to find out edge of input image by using our proposed method with adaptive threshold value and standard GSA algorithm[10].
- 5. Evaluate parameter (SSIM):** To compute and showing the SSIM value of input images. With above step 2, 3 and 4.
- 6. Find result.**

#### V. RESULTS & ANALYSIS

In this section we have presented the experimental result and evaluated the performance of the proposed methodology [7]. The proposed methodology is implemented in the MATLAB R2015a and the operating system used is windows 7[9].

##### Measurement of Structural Similarity Index (SSIM)

This parameter was suggested by Wang. It is composed of three values: Structural comparison, Luminance comparison & Contrast comparison. These components are normalized such that they are default SSIM value is 1.0 for identical images. The SSIM index is the product of these three components (raised by an exponent, if required). The formula for this measure is given by SSIM(1,2) Equal is

$$\frac{(2\mu_1\mu_2 + C_1)(\sigma_{12} + C_2)}{(\mu_1^2 + \mu_2^2 + C_1)(\sigma_1^2 + \sigma_2^2 + C_2)}$$

Where  $\mu_1, \mu_2, \sigma_1, \sigma_2,$  and  $\sigma_{12}$  local statistics parameters of the two images 1 and 2 and  $C_1, C_2$  are constants used to avoid division by zero.

Here the results are shown for different human images with changes background and some other images i.e. cameraman.

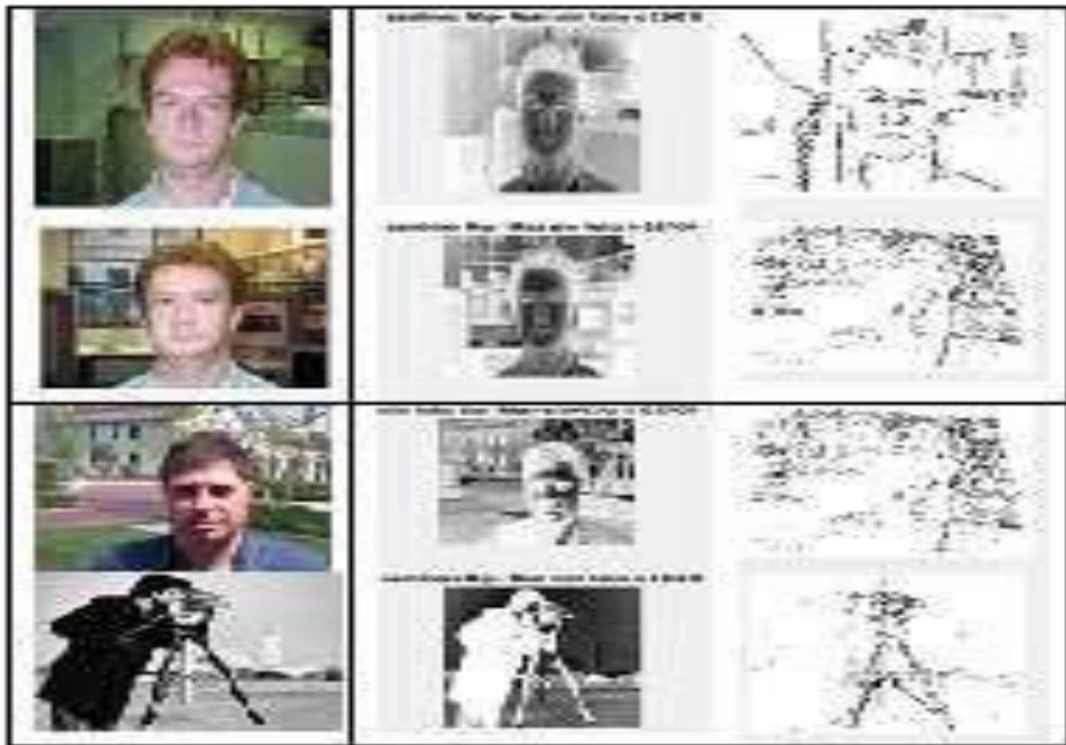


Fig.3 I-GSA algorithm based human image

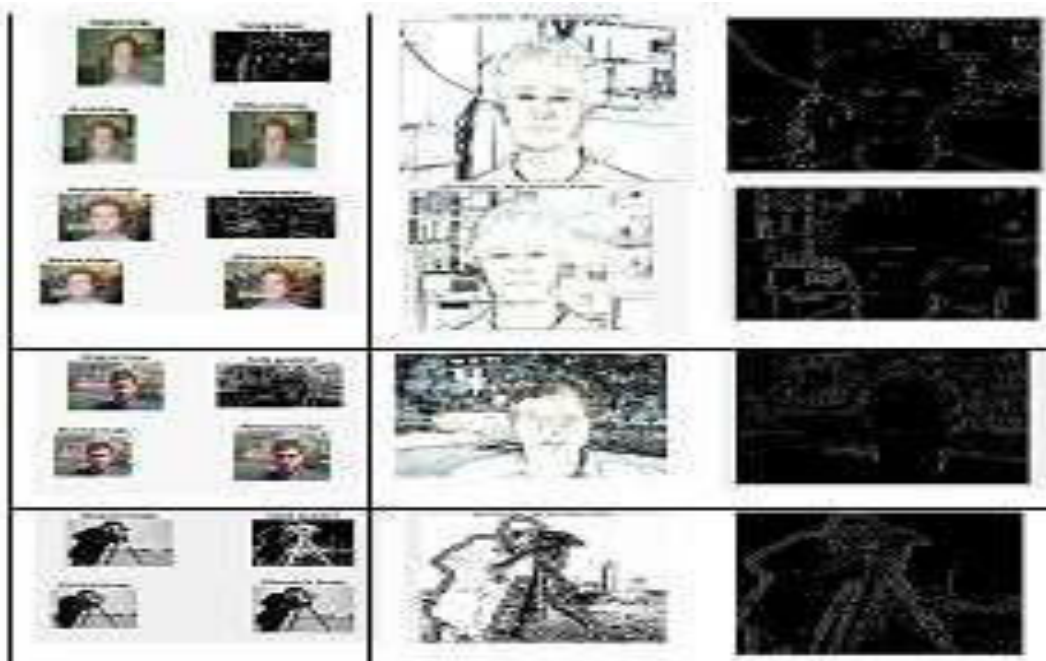


Fig.4 SOBEL algorithm based human image



Table 1 Different SSIM Value for human image with compare to I-GSA & SOBEL

Human Image	I-GSA based SSIM Value	SOBEL based SSIM Value
Image 1	0.8423	0.714
Image 2	0.8892	0.6162
Image 3	0.9093	0.7171
Image 4	0.9801	0.8404
Image 5	0.9749	0.9065

**VI. CONCLUSION AND FUTURE SCOPE**

Our proposed improved GSA with adaptive threshold function based algorithm provide better result for human image with edge detection in quality improvement and also find better SSIM Value . But this quality improvement result is not provides by SOBEL operator. But our proposed algorithm is better to finding, edge detection with SSIM value than SOBEL operator edge detection technique.

In Future this result can be also implemented by using different edge detection technique i.e. canny operator, prewitt operator with image processing based technique. propose improved GSA algorithm can be not provide better quality results for using nature image, but SOBEL Operator based algorithm is provide this. This is future work in our research.

**REFERENCES**

- (1.)A. Ahmed, "Implementing Relevance Feedback for Content-Based Medical Image Retrieval," in IEEE Access, vol. 8, pp. 79969-79976, 2020, doi: 10.1109/ACCESS.2020.2990557.
- (2.)Pooja Devi & Mahesh Parmar, "A Survey on CBIR Techniques and Learning Algorithm Comparison." International Journal of Latest Trends in Engineering and Technology, Vol.(8)Issue(1), pp.197-205, DOI: <http://dx.doi.org/10.21172/1.81.026> e-ISSN:2278- 621X.
- (3.)Zhang Jin-Yu1, Chen Yan & Huang Xian- Xiang "Edge Detection of Images Based on Improved SOBEL Operator and Genetic Algorithms." 978-1-4244-3986-7/09/\$25.00 ©2009 IEEE.
- (4.)Amitava Podder, Prमित Brata Chanda, "Comparative Performance Study and Analysis on Different Edge based Image Segmentation Techniques of Thermal Images." International Journal on Recent and Innovation Trends in Computing and Communication (IJRITCC), ISSN: 2321-8169 632 – 636 Year 2017 Volume: 5 Issue:5 632 – 636.
- (5.)C.Gururaj, D.Jayadevappa & Satish Tunga, "Content Based Image Retrieval System Implementation through Neural Network." IOSR Journal of VLSI and Signal Processing (IOSR- JVSP) Volume 6, Issue 3, Ver. III (May. - Jun. 2016), PP 42-47 e-ISSN: 2319 – 4200, p-ISSN No.: 2319 – 4197 [www.iosrjournals.org](http://www.iosrjournals.org).
- (6.)J. P. Papa, A. Pagnin, S. A. Schellini & others. "Feature selection through gravitational search algorithm." the authors are grateful to FAPESP grant 2009/16206-1 and CNPQ grant 481556/2009- 5.
- (7.)Alain Horé & Djemel Ziou, "Image quality metrics: PSNR vs. SSIM" 2010 International Conference on Pattern Recognition 1051-4651/10 \$26.00 © 2010 IEEE DOI 10.1109/ICPR.2010.579.
- (8.)Pinaki Pratim Acharjya, Ritaban Das & Dibyendu Ghoshal. "Study and Comparison of Different Edge Detectors for Image Segmentation."Global Journal of Computer Science and Technology Graphics & Vision Volume 12 Issue 13 Version 1.0 Year 2012 Type: Double Blind Peer Reviewed International Research Journal Publisher: Global Journals Inc. (USA) Online ISSN: 0975-4172 & Print ISSN:0975-4350.
- (9.)Kokila Jandial, Nitika Kapoor and Harish Kundra, "Edge detection based on the theory of Universal gravity: Implementation in MATLAB." Journal of Academia and Industrial Research (JAIR) ,Youth Education and Research Trust (YERT), Volume 2, Issue 1 June 2013 ISSN:2278-5213.
- (10.)Rohit Rai, Prof. Ratnesh Dubey & Dr. Vineet Richhariya, "Advanced Content Based Image Retrieval using



Gravitational Search Algorithm.” International Journal of Technology Research and Management, ISSN (Online): 2348-9006, Vol 2 Issue 7 July 2015, Paper ID: 2015/IJTRM/7/2015/5480.

(11.)Esmat Rashedi & Hossein Nezamabadi-pour, “Improving the Precision of CBIR Systems by Feature Selection Using Binary Gravitational Search Algorithm, The 16th CSI International Symposium on Artificial Intelligence and Signal Processing (AISP 2012), 978-1-4673-1479- 4/12/\$31.00 ©2012 IEEE.

(12.)Rekha Rani & Shailja Kumari, “A Review on Edge Detection Using Different Techniques.” International Journal of Science and Research (IJSR), ISSN (Online): 2319-7064 Index Copernicus Value (2013): 6.14 | Impact Factor (2015): 6.391.





Impact Factor:  
7.569



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  [ijirset@gmail.com](mailto:ijirset@gmail.com)



[www.ijirset.com](http://www.ijirset.com)

Scan to save the contact details