Probability Based Image Edge Detection Using Modified PSOGSA Algorithm

Kanica, Beant Kaur, Mandeep Kaur

Department of ECE, Punjabi University, Patiala, Punjab, India

Abstract - There are number of algorithms used for the image edge detection. There are many optimization algorithms which are inspired by the nature for optimization purpose in the field of image processing. The methods are genetic algorithm (GA), evolutionary algorithm, particle swarm algorithm (PSO), ant colony optimization algorithm, gravitational search algorithm (GSA) etc. These methods have been successfully applied in their field of job. But yet the breakdown of image edge detection algorithms is that in some images especially noisy images, the broken edges are produced. For this problem the two algorithms are combined in this paper. The particle swarm optimization algorithm and the gravitational search algorithm are chosen for the purpose which has been modified for the better results. The PSO is good for its ease to implement, fewer operators, limited memory for each particle to save its previous state, high speed convergence. The GSA is based on the law of gravity and mass interaction. Probability based PSOGSA is based on the probability of the fitness in an image. The experimental result shows that the proposed method gives better results than the basic particle swarm optimization algorithm and gravitational search algorithm.

Keywords *- image edge detection, particle swarm optimization algorithm, gravitational search algorithm, particle swarm optimization and gravitational search algorithm, modified particle swarm optimization and gravitational search algorithm.*

I. INTRODUCTION

Image processing has been widely used in many fields like medical, scientific, security purpose, technical fields etc. Image processing include several methods and techniques among which image edge detection is the one. Edge detection is basically aimed at identifying the image brightness discontinuities especially along the edges where the intensity tends to change sharply. Edge detection and clustering are two basic segmentation methods among the various techniques. Image segmentation is an attempt to partition an image into multiple segments which is also known as sets of pixels or super pixels. The goal of segmentation is to simplify or change the image into something that is more meaningful and easier to analyse. Canny edge detection is a premium technique used for detecting the edge in an image. Clustering is a process whereby a data set is replaced by clusters, which are collections of data points that "belong together". The specific criterion to be used depends on the application. Pixels may belong together because of the same colour or similarity measure. During this detection process, the broken edges are detected especially in noisy images. Due to which various optimization algorithms has been used till the date like genetic algorithm (GA), evolutionary algorithm, particle swarm optimization (PSO), ant colony search algorithm, gravitational search algorithm (GSA) etc. These algorithms have shown the suitable results for the optimization purpose but still the breakage in the noisy images still exists. By analysis, Particle swarm optimization algorithm has proved to optimize an image without any breakage in the noisy images. As by observing the previous work, gravitational search algorithm has shown the satisfactory results in the image edge detection method.

Particle swarm optimization is a population based meta-heuristic method for solving optimization problems introduced by Kennedy and Eberhart [9]. PSO has the various advantages detailed in the section of particle swarm optimization in this paper. Particle swarm optimization has been used in many fields like function optimization, combinatorial optimization, system identification, neural network training [11]. Before evolution, an initial population of individual particles are randomly generated as candidate solutions. An iterative evolutionary learning process to improve these candidate solutions is set in motion. The learning process iteratively evaluates the goodness/fitness of the candidate solutions and remembers the locations of the individual particles where they had their best success. The individual's best solution is called the local best. Each particle makes this information available to their neighbors. They can also see where their neighbors have had success. Movements through the search space are guided by these successes, with the population usually converging, by the end of the evolution, on a global best solution. Although relatively new compared with other AI methods such as neural networks and genetic algorithms, PSO is considered particularly suitable to optimising a large number of parameter values efficiently, which could provide a great potential to edge detection where many pixel positions need to be found. To date, PSO has been used in a number of vision applications such as object detection, object classification and segmentation, but has not applied to edge detection [2].

Gravitational search algorithm (GSA) is a population-based search algorithm which is inspired by universal law of gravity. Algorithm uses the theory of Newtonian gravity and its searcher agents are the collection of masses. In this paper, GSA and law of universal gravity is used to tackle the edge detection problem. Theory of universal gravity is used to detect edge pixels while the movement of agents are computed using the gravitational search algorithm [7]. In GSA, each particle has associated with four specifications: particle position, its inertial mass, active gravitational mass and passive gravitational mass. The position of particles provides the solution of problem while fitness function is used to calculate the gravitational and inertial masses. Every population based algorithm has two capabilities: exploration and exploitation. This algorithm uses exploration capability at the beginning to avoid local optimum problem and after that exploitation[12].

PSOGSA is made by combining the two optimization algorithms named as PSO and GSA. This algorithm has shown the satisfactory results in the field of image processing and in others as well. The ultimate goal of all heuristic optimization algorithms is to balance the ability of exploitation and exploration efficiently in order to find global optimum. Exploration is the ability of an algorithm to search whole parts of problem space whereas exploitation is the convergence ability to the best solution near a good solution [5].

This paper presents the probability based PSOGSA algorithm in which the results are based on the probability of fitness of an image. The goal of this paper is to investigate the technique in the field of image processing by modifying the psogsa algorithm for the better results. This modified method has worked sufficiently with the better results shown below in this paper. In this paper the next section gives the review of the previous studies of the applied algorithm or the related works. The third section of this paper gives the information about the proposed algorithm and both the algorithms which are combined for the research besides which the difference between both the algorithms also given. The afterwards of this, the modified particle swarm optimization and gravitational search algorithm has been explained. The results with the images has been given after explaining the modified particle swarm optimization and gravitational search algorithm along with their respective values of the images.

II. PREVIOUS WORK

P.Papa, A. Pagnin, S. A. Schellini, A. Spadotto, R. C. Guido, M. Ponti, G. Chiachia and A. X. Falcao [1] **p**resented the feature selection of gravitational search algorithm (GSA). The proposed algorithm combines the optimization behaviour of GSA together with the speed of Optimum-Path Forest (OPF) classifier in order to provide a fast and accurate framework for feature selection. The main idea is to use the OPF accuracy over an evaluating set as the fitness function to guide GSA into searching the best solutions. As the number of masses increases, more reliable the solution vector obtained by GSA is. Thus, one needs a fast classifier to train all possible subset of features, denoted by the position of each mass particle. Although the algorithm presented here does not restrict OPF as the only classifier to be applied, it had decided to use it because of its efficiency in training. Another strong point is that OPF does not have parameters to be optimized, such as Support Vector Machines and some neural networks. This paper present here the experiments to asses the robustness of the proposed GSA-based algorithm for feature selection. Experiments using five different datasets from a wide range of applications comparing the proposed approach with the additional OPF, OPF with Particle Swarm Optimization (OPF-PSO), OPF with Principal Component Analysis (OPF-CA), and OPF with Linear Discriminant Analysis (OPF-LDA) demonstrated that OPFGSA seems to be an interesting strategy for feature selection, since that no consensus was observed about which technique is better than the other to perform the given tasks.

Mahdi Setayesh, Mengjie Zhang and Mark Johnston [2] The goal of this paper is to investigate a new approach to the use of PSO technique for edge detection. Rather than using a simple track of a particular pixel with its neighbors at a time as in many existing edge detection operators, the new approach aims to operate on the entire possible edges or boundaries (entire fitting curves in images) at a time and improve the possible solutions via the automatic evolutionary learning in PSO. The main advantage of an algorithm is detection of edges in one step and there is no need for smoothing, enhancement and localization as pre-processing steps. This algorithm can be used for detecting edges for images with complex objects. The results show that this proposed algorithm outperforms the Sobel and homogeneity edge detectors on the images. In addition, the proposed PSO algorithm can detect complex edges in noisy images without using any pre-processing and post processing algorithms.

Mohammad Alipoor, Sajjad Imandoost and Javad Haddadnia [3] This paper presents a novel edge detection method based on Particle Swarm Optimization. Unlike classical filters that are set by intuitive knowledge, a new filter is proposed on the basis of evolutionary computation**.** A proper synthetic training image and its edge map are used to find an optimum edge filter. The advantage of this method is that an effective edge detection filter can be easily constructed. Exact and highly efficient edge filter is developed and comparative results are provided to certify superiority of this method over classis filters.

Mahdi Setayesh, Mengjie Zhang and Mark Johnston [4] Traditional edge detection approaches often result in broken edges especially in noisy images. This study presents a particle swarm optimisation based algorithm to detect edges continuously in such images. In this paper, a new objective function and a new encoding scheme are proposed to address noise and reduce broken edges. The newly developed algorithm is compared to a modified version of the Canny algorithm as a Gaussian-based edge detector based on Pratt's figure of merit measure. The algorithm to the images in different noise levels is applied and compares the outcome with the modified version of the Canny edge detection algorithm. The results show that our algorithm generally outperforms the Canny edge detector. In addition, our algorithm can detect edges in noisy images without using any pre-processing and post processing algorithms such as a Gaussian filter and an edge linking technique. However, the current version of the algorithm takes a relatively longer time than the Canny edge detector.

Seyedali Mirjalili and Siti Zaiton Mohd Hashim [5] a new hybrid population-based algorithm (PSOGSA) is proposed with the combination of Particle Swarm Optimization (PSO) and Gravitational Search Algorithm (GSA). The main idea is to integrate the ability of exploitation in PSO with the ability of exploration in GSA to synthesize both algorithms strength. Some benchmark test functions are used to compare the hybrid algorithm with both the standard PSO and GSA algorithms in evolving best solution. The main idea is to integrate the abilities of PSO in exploitation and GSA in exploration. The results show that PSOGSA outperforms both in most function minimization. The results are also proved that application of any edge detection algorithm on an entire image requires a huge memory which leads to optimization problems. Gravitational search algorithm is an optimization algorithm inspired by Newtonian gravity. Objects in space attract each other by way of gravity force, and this force causes a global movement of all objects towards the objects with heavier masses. Hence, masses cooperate using a direct form of communication, through gravitational force. In the proposed approach the edges are detected using the law of universal gravity and movement of agents are computed using gravitational search algorithm. The proposed approach is able to detect the edge pixel in an image up to a certain extent. The proposed approach leads to a minimal set of input data to be processed thus making the process much faster and memory-efficient then the edge detection algorithm.

Mahdi Setayesh, Mengjie Zhang and Mark Johnston [6] proposed an algorithm based on discrete particle swarm optimisation (PSO) to detect continuous edges in noisy images. A constrained PSO-based algorithm with a new objective function is proposed to address noise and reduce broken edges. The localisation accuracy of the new algorithm is compared with that of a modified version of the Canny algorithm as a Gaussian-based edge detector, the robust rank order (RRO)-based algorithm as a statistical based edge detector, and the previously developed PSO-based algorithm. Pratt's figure of merit is used as a measure of localisation accuracy for these edge detection algorithms. The results show that the new algorithm generally outperformed the Canny and RRO edge detectors and also a previous PSO algorithm for detecting edges in the images corrupted by the Gaussian and impulsive noises.

Om Prakash Verma and Rishabh Sharma[7] This paper present a new approach for edge detection using gravitational search algorithm (GSA) and universal law of gravity. The direct application of any edge detection algorithm on an entire image requires a huge memory which leads to optimization problems. Gravitational search algorithm is an optimization algorithm inspired by Newtonian gravity. Objects in space attract each other by way of gravity force, and this force causes a global movement of all objects towards the objects with heavier masses. Hence, masses cooperate using a direct form of communication, through gravitational force. In the proposed approach the edges are detected using the law of universal gravity and movement of agents are computed using gravitational search algorithm. The proposed approach is able to detect the edge pixel in an image up to a certain extent. The proposed approach leads to a minimal set of input data to be processed thus making the process much faster and memory-efficient then the edge detection algorithm.

Fatemeh Deregeh and Hossein Nezamabadi-pour [8] In this paper, a new algorithm for image edge detection using Gravitational Search Algorithm (GSA) is proposed. In order to adapt the proposed algorithm to edge detection problem, some modification is applied on the original GSA. Each image pixel is considered as a celestial body and its mass is considered to be corresponding to the pixel's greyscale intensity. To find out the edgy pixels a number of agents are randomly generated and initialized through the image space. Artificial agents move through the space via forces of bodies that are located in their neighbourhood. The results confirmed that the proposed method outperforms the recent Ant edge detection algorithm and also compared to these algorithm, the used population in our algorithm is smaller. Besides, in comparison with Ant algorithm, the proposed method has less parameters and this makes the proposed algorithm more simple. Also in comparison with Sobel method the result of proposed algorithm has more accuracy.

Romesh Laishram[11] This paper attempts to pull out a new and a practical approach for enhancing the underlying delicate architectures of the human brain images captured by a Magnetic Resonance Imaging (MRI) machine in a much better way. Edge detection is a fundamental tool for the basic study of human brain particularly in the areas of feature detection and feature extraction. The edge detection methodology presented in this paper relies on two basic stages: Firstly, the original MRI image is subjected to image segmentation which is done using Particle Swarm optimization incorporating Fuzzy C Means Clustering (PSOFCM) technique. And secondly, canny edge detection algorithm is used for detecting the fine edges. After implementation it was found that this technique yields better edge detected image of the human brain as compared to other edge detection methods.

III. PARTICLE SWARM OPTIMIZATION AND GRAVITATIONAL SEARCH ALGORITHM

The PSOGSA algorithm is the combination of the two algorithms which are particle swarm optimization algorithm and the gravitational search algorithm. The basic information about both the used algorithm and the proposed algorithm are explained below.

A. Particle Swarm Optimization Algorithm

Particle swarm optimization is population based meta-heuristic method for solving optimization problems based on social-psychological principles, introduced by Kennedy and Elberhart in 1995 [4]. The PSO is a robust stochastic evolutionary computation technique based on the movement and intelligence of swarms looking for the most fertile feeding location [3]. The most important advantages of PSO are: ease of implementation, as it needs fewer operators, the limited memory is used for each particle to save its previous state, it has the high speed convergence. PSO does not use the gradient information of the functions being optimized and has a high capability to optimise noise functions. It has been successfully applied problems in noisy environment, like noise cancellation and vision tracking [6]. PSO as a global optimization method is inspired by the social behaviour of animals and biological populations and simulates a simplified social model such as flocking of birds and schooling of fish. It was originally developed to optimize continuous non-linear functions; however some discrete versions of PSO have also been proposed. In PSO, there is a population of individuals (particles) and each particle has its limited memory to keep its previous states. PSO has been successfully been used in the applications like training neural networks, optimizing power systems, fuzzy control systems, robotics, radio and antenna design, computer games[6].

The basic PSO algorithm contains a population of m particles that move through an n-dimensional search space. The position of the i^{th} particle at time t is represented as the vector,

$$\overrightarrow{X_i}(t) = (x_{i1}(t), x_{i2}(t), \dots, x_{in}(t)) \quad (1)$$

and is updated according to its own experience (particle influence) and that of its neighbour (swarm influence). $\overrightarrow{X_i}(t)$ is updated at each iteration of PSO by adding a velocity $\overrightarrow{V_i}(t)$.

$$\overrightarrow{X_i}(t+1) = \overrightarrow{X_i}(t) + \overrightarrow{V_i}(t+1) \quad (2)$$

The velocity is changed based on three components : current, motion influence, particle memory influence and swarm influence, i.e.

$$\overrightarrow{V_{i,j}}(t+1) = w\,\overrightarrow{V_{i,j}}(t) + C_1\,Rand_1(\overrightarrow{X_{pbesti,j}} - \overrightarrow{X_{i,j}}(t)) + C_2 Rand_2\,(\overrightarrow{X_{leader,j}} - \overrightarrow{X_{i,j}}(t)) \quad (3)$$

$Rand_1$ and $Rand_2$ are uniform random variables between 0 and 1 . w is inertia weight that controls the impact of the previous velocity. C_1 (self confidence), C_2 (swarm confidence) are learning factors that represents the attraction of particles towards either its own success or that of its neighbours. Typically these are both set to a value of 2.0, although the setting $C_1 \neq C_2$ can be lead improved performance. $\overrightarrow{X_{pbesti,i}}$ is the best position of i^{th} particle . $\overrightarrow{X_{leader}}$ is the position of the particle (the leader) which is used to guide other particles towards better region of the search space. The methods of handling constraints in PSO are categorized in four groups: Preservation: All the potential solutions, represented by particles are initialised such that they fall within the feasible search space, and particular operators are applied in order to prevent new solutions from violating existing constraints. Penalisation: To penalise the fitness of the particles which are not placed in a feasible area. Partitioning: There are respective two partitioning methods known as feasible set and infeasible set. Pre-Processing methods: The pre-processing methods transform the optimization problems into another one such that either the constraints can be handled in an easier way , or they can be eliminated.

B. Gravitational Search Algorithm

GSA is a novel heuristic optimization method which has been proposed by E. Rashedi et al in 2009. The basic physical theory which GSA is inspired from is the Newton's theory that states: 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 [5]. In GSA, Newtonian laws of gravity are applied to find the optimum solution by a set of agents called masses. This algorithm has a number of distinguishing features such as lower memory usage, fast convergence, and the use of some parameters. In GSA, each mass (agent) has four characteristics: position, inertial mass, active gravitational mass, and passive gravitational mass. The position of the mass corresponds to a solution of the problem, and its gravitational and inertial masses are determine during a fitness function [7]. According to [10] ,suppose there is a system with N agents. The position of each agent (masses) which is a candidate solution for the problem is defined as follows:

$$X_i = (x_i^1 \dots x_i^d \dots x_i^n) \text{ for i = 1 to N} \quad (4)$$

where N is the dimension of the problem and x_i^d is the position of the i^{th} agent in the d^{th} dimension. After evaluating the current population fitness, the mass of each agent is calculated as follows:

$$M_i(t) = \frac{m_i(t)}{\sum_{j=1}^{N} m_j(t)} \quad (5)$$

Where :

$$m_i(t) = \frac{fit_i(t) - worst\ (t)}{best\ (t) - worst\ (t)} \quad (6)$$

where $M_i(t)$ and $fit_i(t)$ represent the mass i and t the fitness value of the agent at , respectively. For a minimization problem, worst(t) and best(t) are defined as follows :

$$\text{best(t)} = \min_{j\in\{1.....N\}} fit_i(t) \qquad (7)$$

$$\text{worst(t)} = \max_{j\in\{1......N\}} fit_i\,(t) \qquad (8)$$

The algorithm starts by randomly placing all agents in a search space. At a specific time t, the force acting on the i^{th} mass from the j^{th} mass is defined as in the following equation:

$$F_{ij}^d(t) = G(t)\frac{M_{aj}(t)-M_{pi}(t)}{R_{ij}(t)+\varepsilon}\left(x_j^d(t) - x_i^d(t)\right) \quad (9)$$

where M_{aj} is the active gravitational mass related to agent j, M_{pi} is the passive gravitational mass related to agent i, G(t) is a gravitational constant at time t, e is a small constant, and $R_{ij}(t)$ is the Euclidian distance between two agents i and j and the gravitational constant G given by the following equations:

$$R_{ij}(t) = \left\|X_i(t), X_j(t)\right\|_2 \qquad (10)$$

$$\text{G(t)} = (G_0, t)\,,\ \ \text{G(t)} = G_0\, e^{-\alpha\frac{iter}{maxiter}} \qquad (11)$$

where a is the descending coefficient, G_0 is the initial gravitational constant, iter is the current iteration, and max-iter is the maximum number of iterations.
To ensure the stochastic characteristic of the GSA, it is expected that the total force that acts on the i_{th} agent in the d_{th} dimension be α randomly weighted sum of d_{th} components of the forces exerted from other agents given by following equation:

$$F_i^d(t) = \sum_{j\in kbest, j\neq i}^{N} rand_i\, F_{ij}^d(\text{t}) \qquad (12)$$

where $rand_i$ is a random number in the interval [0, 1]
According to the law of motion, the acceleration of an agent is proportional to the result force and inverse of its mass, so the acceleration of all agents should be calculated as follow:

$$ac_i^d(t) = \frac{F_i^d(t)}{M_i} \qquad (13)$$

where M_i is the inertial mass of the i^{th} agent. The next velocity and position of an agent is considered as fraction of its current velocity added to its acceleration i.e.

$$V_i^d(t+1) = rand_i \times v_i^d(t) + a_i^d(t) \qquad (14)$$

$$X_i^d(t+1) = x_i^d(\text{t}) + v_i^d(t+1) \qquad (15)$$

The GSA algorithm is composed of following steps [7] :

1. Search space identification.
2. Randomized initialization.
3. Fitness evaluation of agents.
4. Update $G(t)$,$best(t)$,$worst(t)$ and $M_i(t)$ for i=1,2,..N.
5. Calculation of the total force in different directions.
6. Calculation of acceleration and velocity.
7. Updating agents' position.
8. Repeat steps 3 to 7 until the stop criterion is reached.
9. End

Where G(t) is the gravitational constant, initialized at the beginning of the algorithm. The G(t) is decreased with time to control the search accuracy. The principle of GSA is shown below[13] :

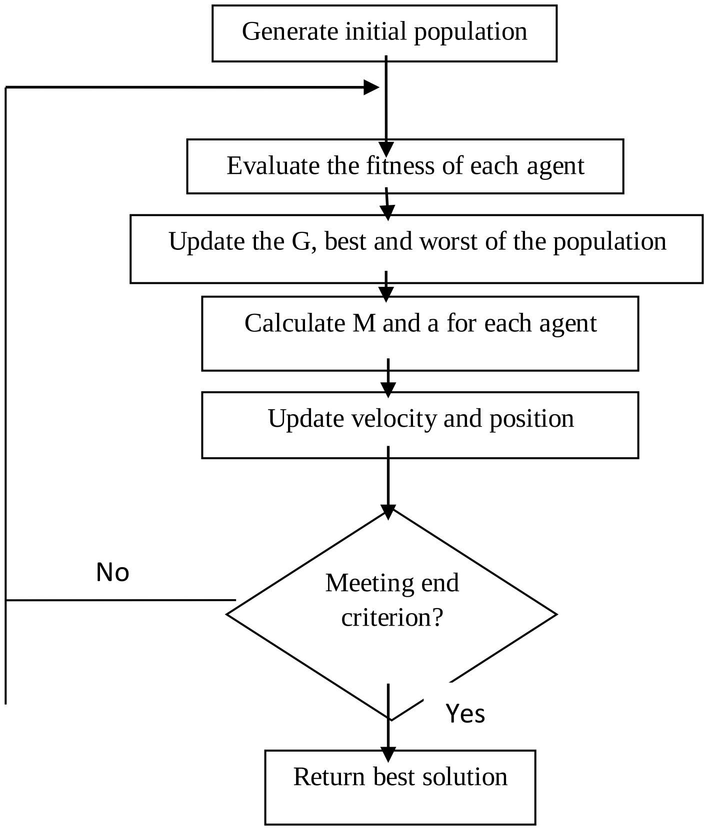

Fig.1: General principle of GSA

GSA versus PSO [13]:
In both GSA and PSO the optimization is obtained by agents' movement in the search space, however the movement strategy is different. Some important differences are as follows:

- In PSO the direction of an agent is calculated using only two best positions, pbest and gbest. But in GSA, the agent direction is calculated based on the overall force obtained by all other agents.
- In PSO, updating is performed without considering the quality of the solutions, and the fitness values are not important in the updating procedure while in GSA the force

is proportional to the fitness value and so the agents see the search space around themselves in the influence of force.

- PSO uses a kind of memory for updating the velocity (due to pbest and gbest). However, GSA is memory-less and only the current position of the agents plays a role in the updating procedure.
- In PSO, updating is performed without considering the distance between solutions while in GSA the force is reversely proportional to the distance between solutions.
- Finally, note that the search ideas of these algorithms are different. PSO simulates the social behavior of birds and GSA inspires by a physical phenomena.

C. PSOGSA Algorithm

PSO is an evolutionary computation technique which is proposed by Kennedy and Eberhart. The PSO was inspired from social behavior of bird flocking. It uses a number of particles (candidate solutions) which fly around in the search space to find best solution. Meanwhile, they all look at the best particle (best solution) in their paths. In other words, particles consider their own best solutions as well as the best solution has found so far. Each particle in PSO should consider the current position, the current velocity, the distance to *pbest*, and the distance to *gbest* to modify its position. PSO was mathematically modelled as follow:

$$v_i^{t+1} = \mathrm{w}v_i^t + c_1 \times \mathrm{rand} \times (pbest_i - x_i^t) + c_2 \times \mathrm{rand} \times (\mathrm{gbest} - x_i^t) \quad (16)$$

$$x_i^{t+1} = x_i^t + v_i^{t+1} \quad (17)$$

Where v_i^t is the velocity of particle *i* at iteration *t*, *w* is a weighting function, c_i is a weighting factor, rand is random number between 0 and 1, x_i^t is the current position of particle *i* at iteration *t*, $pbest_i$ is the *pbest* of agent *i* at iteration *t*, and *gbest* is the best solution so far. The first part of (16), wv_i^t , provides exploration ability for PSO. The second and third parts, $c_1 \times$ rand × ($pbest_i$ - x_i^t) and , $c_2 \times$ rand × (gbest - x_i^t) represent private thinking and collaboration of particles respectively. The PSO starts with randomly placing the particles in a problem space. In each iteration, the velocities of particles are calculated using (16). After defining the velocities, the position of masses can be calculated as (17). The process of changing particles' position will continue until meeting an end criterion.

VI. MODIFIED PSOGSA ALGORITHM

The main idea of this paper is to modify the respective algorithm for the betterment and ease in the various applications. The modification done in the PSOGSA algorithm is that the results are made according to the probability of an image in the image edge detection.

Researchers can use this modified algorithm in the various other applications in future with any adjustment or transformation as per requirement. As the results shown in this paper are satisfactory in this application compared to the basic PSOGSA algorithm. The fitness function of basic PSOGSA is modified to achieve the goal for the results. This algorithm can be used for the various file formats like jpg, png, bmp, etc.

The basic idea of PSOGSA is to combine the ability of social thinking (*gbest*) in PSO with the local search capability of GSA. In order to combine these algorithms, (18) is proposed as follow:

$$V_i(t+1) = w \times V_i(t) + c_1{}' \times rand \times ac_i(t) + c_2' \times rand \times (\mathrm{gbest}\text{-}X_i(t)) \quad (18)$$

Where $V_i(t)$ is the velocity of agent *i* at iteration *t*, c_j' is a weighting factor, *w* is a weighting function, rand is a random number between 0 and 1, a$c_i(t)$ is the acceleration of agent *i* at iteration *t*, and g*best* is the best solution so far. In each iteration, the positions of particles are updated as follow:

$$X_i(t+1) = X_i(t) + V_i(t+1) \quad (19)$$

In PSOGSA, at first, all agents are randomly initialized. Each agent is considered as a candidate solution. After initialization, Gravitational force, gravitational constant, and resultant forces among agents are calculated respectively. After that, the accelerations of particles are defined . In each iteration, the best solution so far should be updated. After calculating the accelerations and with updating the best solution so far, the velocities of all agents can be calculated . Finally, the positions of agents are defined. The process of updating velocities and positions will be stopped by meeting an end criterion.

- *FITNESS FUNCTION*

The main idea in the anticipated approach is to optimize the interest by doing modification in it. The proposed method has been made on the basis of probability. Thus the main parameter of this method is fitness function. The image fitness has been modified to achieve the goal. The probability has been added in the fitness function and the resultant image fitness has been calculated on the basis of probability in an image edge detection. The results are shown in the next section of the probability based image edge detection by using modified PSOGSA algorithm.

VII. RESULTS

The different images from the different formats and colours are taken as an input images for an image edge detection by using modified particle swarm optimization and gravitational search algorithm .The difference can be calculated between the basic PSOGSA algorithm and the modified PSOGSA algorithm as the results have improved the drawback of the basic PSOGSA algorithm and gives the satisfactory results. The resultant images by using modified PGOGSA algorithm for image edge detection are shown below:

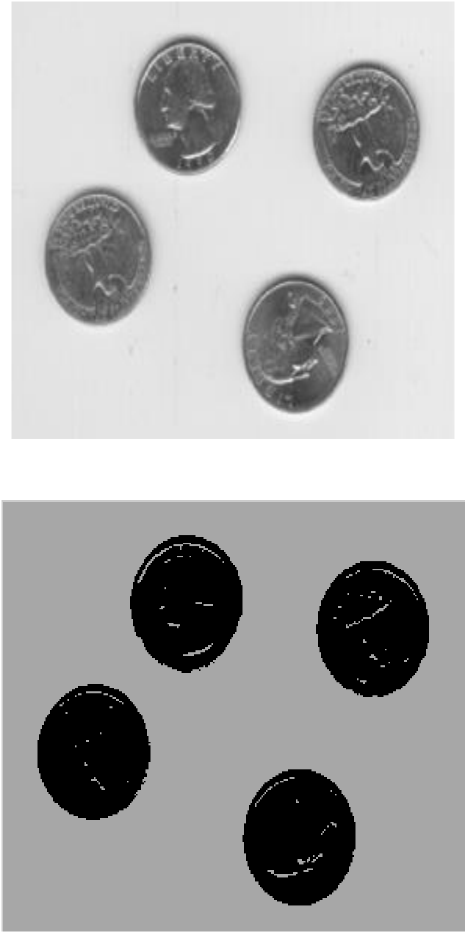

Fig.2: An input image in .png file format and its resultant output in image edge detection.

Fig.3: An input image in .bmp file format and its resultant output image in image edge detection.

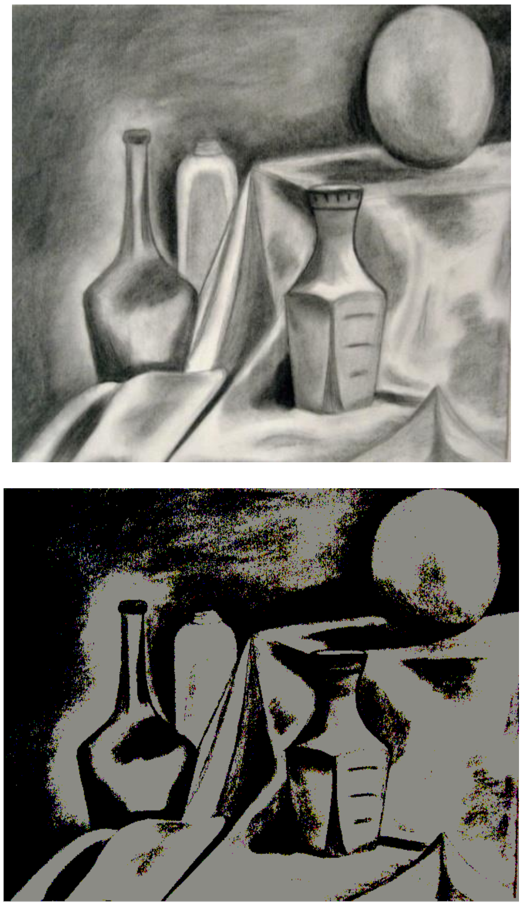

Fig.4: An input image in .jpg file format and its resultant output image.

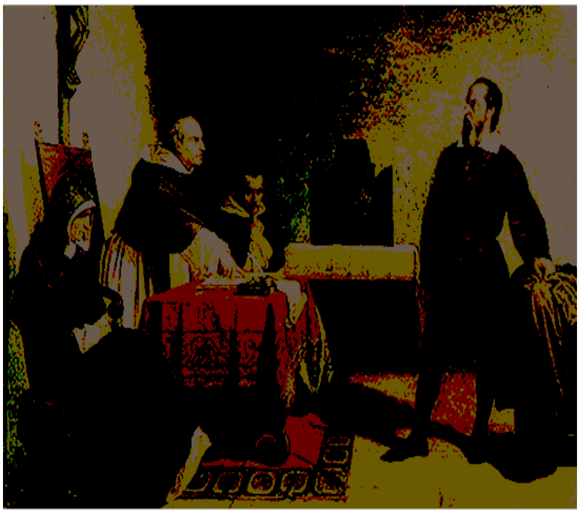

Fig.5: A coloured input image in .jpg file format and its respective image edge detection output.

Fig.6: A coloured input image in .jpg file format and its output in image edge detection.

The results of the images are shown in tabular form are given below respectively.

Table1: Results of the both black and white and coloured images in different formats respectively.

INPUT IMAGES	IMAGE INTENSITY	IMAGE FITNESS	TIME ELAPSED (sec)
Fig.2	167 167 167	1.0e+03* 2.6013 2.6013 2.6013	5.840700
Fig.3	104	1.2247e+03	2.217867
Fig.4	139 139 133	1.0e+03* 1.5878 1.4316 1.4367	6.088445
Fig.5	106 90 77	1.0e+03* 2.8151 2.0962 1.3524	5.885681
Fig.6	80 65 56	1.0e+03* 2.2273 1.1632 0.8299	5.806657

VIII. CONCLUSION

This paper has shown the satisfactory results in image processing by modifying an algorithm. The probability based image edge detection by using modified PSOGSA algorithm has shown the satisfactory results in both the coloured and black and white images in the different file formats like .jpg, .png , .bmp etc. The respective results of the applied algorithm are also shown with the respective output values of the image intensity, fitness function and time elapsed. The main area of work in this paper is the fitness function which has been modified for the proposed method. The future work can be done on this algorithm by using in the different applications for the better results of that application by doing changes according to the requirement.

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