International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 03 Issue: 05 | May-2016 www.irjet.net p-ISSN: 2395-0072

Trilateral filter based Enhanced Exudate Segmentation in fundus images

Gazal[1], Anil Kumar[2]

[1]*Research Scholar, Dept. of C.E.T., G.N.D.U., Amritsar, INDIA*
[2]*Assistant Professor, Dept. of C.E.T., G.N.D.U., Amritsar, INDIA*

Abstract - This Diabetic retinopathy poses a heavy threat to vision. Digital colour structure images can be used for distinguishing the eye structure. They produce a high-quality record of the structured image which is useful for detecting DR as primitive signs. Exudates are considered one in every of the earliest signs of DR. Different filters and particle swarm optimization approach is used for segmenting exudated images. A brand new integrated approach is employed which mixes filtering with particle swarm optimization to sight exudates in structure pictures and data parallelism to pump up the speed for getting better outcomes using various approaches, moreover a membranel Vessel segmentation algorithmic program is additionally used that uses a texton to differentiate vessel and non-vessel pixels and so that the matched filter that has been widely employed in the detection of blood from the retinal image. Particle swarm optimization also helps in achieving improved accuracy of retina vessel segmentation.

Key Words: Fundus image; exudate segmentation; particle swarm optimization; trilateral filter

1. INTRODUCTION

Diabetic retinopathy poses a significant threat to vision. DR is estimated to be most frequent reason of vision defect from adults to aged people.

With adequate screening and treatment vision defect owing to DR may be prevented. Patients with diabetes while not proof of DR will have their eyes examined each two years. Patients at high risk need an annual eye examination.

Treatment includes intensive management of diabetes, laser, intravitreal medication delivery, and surgery. It ought to be noted that retinopathy isn't the sole visually threatening aspect of diabetic ocular disease. People with DM even have exaggerated risk of cataracts and bone neuropathies, which may result in visual blurring or diplopic, severally.

The perfect methodology regarding preventing DR is photographic camera color building images. They make a high-quality record inside structure regarding detection DR early signs and remark its improvement. Exudates are generally one amongst the earliest signs of DR. They disclose exaggerated motorboat porousness as they are plasma lipid as well as protein accumulations on the tissue level. In building pictures, exudates appear as vivid yellow–white dots combined with sharp edges. the concerns in effectively detection exudates within just structure photos are noises, Presence, reduced distinction, sloping illumination, as well as color alternative. Many approaches are planned within the literature in order to section this sort of lesion from color construction images. A retinal Vessel segmentation algorithmic program that uses a texton to classify vessel/non-vessel pixels is additionally useful for identification of exudates. The matched filter that has been wide utilized in the detection of blood vessels of the human tissue layer digital image is exaggerated by Gabor filter parameters.

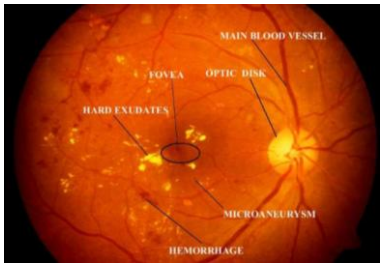

Fig -1: Different parts of an exudate image

2. IMAGE SEGMENTATION TECHNIQUES

a. Region based

That divides an image into completely different regions recognized pre-defined conditions, electronic, color, power, or subject. Region based segmentation tactics are grouped into 3 main classes, electronic., region rising, region breaking, and spot merging. Region growing could be a procedure [4] that will group's pixels in whole image in to sub locations or greater regions recognized predefined qualifying criterion. In spot merging and also rending end user will divide an image

into an accumulation arbitrary unconnected locations so assimilate the locations [1] inside a trial in order to meet the circumstances of very affordable image segmentation.

b. Edge based

Edge detection might be considered as a simple step for image segmentation strategy. It divides an image graphic into object and its background. Edge research divides your current image by simply analyzing your current modification in intensity in addition to pixels of the picture. Gray histogram in addition to Gradient are usually two main means of edge research of picture segmentation.Edge based mostly techniques, on the opposite hand, will considerably scale back useless info whereas protective the necessary structural properties in a picture [1,3]

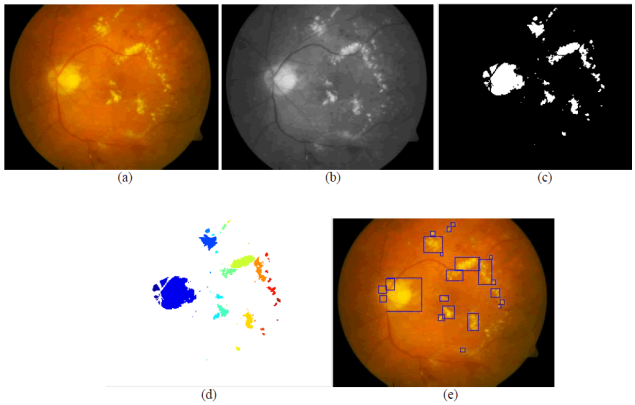

Fig -2: Segmented view of fundus image

d. Watershed transformation

The watershed remodel has fascinating properties that build it helpful for a lot of completely different image segmentation application. The watershed transformation may be a powerful tool for image segmentation supported mathematical morphology. A watershed transformation as a method to separating overlapping objects [1].

e. Histogram based

Histogram based strategies are terribly inexpensive when put alongside different graphic segmentation strategies because they normally need just one pass from your pixels. With this technique, a histogram will be computed from each of the pixels from the image, and then the peaks together with valleys from the histogram usually are accustomed find the clusters from the image [2].

3 LITERATURE SURVEY

Michael Stoll et al. [5] has talked about about recent developments in optical circulation estimation to increase the results of state-of-the-art variance methods through the use of additional filtering steps such as median filter systems, bilateral filter systems, and non-local techniques. Thus both applications to sole flow domains as well as the filtering of the complete spatial-temporal flow amount has been considered. The consumption of the joint trilateral filtration system is performed that functions all flow areas together while imposing persistence of joint move structures at exactly the same time.

K.S. Sreejini et al. [9] has referred to about the idea of matched filtration which is trusted in the region of retina vessel segmentation. Multiscale matched up filter systems have superior performance over sole scale filters. A better noises suppression feature of multiscale filtration systems has been used. A significant performance concern is the dedication of the right parameter worth of the filtration system that particle swarm marketing can be used for locating the optimal filter variables of the multiscale Gaussian matched up filter for reaching improved correctness of retina vessel segmentation..

Chunming Yang et al. [8]has mentioned in regards to a new particle swarm search engine optimization method (NPSO). It really is compared with the standard particle swarm optimizer (PSO) developed by Kennedy and Eberhart in 1995. PSO is encouraged by the communal behavior of microorganisms, such as parrot seafood and flocking schooling. Each particle studies its previous best answer to the optimization problem, and its own group's previous best, and then adjusts its position (solution) accordingly. The perfect value will be found by duplicating this technique. Inside the NPSO proposed here, each particle adjusts its position according to its previous worst solution and its own group's previous worst to get the optimal value. The strategy here's to avoid a particle's prior worst solution and its own group's previous most severe predicated on similar formulae of the standard PSO. Under all test conditions, simulation demonstrates the NPSO confirms better alternatives than PSO always.

Liu Ying-hui et al. [4] have presented a fresh edge-preserving nonlinear filtration for eliminating the mixture of Gaussian and impulse sound.. It smoothes image toward a sharply-bounded, gradient piecewise-linear approximation which gives more powerful noises decrease and better edge-limited smoothing behavior. Compared to almost every other spatial area nonlinear filtration systems, algorithm regularly produces great results in getting rid of the mixture of Gaussian and impulse noises and more noteworthy edge-

limited smoothing behavior. Just like the trilateral filter, the algorithm can extend to N-dimensional signals.

Anita Tandan et al.[14] has talked about Digital Image division which is one of the significant assignments in advanced picture handling. It is the procedure of subdividing an advanced picture into its constituent items. PSO is one of the most recent and rising advanced picture division systems motivated from the nature. Distinctive PSO based strategies are utilized to hunt group focus in the subjective information set consequently with no info learning about the quantity of normally happening areas in the information, and their applications to image segmentation.

Zahra Beheshti et al. [10] has examined about, Particle Swarm Optimization (PSO) which is a bio-enlivened enhancement calculation that has been observationally shown to perform well on numerous advancement issues. The calculation can undoubtedly get caught in the nearby optima and has moderate union rate. In this way, change and/or disposal of these hindrances are the most vital target in PSO research Median-arranged Particle Swarm Optimization (MPSO) is utilized to complete a worldwide hunt over whole inquiry space with quickening meeting speed and staying away from neighborhood optima. The middle position of particles and the most exceedingly awful and middle wellness estimations of the swarm are fused in the standard PSO to accomplish the objectives.

Hui Wang et al. [13] has examined about Particle swarm enhancement (PSO) which has demonstrated a compelling execution for fathoming variation benchmark and genuine streamlining issues. A half breed PSO calculation, called DNSPSO is utilized which utilizes a differing qualities improving system and neighborhood seek procedures to accomplish an exchange off amongst investigation and misuse capacities.

Fahd M. A. Mohsen et al.[12] have depicted another multilevel thresholding technique fragmenting pictures in light of molecule swarm advancement (PSO). In this technique, the thresholding issue is dealt with as an enhancement issue, and unraveled by utilizing the standard of PSO. The calculation of PSO is utilized to locate the best estimations of edges that can give us a fitting parcel for an objective picture as indicated by a wellness capacity. The new assessment capacity is utilized as a target capacity for the calculation of PSO in the proposed strategy. Since quantitative assessment capacities manage sectioned pictures as an arrangement of areas, the objective picture is separated into an arrangement of locales and not to an arrangement of classes amid the distinctive phases of our technique.

4 PROPOSED METHODOLOGY

PROCEDURE OF BASIC PSO

PSO has a place with the class of swarm insight methods [11]that are utilized to take care of streamlining issues. PSO mimics the practices of winged creature rushing. Implies, a gathering of winged animals are arbitrarily looking nourishment in a territory. There is one and only bit of nourishment in the zone being looked. All the winged creatures don't know where the sustenance is. In any case, they know how far the nourishment is in every cycle. So the most ideal approach to discover the nourishment is to take after the flying creature which is closest to the sustenance. Rushing conduct is the conduct displayed when a gathering of winged animals, called a herd, are scavenging. Every molecule in PSO is redesigned by taking after two "best" values:pbest- Each particle keeps track of its coordinates in the solution space which are associated with the best solution (fitness) that has achieved so far by that particle. This value is called personal best, pbest.

gbest- It is tracked by the PSO is the best value obtained so far by any particle in the neighborhood of that particle. This value is called Global Best, gbest. Each particle tries to modify its position using:

- the current positions,
- the current velocities,
- the distance between the current position and pbest,
- the distance between the current position and the gbest.

After finding the two best values, the particle updates its velocity and positions with following equations

Where;

$V[\,] = v[\,] + c1 * rand[\,]$ *(pbest[ ]-ppresent[ )+(2*rand( )*(gbest[ ]-ppresent[ ]) (1)

$presnt() = present[\,] + V[\,]$ (2)

V[ ] is the particle velocity, present[ ] is the current particle (solution);rand ( ) is a random number between (0; 1).
c1; c2 are learning factors. usually c1 = c2 = 2.

Pseudo code for PSO algorithm

I) For each particle:

Initializeparticle

II) Do:

a) For each particle:

1) Calculate fitness value

2) If the fitness value is better than the best fitness value (pBest) in all the previous values.

3) Set current value as the new pBest

End

b)For each particle:

1) Find the neighbourhood of the particle with the best fitness value

2) Calculate particle velocity according to the velocity equation (1)

3) Apply the velocity constriction

4) Update particle position according to the position equation (2)

5) Apply the position constriction

End

While maximum iterations or minimum error criteria is not attained.

Algorithm flow

Input variables:

P,G, , C_1, C_2, V_{max}, R

Output variables:

P*

Begin

1. Initialize population at s = 0;

$B[0] \sim U[P_{min}; P_{max}]$

$b_p^{best}[0] = b_p[0]$ *and* $b_g^{best}[0] = P_{max};$

$V_p[0] = 0;$ *initial velocity is set to null.*

2. *while s :*

a. $Q(b_p[s]), \forall b_p[t] \in E$

b. *update velocity* $V_p[s] p = 1 \ldots\ldots$

c. *now we need to update the best possible positi*

for $p = 1 \ldots\ldots P$

if $Q(b_p[t]) < Q(b_p^{best}[s])$ *and* $R_p(s) \geq R_{min}$

$b_p^{best}[s+1] \leftarrow b_p[s]$

else $b_p^{best}[s+1] \leftarrow b_p^{best}[s]$

end

if $\exists b_p[s] : [Q(b_p[s]) < Q(b_g^{best}[s])]$ *and* $R_p(s) > R_{min}$ *and*

$b_g^{best}[s+1] \leftarrow b_p[s]$

else $b_g^{best}[s+1] \leftarrow b_g^{best}[s]$

d. A new swarm population is being evolved

$B[s]$

e. *set* $S = s$

End

3. $p *= b_g^{best}$

End.

Where P is the population size = (1..... .....p)Particle population matrix is the maximum no of swarm iterations, P_i is the maximum power vector considerations, R is the minimum data rate common to all users.

Flow with concept of image segmentation

Step 1: Read the information picture to be fragmented.

Step 2: Select PSO strategy to be connected on that Picture with a specific limit level.

Step 3: for every particle in the population do redesign particle's wellness in the hunt space and overhaul molecule's best in the pursuit space move patticle in the population

Step 4: for every particle improve then compensate the swarm generate the molecule: develop the swarm life

Step5: for every particle do if swarm is not enhancing its execution then rebuff swarm: erase the swarm: or diminish the swarm life.

Step 6: Extend the swarm to generate (the swarm is considered for next cycle)

Step 7: Delete the fizzled swarms. (the swarm will never come into hunt space) and Reset edge counter.

5 Joint trilateral filter (JTF)

Joint trilateral channel is a blend of two-sided channel and trilateral channel. The bilateral sifting smoothes pictures while safeguarding edges, by method for a nonlinear blend of adjacent picture values[15]. This strategy is non-iterative, nearby, and basic. The customary reciprocal channel at the same time weights pixels in light of spatial separation from the middle pixel and in addition separation in tone. The area channel weights pixels in light of their separation from inside. $p(i-j) = \frac{1}{2} e^{-\frac{(i-j)(i-j)}{2x^2}}$

Where i and j denotes the spatial positions.

The bilateral filter can be written as:-

$$\frac{\int H^b F(j) p(i-j) q(F(i)-F(j)) dj}{\int H^b F(i-j) p(f(i)-f(j)) dj}$$

Bilateral separating has been connected in smooth pictures while safeguarding the edges. Be that as it may, to stay away from over smoothing structures of sizes similar to the picture resolutions, a limited spatial window has been utilized. This prompts the need of performing more cycle in the sifting procedure which is done utilizing trilateral channel.

$$\bar{F}(i) = \frac{1}{\delta(i)} \int_{\Omega} Q_{\sigma C}(j) Q_{\sigma d}(F(i-j)] - f(i) f(i-j) dj$$

Joint trilateral channel (JTF) is utilized to beat the slope inversion ancient rarities happening. The sifting Procedure of JTF is firstly done under the direction of the picture G which can be another reference picture or the information picture I itself. Give Ix and Gx a chance to be the force esteem at pixel p of the base channel picture and guided info picture, be the bit window focused at pixel p, to be steady with two-sided channel. JTF is then formulated by

$$\mathrm{JTF}(I)_x = \frac{1}{\sum_{y \epsilon z_p} WJTF_{xy}(G)} \sum_{y \epsilon Z_p} WJTF_{xy}(G) I_y$$

Where the kernel weight function is written by

$$WGBTF_{xy}(G)$$

$$WJTF_{xy}(G) = \frac{1}{|W|^2} \sum_{K:(x,y) \epsilon Z_p} (1 + \frac{(G_{x-u_p})(G_{y-u_p})}{{\sigma_p}^2 + \varepsilon})$$

Where G_x and ${\sigma_p}^2$ are the mean and variance of the guided image G in a local window z_p.w is the number of pixels in the window.

6 Results and discussion

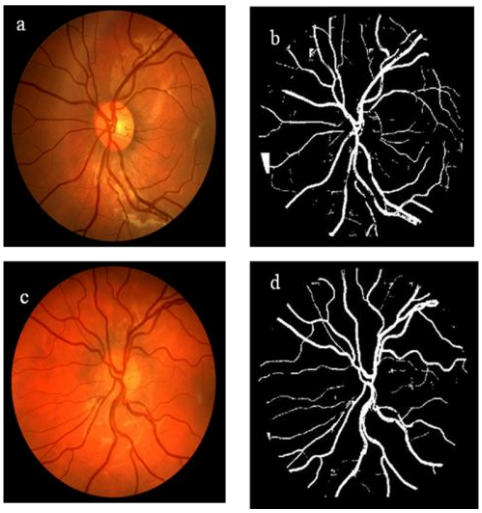

Fig -3: (a)(b) are the tester images of eye fundus image where (c)(d) are the output images after applying morphological operations.

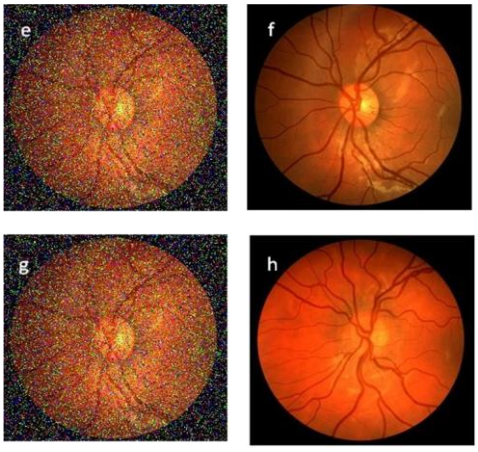

Fig -4: (e)(f) are the noisy images of the eye fundus and (f)(h) are the filtered images.

From the results being concluded figure 3(a)(c) specifies the tester image and the results after applying particle swarm

optimization is the morphological output image is figure 3(b)(d).Noise is being added to the figure 4(e)(g) and after applying joint trilateral filter we get the filtered image 4(f)(h).

7 PERFORMANCE ANALYSIS

Terms used for performance analysis-

$$SENSITIVITY = \frac{TP}{TP + FN}$$

WHERE TP IS TRUE POSITIVE, TN IS TRUE NEGATIVE, FN IS FALSE NEGATIVE ,FP IS FALSE POSITIVE.

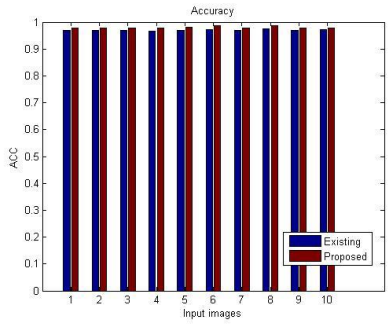

FIG -5: ACCURACY

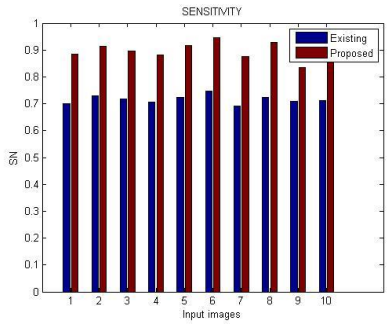

FIG -6: SENSITIVITY

Figure 5 shows the accuracy graph of the two approaches being compared. Accuracy of the proposed technique is higher than the existing technique.

Figure 6 shows the sensitivity graph of the two approaches being compared. Sensitivity of the proposed technique is higher than the existing technique.

a. Table for proposed values					
b. Input images	c. SN	d. SP	e. ACC	f. PPV	g. FDR
h. 1	i. 0.884	j. 0.9865	k. 0.9786	l. 0.8513	n. 0.1487
n. 2	o. 0.9152	p. 0.9829	q. 0.9780	r. 0.8094	s. 0.1906
t. 3	u. 0.8960	v. 0.9836	v. 0.9781	x. 0.7845	y. 0.2155
z. 4	a. 0.8820	b. 0.9858	c. 0.9777	d. 0.8399	e. 0.1600
f. 5	g. 0.9176	h. 0.9876	i. 0.9817	j. 0.8718	k. 0.1282
l. 6	n. 0.9446	n. 0.9898	o. 0.9862	p. 0.8885	q. 0.1150
r. 7	s. 0.8762	t. 0.9867	u. 0.9790	v. 0.8322	v. 0.1678
x. 8	y. 0.9295	z. 0.9900	a. 0.9859	o. 0.8731	c. 0.1269
d. 9	e. 0.8348	f. 0.9897	g. 0.9780	h. 0.8686	i. 0.1314
j. 10	k. 0.8818	l. 0.9824	n. 0.9775	n. 0.7278	o. 0.2722

p. Table for existing approach					
q. Input images	r. SN	s. SP	t. ACC	u. PPV	v. FDR
v. 1	x. 0.7016	y. 0.9844	z. 0.9701	a. 0.7052	o. 0.2948
c. 2	d. 0.7300	e. 0.9889	f. 0.9699	g. 0.8392	h. 0.1608
i. 3	j. 0.7184	k. 0.9852	l. 0.9685	n. 0.7637	n. 0.2365
o. 4	p. 0.7052	q. 0.9894	r. 0.9672	s. 0.8488	t. 0.1512
u. 5	v. 0.7230	v. 0.9916	x. 0.9689	y. 0.881	z. 0.1119
a. 6	o. 0.7484	c. 0.9921	d. 0.9728	e. 0.8902	f. 0.1098
g. 7	n. 0.6902	i. 0.9912	j. 0.9701	k. 0.8549	l. 0.1451
n. 8	n. 0.7225	o. 0.9927	p. 0.9741	q. 0.8789	r. 0.1211
s. 9	t. 0.7097	u. 0.9890	v. 0.9890	v. 0.9680	x. 0.8407
y. 10	z. 0.7130	a. 0.9859	o. 0.9721	c. 0.7290	d. 0.2710

3. CONCLUSIONS

Diabetic retinopathy is a leading health problem, which can cause blindness and is becoming common from the 12-75 aged grouped people. Exudates which are the foremost sign of DR can be segmented using PSO based technique which is a more efficient technique than ant colony optimization that possess low speed; which can be reduced by using data parallelism algorithm or parallel computing. We will use trilateral filter for processing exudates segmentation. PSO has slow speed; this issue can be reduced by using data parallelism algorithm or parallel computing. The existing technique has ignored the effect of noise therefore we will use trilateral filter for processing exudates segmentation. We can study fundus image segmentation using PSO based technique, which is used for removing high density noise.

REFERENCES

[1] Khan, W. (2013). Image Segmentation Techniques:" A Survey. Journal of Image and Graphics," 1(4), 166-170.

[2] Acharya, J., Gadhiya, S., &Raviya, K. (2013). "Segmentation techniques for image analysis: A review". International Journal of Computer Science and Management Research, 2(1), 1218-1221.

[3] Kaganami, H. G., &Beiji, Z. (2009, September). "Region-based segmentation versus edge detection. In Intelligent Information Hiding and Multimedia Signal Processing," 2009. IIH-MSP'09. Fifth International Conference on (pp. 1217-1221). IEEE.

[4] Edge new Xiaohan, Y., &Yla-Jaaski, J. (1991, June). "A new algorithm for image segmentation based on region growing and edge detection." In Proceeding IEEE International Symposium on Circuits & Systems (Vol. 1, pp. 516-519).

[5] Ying-hui, L., Kun, G., &Guo-qiang, N. (2010, May). "An improved trilateral filter for Gaussian and impulse noise removal. In Industrial Mechatronics and Automation (ICIMA)," 2010 2nd International Conference on (Vol. 2, pp. 385-388). IEEE

[6] Ali, S., Adal, K. M., Sidibé, D., Karnowski, T. P., Chaum, E., &Mériaudeau, F. (2013, September). "Exudate segmentation on retinal atlas space. InImage and Signal Processing and Analysis (ISPA)," 2013 8th International Symposium on (pp. 700-704). IEEE.

[7] Ma, L., Wang, K., & Zhang, D. (2009)." A universal texture segmentation and representation scheme based on ant colony optimization for iris image processing. Computers & Mathematics with Applications,"57(11), 1862-1868.

[8] Lin, Y. J., & Chang, H. H. (2015). "Automatic Noise Removal in MR Images Using Bilateral Filtering Associated with Artificial Neural Networks."

[9] Lei Zhang, Mark Fisher, Wenjia Wang, "Retinal vessel segmentation using multi-scale textons derived from keypoints, Computerized Medical Imaging and Graphics," Volume 45, October 2015, Pages 47-56, ISSN 0895-6111, http://dx.doi.org/10.1016/j.compmedimag.2015.07.006

[10] Beheshti, Z., Shamsuddin, S. M. H., & Hasan, S. (2013). "MPSO: Median-oriented Particle Swarm Optimization. Applied Mathematics and Computation," 219(11), 5817-5836

[11] Sedighizadeh, D., & Masehian, E. (2009)." Particle swarm optimization methods, taxonomy and applications. International Journal of Computer Theory and Engineering," 1(5), 486.

[12] Mohsen, F. M., Hadhoud, M. M., & Amin, K. (2011). "A new optimization-based image segmentation method by particle swarm optimization. International Journal of Advanced Computer Science and Applications, Special Issue on Image Processing and Analysis," 10-18.

[13] Wang, H., Sun, H., Li, C., Rahnamayan, S., & Pan, J. S. (2013). "Diversity enhanced particle swarm optimization with neighborhood search. Information Sciences," 223, 119-135.

[14] Tandan, A., Raja, R., & Chouhan, Y. (2014). "Image Segmentation Based on Particle Swarm Optimization Technique. International Journal of Science, Engineering and Technology Research (IJSETR)," 3(2).

[15] Serikawa, S., & Lu, H. (2014). "Underwater image dehazing using joint trilateral filter. Computers & Electrical Engineering, "40(1), 41-50.