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Object Recognition Using Artificial Fish Swarm Algorithm on Fourier Descriptors

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Abstract

In this paper, we present an Artificial Fish Swarm Algorithm is a class of an evolutionary optimization technique with three types of classifier combinations using different geometrics' shape for the recognition of the plant leaves. Fish Swarm Algorithm is applied on Fourier descriptors to get optimum weights that maximize the recognition rate. Fourier descriptors are invariant to rotation, translation or scaling. These optimum Fourier descriptors are then used in process of recognition. The obtained results achieve a recognition rate of 98.75% for Log of Euclidean Distance classifier. Results show that our proposed system advances object recognition with highly effective.

Keywords

Object Recognition, Artificial Fish Swarm Algorithm (AFSA), Fourier Transform and Classifier

1. Introduction

There are many research works in a wide range of applications from Computer vision and Image processing [1-3]. Very important research subjects in computer vision are detection and recognition of objects from their images. Industry, robotics, 2D and 3D object tracking and clustering and face recognition are employed in many applications of object recognition systems [4-7].

Optimization problem is a fundamental component of pattern recognition and artificial intelligence [8, 9]. An evolutionary computation technique has recently gained a lot of attention in object detection and recognition. Artificial Swarm Algorithms (ASA) that focuses on the decentralized collective behavior is based on the local and global information that shows the properties of self-organization [10, 11]. The basic properties of swarm intelligence systems are, Proximity Principle, Quality Principle, Principle of Diverse Response, Principle of Stability and Principle of Adaptability. ASA has become a core component in applications such as image recognition and image registration. Some examples are the particle swarm optimization (PSO) [12], an artificial swarm bee colony optimization algorithm [13], Genetic algorithm (GA) [14], an artificial Ant Colony Optimization (ACO) [15] and the cat swarm optimization (CSO) [16].

The descriptors can be divided into the three main categories: distribution based descriptors, filter based descriptors and other methods. The shape descriptors are categorized into two groups: contour-based and volume-based. The first descriptor group includes Fourier descriptor (FD), wavelet descriptors, curvature scale space and shape signatures [17, 18]. FDs Fourier transformation is a classic method for contour matching, characterization, shape description, shape classification and recognition of objects. FD represents the objects in a frequency domain and exploits only boundary information.

In this paper, we are using an Artificial Fish Swarm Algorithm (AFSA) on Fourier descriptors with different combinations, for object recognition. The fitness functions of the AFSA are to find the best descriptors that maximize the recognition rate and minimize the number of descriptors. The paper is organized as follows. In Section 2, describes the framework of the proposed system. Section 3, the preprocessing techniques are briefly described. Section 4, presents a brief concept of the Fourier transform. Section 5, proposes the use of the Artificial Fish Swarm Algorithm

(AFSA) in object recognition. In Section 6 a brief overview of Similarity Measures is presented. Section 6 studies the results for object recognition and discussion. Section 7, concludes the paper.

2. The Proposed System

The work methodology of this paper is illustrated in figure (1). Our proposed system starts with the decomposition of objects into entities that can be used for Boundaries detection and recognition by an Artificial Fish Swarm Algorithm (AFSA) and the Fourier transform.

3. Pre-processing

There are three types of image, binary image, grayscale image and true color image. The input image are initially converted to grayscale and then into binary images. In this paper, the shape description method in [19] is based on the boundary of the object.

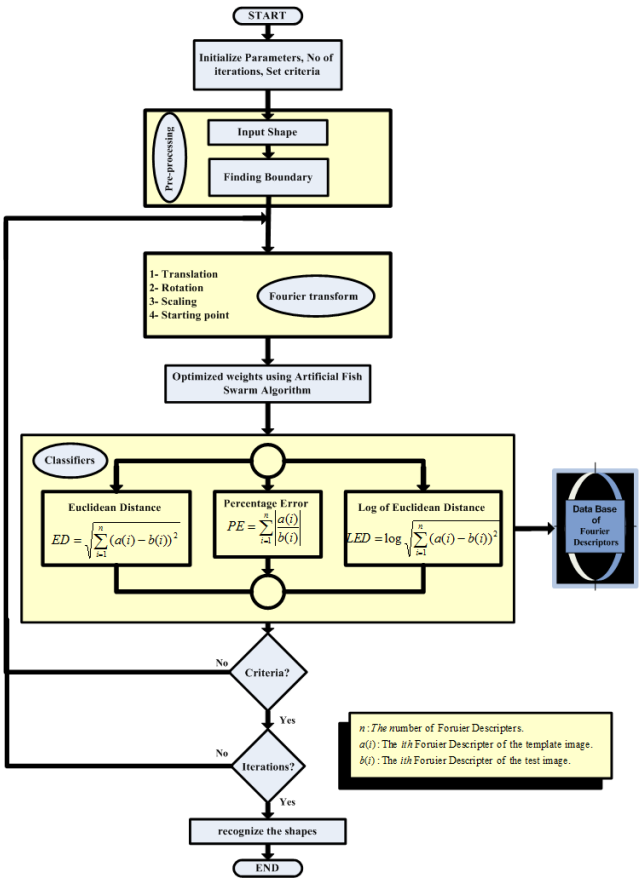


Figure (1). *The proposed system flowchart for Object Recognition.*

4. Fourier Transform

The image feature extraction methods are used in many different ways in objects recognition [20]. Objects are classified based on the shape features that are computed using the Fourier domain low frequency components denote the shape of the object (are used to derive shape descriptors). High frequency components denote finer features of the shape. Different Fourier transform invariants of shape signatures have been exploited to obtain Fourier descriptors (FDs). The useful set of features (FDs) is an efficient way to extract closed boundary information from the shape. The FDs is invariant to translation due to the translation invariance of the shape signature. The Fourier coefficients have to be properly normalized (take the magnitude of these normalized coefficients) to obtain a descriptor that is invariant with respect to the desired transformations (rotation, changes in scale and the starting point).

The evaluation of Fourier Descriptor is the criterion of the feature vector extraction process. Given a contour *c(l)* the n:th FD coefficient is given according to [21]:

$$f_n = \frac{1}{N}\int_{l=0}^{L} c(l)\exp\left(-\frac{2\pi i n l}{L}\right) dl \quad (1)$$

FD Invariance to translation, scale, rotation and index-shift can be obtained as follows:

Translation: *c(l)+T*

$$f_n^T = f_n + \frac{1}{N}\int_{l=0}^{L} T\exp\left(-\frac{2\pi i n l}{L}\right) dl \quad (2)$$

Scaling: *A c(l)*

$$f_n^A = \frac{A}{N}\int_{l=0}^{L} c(l)\exp\left(-\frac{2\pi i n l}{L}\right) dl = A\, f_n \quad (3)$$

Rotation: exp*(iØ)c(l)*

$$f_n^{\emptyset} = \frac{A}{N}\int_{l=0}^{L} c(l)\exp\left(-\frac{2\pi i n l}{L}\right) dl = \exp(i\emptyset)\, f_n \quad (4)$$

Starting point: *c(l)+Δl*

$$f_n^{\Delta l} = \frac{1}{N}\int_{l=0}^{L} c(l+\Delta l)\exp\left(-\frac{2\pi i n l}{L}\right) dl = \exp\left(\frac{2\pi i n \Delta l}{L}\right) f_n \quad (5)$$

5. Artificial Fish Swarm Algorithm (AFSA)

In recent years, a number of artificial swarm algorithms have been proposed and studies for object recognition. For example, Genetic Algorithm (GA), Ant Colony Optimization (ACO), Bee Colony Algorithm (BCA), Cat Swarm Optimization (CSO) and Particle Swarm Optimization (PSO). In this paper the Artificial Fish Swarm Algorithm (AFSA) was implemented in Matlab 7.1 (simulator). The fitness functions of the AFSA to find the best descriptors that maximize the recognition rate and minimize the number of descriptors. The Artificial Fish Swarm Algorithm is used to find the fitness function aims to obtain optimal descriptors to perform reliable object recognition.

In the AFSA, a set of fish and behavior in four different behavior kinds: prey behavior (PB), swarm behavior (SB), follow behavior (FB) and random behavior (RB) are used for searching the global optimum. The figure bellow explains the principle of AFSA [22, 23]:

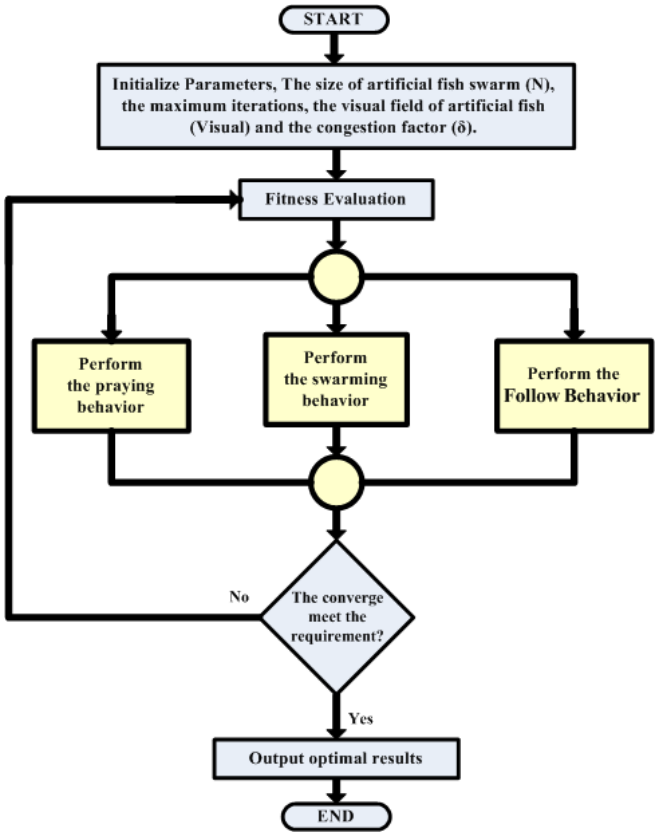


Figure (2). *(a) Flowchart of Artificial Fish Swarm Algorithm.*

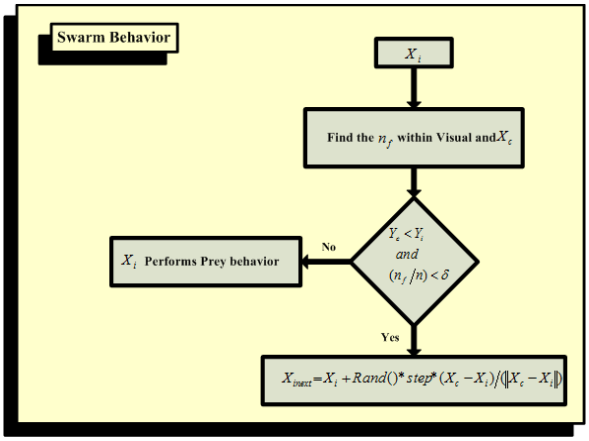


Figure (2). *(b) Flowchart of PB Artificial Fish Swarm Algorithm.*

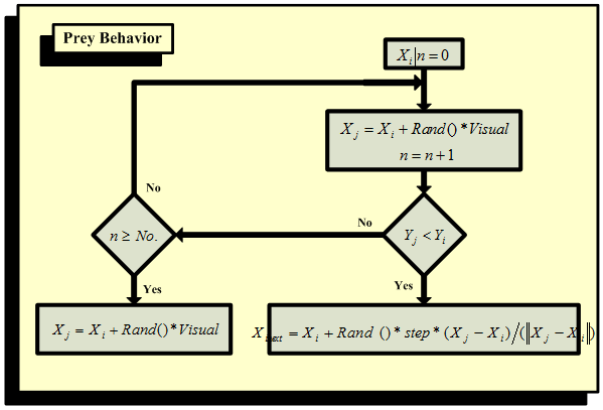


Figure (2). *(c) Flowchart of SB Artificial Fish Swarm Algorithm.*

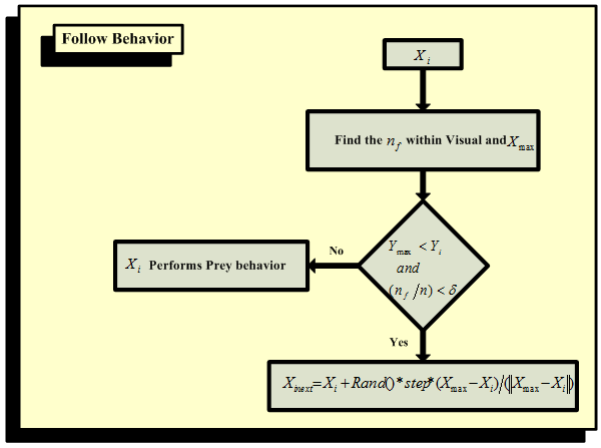


Figure (2). *(d) Flowchart of FB Artificial Fish Swarm Algorithm.*

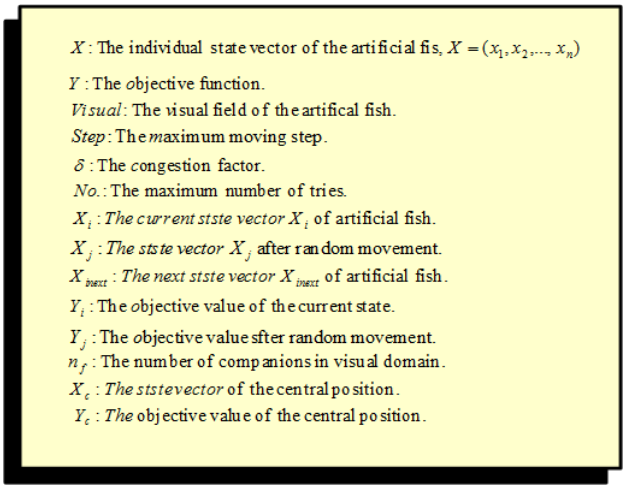


Figure (2). *(e) The Artificial Fish Swarm Algorithm parameters.*

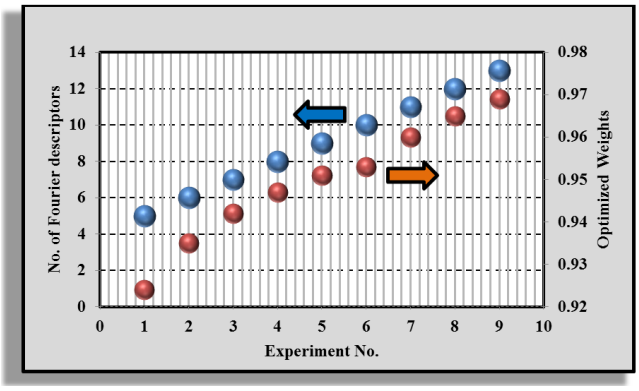


Figure (3). *Optimized descriptor weights for different numbers experiments.*

6. Classifier

Object recognition has been used in the recent years in order to find of a set of objects based on similarity measures of the corresponding Fourier descriptors of the input testing shape and each of the shapes stores in our database. In this paper the classifiers can be implemented in three different ways: (1) Euclidean Distance (ED), (2) Log of Euclidean Distance (LED), and (3) Percentage Error (PE) as shown in Figure (1).

7. Results and Discussion

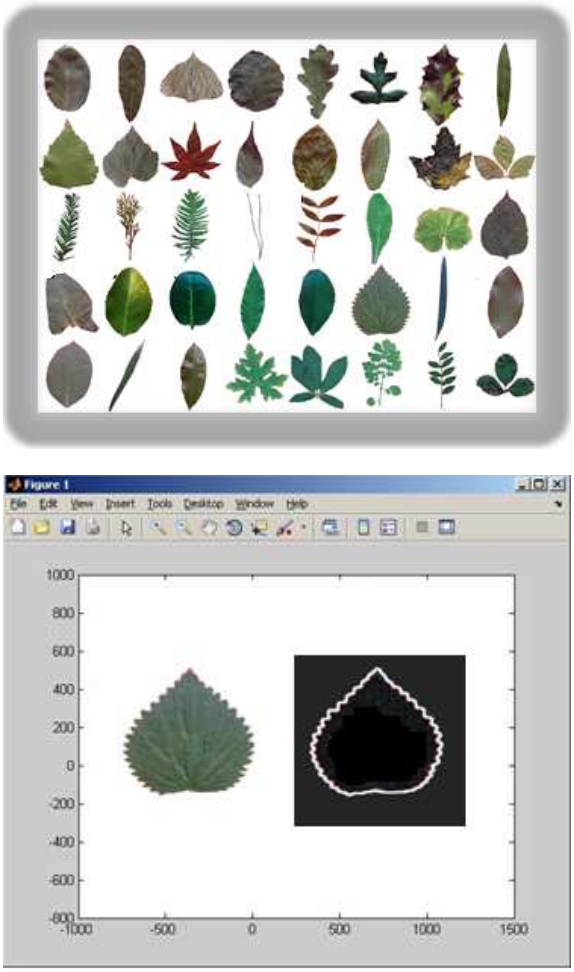
The results for the object descriptors using the Artificial Fish Swarm Algorithm (AFSA) are given in Figure (3) below.

In the graph in Figure (3) we have summarized the results by plotting the optimized descriptor weights for different numbers experiments and Fourier descriptors using Artificial Fish Swarm Algorithm with the specific parameters that applied to the descriptors during testing. In this paper, nine experiment numbers and a database of 100 transformed objects have been used. The AFSA parameters are listed in Table 1.

Table (1). *AFSA Parameters.*

Parameter	Value
Size of artificial fish swarm	150
Number of maximum iterations	150
Perception scope *Visual*	3
Step	1
The congestion factor	1.5

Figure (4) shows the different types of images that are presented in the data base and the test object image (plant leaf) used for the proposed system.



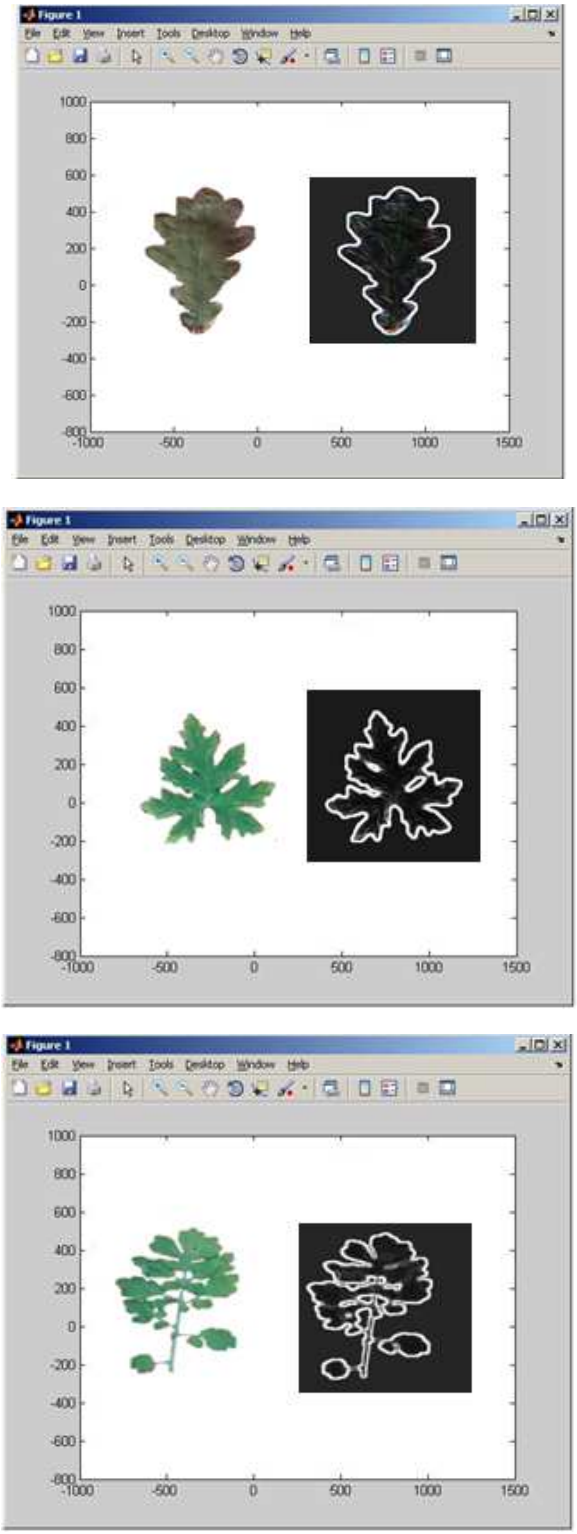


Figure (4). *Data base and tested Leaf of the different types.*

The results obtained (Recognition Rate) from the optimized descriptor weights with AFSA are illustrated in Figure (5) based on the different type of classifiers, Euclidean Distance (ED), Log of Euclidean Distance (LED), and Percentage Error (PE). Figures (5) show the influence of the proposed system parameters to maximize the rate of recognition and minimize the number of Fourier descriptors.

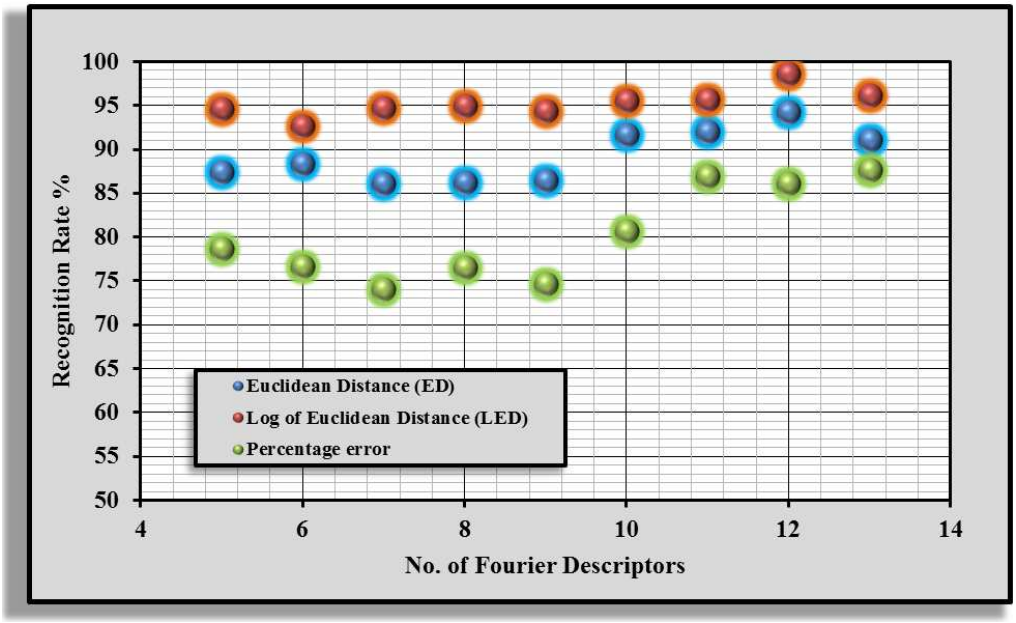


Figure (5). *The influence of the proposed system parameters on Recognition rates based on the different type of classifiers.*

A figure (5) presents the recognition rates of the testing results comparison among the three different classifiers using AFSA. Tests have been performed using 9 experiment numbers with100 images used for database and 25 images used for testing. These graphs show the recognition rate behavior was universal. In order to validate the proposed system, we compared the recognition rates values for different classifiers type. The result shows that, the highest recognition rate is 94.25%, 98.75%, 87.61% and the lowest recognition rate is 86.45%, 92.66%, 74.05%, for ED, LED and PE classifiers, respectively. The best results are obtained with combination of AFSA, second-type classifier (Log of Euclidean Distance) and optimum weights for Fourier descriptors. However, the recognition rates are be closer to ninety nine percent; using more than 10 Fourier descriptors. This shows us that even though our proposed system is sufficient for object recognition.

8. Conclusion

The proposed system based on the Artificial Fish Swarm Algorithm (AFSA) algorithm on Fourier descriptors with different combinations, has been implemented and successfully applied to solve object recognition problems. AFSA is used for the optimization of these Fourier descriptors weights. We estimate that the rate of recognition 98.75% for Log of Euclidean Distance classifier is probably the highest performance than other classifiers. The obtained results have illustrated that the proposed system is feasible and highly effective. In the future, our research group plans to compare the proposed system with other competing evolutionary algorithms.

References

[1] P. Azad, T. Gockel, and R. Dillmann. Computer Vision - Principles and Practice. Elektor International Media BV, 2008.

[2] D. A. Forsyth and J. Ponce. Computer Vision: A Modern Approach. Prentice Hall, US ed edition, August 2002.

[3] S. M. Smith and J. M. Brady. Susan—a new approach to low level image processing. Int. J. Comput. Vision, 23(1):45–78, 1997.

[4] SERBY, D., KOLLER-MEIER, S., AND GOOL, L. V. 2004. Probabilistic object tracking using multiple features. In IEEE International Conference of Pattern Recognition (ICPR). 184–187.

[5] P. J. Phillips, P. J. Flynn, T. Scruggs, K. W. Bowyer, J. Chang, K. Hoffman, J. Marques, J. Min, and W. Worek, "Overview of the Face Recognition Grand Challenge," Proc. Computer Vision and Pattern Recognition Conference, San Diego, 2005.

[6] BREGLER, C., HERTZMANN, A., AND BIERMANN, H. 2000. Recovering nonrigid 3d shape from image streams. In IEEE Conference on Computer Vision and Pattern Recognition (CVPR). 690–696.

[7] LIYUAN, L. AND MAYLOR, L. 2002. Integrating intensity and texture differences for robust change detection. IEEE Trans. Image Process. 11, 2, 105–112.

[8] Hutter, Marcus (2005). Universal Artificial Intelligence. Berlin: Springer. ISBN 978-3-540-22139-5.

[9] Luger, George; Stubblefield, William (2004). Artificial Intelligence: Structures and Strategies for Complex Problem Solving (5th ed.). Benjamin/Cummings. ISBN 0-8053-4780-1.

[10] Zhuang X., Mastorakis N. E., "Image processing with the artificial swarm intelligence", in WSEAS Transactions on Computers, Issue 4, Vol.4, pp. 333-341, ISSN 1109-2750, April 2005.

[11] Bonabeau, E., Dorigo, M., Theraulaz, G., Swarm intelligence: from natural to artificial systems, Santa Fe Institute in the Sciences of Complexity, Oxford Univ. Press, Oxford, 1999.

[12] H. A. Perlin, H. S. Lopes, and T. M. Centeno, Particle Swarm Optimization for Object Recognition in Computer Vision," New Frontiers in Applied Arti_cial Intelligence 5027, 11 (2008).

[13] Karaboga, Dervis (2010). "Artificial bee colony algorithm". Scholarpedia 5 (3): 6915.

[14] Srinivas. M and Patnaik. L, "Adaptive probabilities of crossover and mutation in genetic algorithms," IEEE Transactions on System, Man and Cybernetics, vol.24, no.4, pp.656–667, 1994.

[15] Ramos V., Almeida F.: Artificial Ant Colonies in Digital Image Habitats - A Mass Behaviour Effect Study on Pattern Recognition. In: Proc. ANTS 2000 - 2nd Int. Works. on Ant Algorithms (From Ant Colonies to Artificial Ants), 2000, pp. 113-124.

[16] Hamid Ali Abed AL-Asadi, Hussein Ali Al_Iedane and Nadra J. Ali AL-Saad, "Object recognition in Image using Hybrid (DRA-CSO) Architecture", International Journal of Engineering Research & Technology (IJERT), Vol. 4 Issue 02, 2015.

[17] ZHANG D S, LU G J. Shape-based image retrieval using generic Fourier descriptor [J]. Signal Processing: Image Communication, 2002, 17(10): 825−848.

[18] Kunyyui I, Lepisto L, Rauhamaa J, Visa A. Multiscale Fourier descriptors for defect image retrieval [J]. Pattern Recognition Letters, 2006, 27(2): 123−132.

[19] R. M. Haralick and L. G. Shapiro. Computer and Robot Vision. Addision-Wesley Longman Publishing, 1992.

[20] D. Lowe (2004). "Distinctive Image Features from Scale-Invariant Keypoints". International Journal of Computer Vision 60 (2): 91.

[21] Chen, S.: A new vision system and the Fourier descriptors method by group representations. In: IEEE CDC Conference, Las Vegas, USA (1985).

[22] Jiang M, Zhu K. Multiobjective Optimization by Artificial Fish Swarm Algorithm. IEEE Transactions. 2011.

[23] Fran, S.L.; Valder, S., Jr. Fish Swarm Optimization Algorithm Applied to Engineering system design. Lat. Am. J. Solids Struct. 2014, 11, 143–156.