

PARTIAL SHAPE FEATURE FUSION USING PSO-ACO HYBRID METHOD FOR CONTENT BASED IMAGE RETRIEVAL

KIRTI JAIN^{a1} AND SARITA SINGH BHADAURIA^b

^aDepartment Of Computer Science & Engg Dept., Lnct Bhopal, India

^bDepartment Of Electronics Dept., M.I.T.S. Gwalior, India

In this paper proposed novel method of partial feature fusion using PSO-ACO hybrid method for content based image retrieval. The partial feature fusion is combination of two or more partial feature extractor. For the combination of partial feature extractor used geometrical invariant function and some other function based on derivate of transform. The hybrid of PSO-ACO used for the process of feature fusion. The process of feature fusion act in two modes one is local mode and other is global mode. The local mode used ACO algorithm and in global mode used PSO algorithm. The local mode of feature selection set the fitness constraints for the selection of feature in two different feature extractor value of feature fusion. The global mode of features selection iterates the process of most common dominated feature equivalent to input image and precede the process of features fusion. The process of feature fusion incorporates with similarity measure and enhanced the capacity of content based image retrieval. For the validation and performance evaluations of proposed method used MALAB software and coral image dataset. The values of precision and recall are enhanced instead of individual partial feature based content based image retrieval.

KEYWORDS: CBIR, Fusion, Partial Feature, PSO, ACO, Fourier Descriptor

The current decade of multimedia data faced a problem of accurate search and retrieval. The diverse features of multimedia data required proper feature extraction and selection process. The partial shape feature is most dominated feature of digital multimedia data. In this paper proposed feature fusion based image retrieval technique. The partial shape features fusion is new approach for content based image retrieval [1,2,5]. The partial shape features used geometrical invariant function and other boundary and counter based method for extraction process. The mapping and matching of partial shape features is very difficult due to irregular behaviors and shape of image objects. For the better mapping and matching of partial features used fusion technique. The feature fusion technique estimate the correct feature set for the mapping and matching purpose for content based image retrieval. For the process of feature fusion used ACO-PSO hybrid swarm intelligence algorithm [22,23]. The ACO-PSO algorithm searches the most common feature of query image and database image and reduces the gap of retrieval. The combination of ACO-PSO work as local and global search space technique [19,20,21], in local search space the ACO algorithm is work and in global search space used particle swarm optimization. The fitness constraints of ACO set the condition of feature selection of the process of fusion. The fusion of feature used two well known features descriptor one is Fourier feature descriptor and other is partial feature descriptor. The Fourier feature descriptor finds the shape feature of image. The shape feature of image estimated in terms of scaling rotating and transformation. The other

feature descriptor is called partial feature extractor; this feature extractor used geometrical transform function for the extraction of features. The geometrical invariants functions estimate the shape features in terms of odd and even feature process of matrix. The rest of paper discuss as in section II. Discuss the Feature extraction process. In section III. Discuss futures fusion process. In section IV Experimental Result and finally discuss conclusion & future work in section V.

Feature Extraction

Feature extraction is primary stage of content based image retrieval. For the extraction of features various features descriptor is proposed by various authors such as color features descriptor, texture features descriptor and shape feature descriptor. In this paper used shape feature descriptor. The behaviors of shape feature are very complicated due to irregular shape of boundary and edges. For the extraction of shape features used geometrical transform function such as Fourier features descriptor [27,28]. In Fourier feature descriptor used Contour Fourier descriptor. The Contour Fourier features descriptor estimate all features component such as positive and negative. The other features descriptor is called the partial feature descriptor. The partial feature descriptor used the geometrical function for the estimation of features such as sine, cosine and tangent, the estimate feature calculated in terms of even and odd process. Both feature descriptors describe in flow chat process.

Fourier descriptors (FD)

The Fourier descriptor finds the shape of image. The processing of Fourier transform function generates the boundary value of image. The value of image represents in terms of lower component of frequency [11]. The Contour Fourier technique makes the Fourier change straightforwardly for the mind boggling coordinate capacity of the question limit. In this technique, the descriptors are taken both positive and negative recurrence hub. The scaling of the descriptors is made by separating the supreme estimations of the chose descriptors by the total estimation of the main non-zero part[13,14]

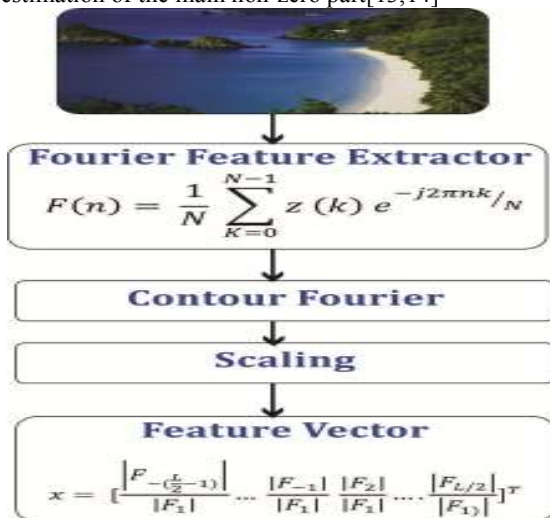


Figure 1 shows that the process of Fourier feature descriptor for the extraction of features.

Partial features descriptor (PF)

1. Partial feature extraction process.

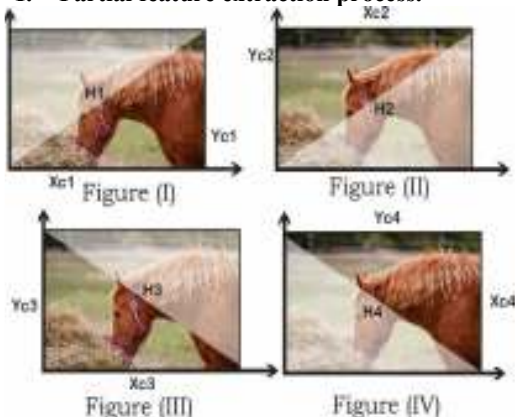


Figure 1, 2, 3 and 4 :Rectangle image and divide into two sections individually each image.

1: estimate the component value Xc and Yc[31,32]

X_{c1} and Y_{c1} from figure 1,

X_{c2} and Y_{c2} from figure 2

X_{c3} and Y_{c3} from figure 3

X_{c4} and Y_{c4} from figure 4 as

2: After getting a value of X_{c1}, Y_{c1}, X_{c2}, Y_{c2}, X_{c3}, Y_{c3}, X_{c4} and Y_{c4}

$$H1^2 = \sum_{i=1}^n \frac{Xi}{n} + \sum_{i=1}^n \frac{Yi}{n}$$

$$H2^2 = \sum_{i=1}^n \frac{Xi}{n} + \sum_{i=1}^n \frac{Yi}{n}$$

$$H3^2 = \sum_{i=1}^n \frac{Xi}{n} + \sum_{i=1}^n \frac{Yi}{n}$$

$$H4^2 = \sum_{i=1}^n \frac{Xi}{n} + \sum_{i=1}^n \frac{Yi}{n}$$

3: Calculate the value of H1, H2, H3 and H4 apply sine, cosine and tangent function for rectangle of boundary[31,32]

4: Sin = X_{c1} / H1 = X_{c2} / H2 = X_{c3} / H3 = X_{c4} / H4

Cosine = Y_{c1} / H1 = Y_{c2} / H2 = Y_{c3} / H3 = Y_{c4} / H4

Tangent = Y_{c1} / X_{c1} = Y_{c2} / X_{c2} = Y_{c3} / X_{c3} = Y_{c4} / X_{c4}

5: After getting of *sin, cosine* and *tangent*, find three consecutive matrix of shape features

6: the all value of feature creates partial features matrix.

Feature Fusion

The feature fusion process used hybrid swarm intelligence algorithm. The hybrid swarm intelligence algorithm is combination of ant colony optimization and particle of swarm optimization. The both swarm algorithm is memory based and gives better optimization results instead of other swarm based algorithm. The combination of swarm algorithm creates the dual search space for the fusion of feature. The fusion of feature process gives the most dominated feature of two different feature extractor. For the extraction of feature used two features descriptor one is Fourier feature descriptor and other is partial feature descriptor. The processing of ACO and PSO is combined in terms of local features set and global features set. The processing of features done by particle swarm optimization and the verification of constraints function done by ant colony optimization. The processing of ant colony optimization gives the value of Gbest and final fused features for the content based image retrieval. in this section discuss PSO, ACO and Fusion of ACO-PSO.

Ant colony optimization (ACO)

The ant colony optimization algorithm is proposed by Dorigo and scholar. The proposed algorithm inspired by the behavior of biological ants. The algorithm support the dynamic population based process[17]. The working principle of ant colony optimization is theory of continuity and shortest path

estimation. Ants are creepy crawlies which live respectively. Since they are visually impaired creatures, they find the most limited way from home to sustenance with the guide of pheromone. The pheromone is the concoction material kept by ants, which serves as basic correspondence media among ants, in this way directing the assurance of the following development. Then again, ants find the briefest way in view of power of pheromone saved on various ways. By and large, power of pheromone and the length of the way are utilized to reenact insect framework. The ant colony optimization used here for the selection of local features process during the fusion process.

Particle swarm optimization (PSO)

Particle swarm optimization algorithm inspired by the concept of bird’s fork. The property of bird’s fork is fly in the sky with constant and optimal velocity and cannot drop in ground. This biological property derived in from of algorithm. the particle swarm optimization work in two phase local phase and global phase. The local phase is called Pbest and the Global phase is called the Gbest. The value of optimization in local phase Pbest in set assigned to Global best Gbest[19]. The process of algorithm proceeds in terms of population and controlled iteration. The movement of each particle is coordinated by a velocity which has both magnitude and direction. Each particle position at any instance of time is influenced by its best position and the position of the best particle in a problem space. The performance of a particle is measured by a fitness value, which is problem specific.

ACO-PSO Feature Fusion

The following parameter is used for the process of features fusion methods, x_1, x_2, \dots, x_n is the features component of extracted feature of two features descriptor. W is the Wight factor for the sum of features, τ is the value of pheromones of ants, v_1 and v_2 is velocity of particle agents, c_1 and c_2 is constants value of particle. The process of fusion step given below.

Step1. Define the value of features set $S_1 \{x_1, x_2, \dots, x_n\}$ with population random population of PSO.

- a. Assign the velocity of particle $V_1=0, V_2=0$ and $W=0$

- b. Fitness constrains function for the selection of ants

$$F(x) = \frac{(Ffd - Fpf)}{Fd + fp} \cdot w \in S(x_1, x_2, \dots, x_n) \dots \dots \dots (1)$$

Here Ffd is fourier descriptor and Fpf is partial feature descriptor and w is set of feature component of sum sets

The selected features components set the value of ants $F = \{fa_1, \dots, an\}$. these ants value proceed for the estimation of local best, the local best function define as

$$Pbest = \begin{cases} (\tau_i)^\alpha (LI_i^{S_j})^\beta & \text{if } i \in S_j \\ \sum_{g \in S_j} (\tau_g)^\alpha (LI_g^{S_j})^\beta & \text{otherwise} \\ 0 & \text{otherwise} \end{cases} \quad (2)$$

Here τ_i is phenomenon value of ants and LI is value of least interface of ants.

Step2. The Pbest value set to Gbest

Input the feature fusion state of Gbest Value

- 1. Calculate the value of relative feature set in Gbest set

$$Rf = \frac{Lsi}{Wd} \quad \text{Here Lsi is interference value of ants and Wd is sum value of PSO space.}$$

- 2. The PSO space creates the fusion state for the processing of feature.

$$FS = \begin{cases} \frac{\max(FP) - F(S)}{\max_{i=1}^m(WS)} & \text{if } s_i \in f_j \\ 0 & \text{otherwise} \end{cases}$$

- (3) create the relative FS difference value

$$Rd = \sum_{fd=1}^n \sum_{pf=1}^m (x_i - f_j) \dots \dots \dots (4)$$

- 4. if the value of Rd is zero the feature fusion process is done.
- 5. Else the process of fusion goes into steps 2
- 6. .it features fusion state is empty the process of fusion is terminated.
- 7. Measure the similarity of features fusion state features P1 and P
- 8. $Sim = \sqrt{|P1 - P2|^2}$
- 9. If value of sim ~ 0
- 10. Image is retrieve

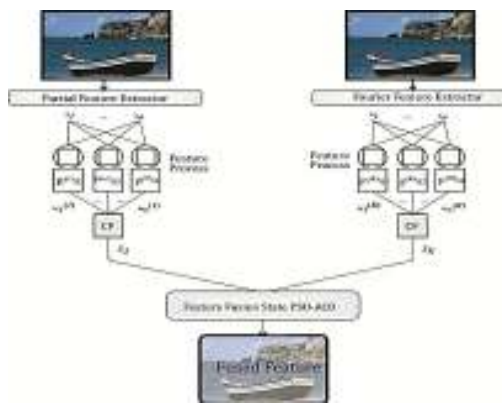


Figure 2: Process block diagram of features of fusion

SIMULATION AND RESULT ANALYSIS

For the validation and evaluation of proposed algorithm used MATLAB software. The hardware system configuration is coreI5 processor and 4GB ram. The coral image dataset contains 1000 image of different categories such as animal, house, river and many more objects. The all image format is jpeg and the dimension of image is 256*384. The format of image is jpg. The mode of image is RGB. Here used two standard parameter precision and recall[31,30]

$$\text{Precision} = \frac{\text{number of relevant images retrieved}}{\text{number of images retrieved}} \dots (1)$$

$$\text{Recall} = \frac{\text{number of relevant images retrieved}}{\text{number of relevant images in database}} \dots (2)$$



Figure 3: The above figure shows the input query and retrieval result image which is based on the top of Beach is query image and result of image shows in bottom by Fourier descriptors based image retrieval. This image shows the combine value of performance parameter such as precision and recall, the both parameters are calculated on the basis of their used algorithm/methods Fourier Descriptor based image retrieval with different for each respective input image. Here we find the value of precision is 0.43 and the value of recall is 0.11.



Figure4 : The above figure shows the input query and retrieval result image which is based on the top of Dinosaur is query image and result of image shows in bottom by Fourier descriptors based image retrieval. This image shows the combine value of performance parameter such as precision and recall, the both parameters are calculated on the basis of their used algorithm/methods Fourier Descriptor based image retrieval with different for each respective input image. Here we find the value of precision is 0.39 and the value of recall is 0.15.



Figure5 : The above figure shows the input query and retrieval result image which is based on the top of Hill is query image and result of image shows in bottom by Fourier descriptors based image retrieval. This image shows the combine value of performance parameter such as precision and recall, the both parameters are calculated on the basis of their used algorithm/methods Fourier Descriptor Hybrid based image retrieval with different for each respective input image. Here we find the value of precision is 0.72 and the value of recall is 0.11.



Figure7 : The above figure shows the input query and retrieval result image which is based on the top of Horse is query image and result of image shows in bottom by Fourier descriptors based image retrieval. This image shows the combine value of performance parameter such as precision and recall, the both parameters are calculated on the basis of their used algorithm/methods Partial feature Hybrid based image retrieval with different for each respective input image. Here we find the value of precision is 0.98 and the value of recall is 0.14.



Figure 6: The above figure shows the input query and retrieval result image which is based on the top of Bus is query image and result of image shows in bottom by Fourier descriptors based image retrieval. This image shows the combine value of performance parameter such as precision and recall, the both parameters are calculated on the basis of their used algorithm/methods Fourier Hybrid to all based image retrieval with different for each respective input image. Here we find the value of precision is 0.57 and the value of recall is 0.07.

Image Category	Partial Feature Extraction Based Retrieval		Fourier Descriptor Based Retrieval	
	Precision	Recall	Precision	Recall

Beaches	0.542	0.112	0.433	0.111
Dinosaurs	0.477	0.121	0.396	0.152
Hills	0.741	0.127	0.734	0.099
horses	0.997	0.205	0.930	0.080
Buses	0.596	0.147	0.318	0.150

Table1 : The above table shows the Experimental result analysis of Partial Feature Extraction Based Image Retrieval and Fourier Descriptor based image retrieval Method for the performance parameter precision and recall which applied on the input images like Beaches, Dinosaurs, Hills, Horses and Buses for the respective methods.

Image Category	Partial Feature Extraction Based Retrieval		Fourier Descriptor Based Retrieval	
	Precision	Recall	Precision	Recall
Beaches	0.658	0.201	0.422	0.144
Dinosaurs	0.485	0.133	0.385	0.144
Hills	0.735	0.188	0.724	0.112
horses	0.988	0.146	0.914	0.098
Buses	0.605	0.187	0.307	0.159

Table2 : The above table shows the Experimental result analysis of Partial Feature Extraction Based Image Retrieval and Fourier Descriptor Hybrid based image retrieval Method for the performance parameter precision and recall which applied on the input images like Beaches, Dinosaurs, Hills, Horses and Buses for the respective methods.

Image Category	Fourier Descriptor Based Retrieval		Partial Feature Extraction Based Retrieval		Fourier Hybrid to All Based Retrieval	
	Precision	Recall	Precision	Recall	Precision	Recall
Beaches	0.568	0.101	0.622	0.102	0.856	0.101
Dinosaurs	0.377	0.102	0.452	0.142	0.548	0.142
Hills	0.448	0.111	0.547	0.089	0.611	0.089
horses	0.610	0.117	0.655	0.195	0.817	0.089
Buses	0.474	0.102	0.498	0.137	0.570	0.070

Table3 : The above table shows the Experimental result analysis of Partial Feature Extraction Based Image Retrieval and Fourier Hybrid to all based image retrieval Method for the performance parameter precision and recall which applied on the input images like Beaches, Dinosaurs, Hills, Horses and Buses for the respective methods.

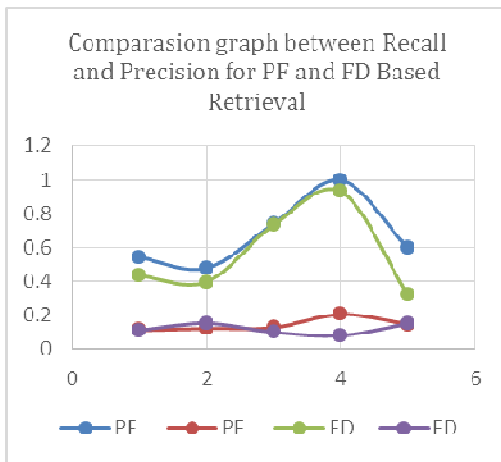


Figure 10: Shows that the performance comparison of Recall and Precision of Partial Feature Extraction Based Retrieval and Fourier Descriptor based Retrieval.

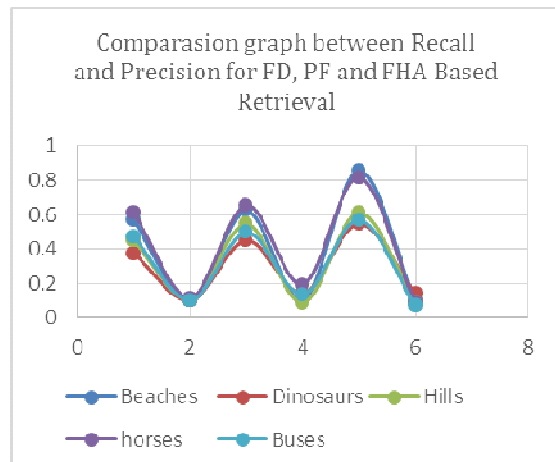


Figure 9: Shows that the performance comparison of Recall and Precision of Partial Feature Extraction Based Retrieval, Fourier Descriptor based Retrieval and Fourier Descriptor to All based Retrieval.

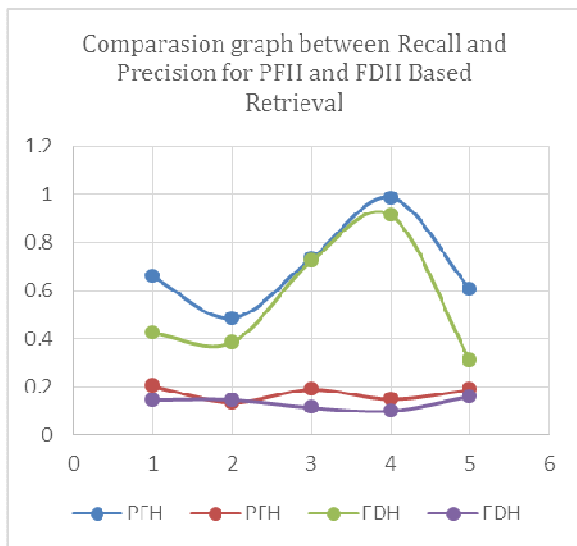


Figure 8: Shows that the performance comparison of Recall and Precision of Partial Feature Hybrid Extraction Based Retrieval and Fourier Descriptor Hybrid based Retrieval.

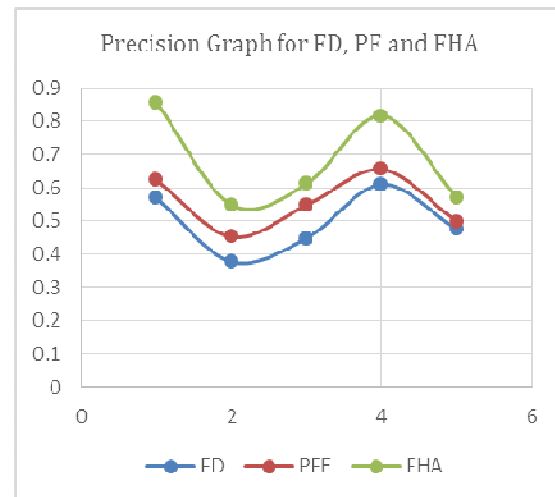


Figure 11: Shows that the performance graph of Precision of Partial Feature Extraction Based Retrieval, Fourier Descriptor based Retrieval and Fourier Descriptor to All based Retrieval.

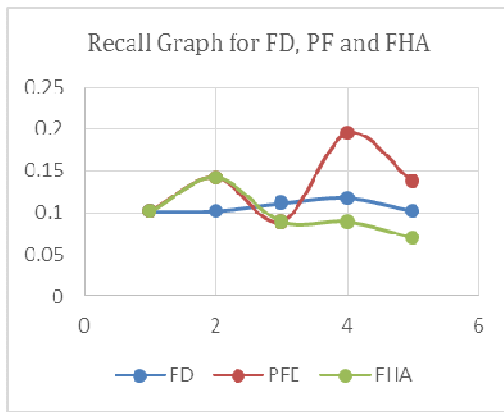


Figure 12: Shows that the performance graph of Recall of Partial Feature Extraction Based Retrieval, Fourier Descriptor based Retrieval and Fourier Descriptor to All based Retrieval.

V Conclusion & future Scope

In this paper proposed a new approach for content based image retrieval. The proposed approach used two swarm based optimization algorithm for the fusion of feature of image. The particle swarm optimization take an input of features descriptor and ACO process the local set features optimization. The process of fusion state defines the two constraints function one is selection of particle for the process of ACO and other is ACO for the Selection of features fusion. For the extraction of features used two features descriptor one is partial features descriptor and other is Fourier counter descriptor. For the validation estimation of the performance of methods used MATLAB software and coral image database. The coral image database consists of 1000 image such as bus, horses, hill and many more image data. the evaluation of performance used precision and recall. The value of precision of fusion of PSO-ACO is 95-98%. And in terms of individual features descriptor the value of partial features descriptor is average on 85-90%. And the value of precision of Fourier descriptor is 80-85 %. the process of features fusion is very complex and take more iteration for the generation of fused features. In future reduces the number of iteration of algorithm and reduces the time complexity in terms of execution factor.

REFERENCES

Qingyong Xu, Shunliang Jiang, Wei Huang, Famao and Shaoping.2015. "Feature Fusion Based Image Retrieval Using Deep Learning", Journal of Information & Computational Science, 2361–2373.

Jing-yan wang and zhen zhu,2010. "image retrieval system based on multi-feature fusion and relevance feedback", ieee, 2053-2058.

Taher Niknam and Babak Amiri 2009. "An efficient hybrid approach based on PSO, ACO and k-means for cluster analysis", Elsevier, 2009, 183-197.

Yan Meng, Qlorundamilola Kazeem and Juan C. Muller, 2007. "A Hybrid ACO/PSO Control Algorithm for Distributed Swarm Robots", IEEE, 2007, 1-8.

Chi Zhang and Lei Huang, 2014. "Content-Based Image Retrieval Using Multiple Features", CIT, 2014, 1-10.

Juan Manuel Ramirez-Cortes, Pilar Gomez-Gil, Gabriel Sanchez-Perez and David Baez-Lopez, 2008. "A Feature Extraction Method Based on the Pattern Spectrum for Hand Shape Biometry", WCECS, 2008. 1-4.

Kulkarni K. Ramesh, Niket Amoda, 2013. "Efficient image retrieval using region based image retrieval" ICWAC, 2013, 22-31.

Zheng Liang, Shengjin Wang, Qi Tian, "Coupled binary embedding for large-scale image retrieval", IEEE Transactions on Image Processing, 2014, 3368-3380.

Huang Wei, Yan Gao and KapLuk Chan, 2010. "A review of region-based image retrieval", Journal of Signal Processing Systems, 2010, 143-161.

M. Rao Babu, 2013. "A new feature set for content based image retrieval", Information Communication and Embedded Systems (ICICES), 2013, 1-1.

P. S. Hiremath and Jagadeesh Pujari, 2010. "Content based image retrieval using color, texture and shape features", IEEE, 2010, 780-784.

Xiangyang Wang, Yongjian Yu and Hongying Yang, 2011. "An effective image retrieval scheme using color, texture and shape features", Computer Standards Interfaces, 2011, 59-68.

J. EAKINS and M. GRAHAM, 2014. "Content-based Image Retrieval" University of Northumbria at Newcastle, 2014, 25-41.

M. S. LEW, N. SEBE and C. DJERABA, 2010. "Content-based multimedia information retrieval: State of the art and challenge" ACM, 2010, 1–19.

- G. Amayeh, G. Bebis, A. Erol, and M. Nicolescu, "Peg-free hand shape verification using high order Zernike moments", IEEE, 2009, Pp. 40-48.
- TaherNiknam, ElaheTaherianFard, NargesPourjafarian and AlirezaRousta "An efficient hybrid algorithm based on modified imperialist competitive algorithm and K-means for data clustering" Engineering Applications of Artificial Intelligence, 2011, Pp 306-317.
- BahmanBahmaniFirouzi, MokhtarShaSadeghi and TaherNiknam "A NEW HYBRID ALGORITHM BASED ON PSO, SA, AND K-MEANS FOR CLUSTER ANALYSIS", ICIC, 2010, Pp 3177-3192.
-] Ganesh Krishnasamy, Anand J. Kulkarni and RaveendranParamesran "A hybrid approach for data clustering based on modified cohort intelligence and K-means", Expert Systems with Applications, 2014, Pp 6009-6016.
- RadhaThangaraj, Millie Pant, Ajith Abraham and Pascal Bouvry "Particle swarm optimization: Hybridization perspectives and experimental illustrations", IEEE, 2011, Pp 1-19.
- TaherehHassanzadeh and Mohammad Reza Meybodi "A New Hybrid Approach for Data Clustering using Firefly Algorithm and K-means", IEEE, 2010, Pp1-5.
- Sun Xu, Zhang Bing, Yang Lina, Li Shanshan and GaoLianru "Hyperspectral image clustering using ant colony optimization(ACO) improved by K-means algorithm", IEEE, 2010, Pp 1-22.
- SunitaSarkar, Arindam Roy and BipulShyamPurkayastha "Application of Particle Swarm Optimization in Data Clustering: A Survey", International Journal of Computer Applications, 2013, Pp 38-46.
- SerkanKiranyaz, JenniPulkkinen, TurkerInce and MoncefGabbouj "MULTI-DIMENSIONAL EVOLUTIONARY FEATURE SYNTHESIS FOR CONTENT-BASED IMAGE RETRIEVAL" IEEE, 2011, Pp 3645-3648.
- Anil Balaji, R.P. Maheshwari and R. Balasubramanian "Content-Based Image Retrieval using colour feature and colour bit planes", IJSISE, 2014, Pp 44-57.
- SwapnaliniPattanaik and D.G. Bhalke "Efficient Content based Image Retrieval System using Mpeg-7 Features", International Journal of Computer Applications, 2012, Pp 19-24.
- ElhamAkbariBaniani and AbdolahChalechale "Hybrid PSO and Genetic Algorithm for Multilevel Maximum Entropy Criterion Threshold Selection", International Journal of Hybrid Information Technology, 2013, Pp 131-140.
- T. Kanimozhi and K. Latha "An Adaptive Approach for Content Based Image Retrieval Using Gaussian Firefly Algorithm" ICIC, 2013, Pp 213-218, 2013.
- N. Singhai and S. K. Shandilya, "A Survey On: Content Based Image Retrieval Systems", International Journal of Computer Applications, 2010 Pp 485-490.
- L. Ballerini, X. Li, R. B. Fisher, Be. Aldridge, J. Rees, "Content Based Image Retrieval of Skin Lesions by Evolutionary Feature Synthesis," Evo Applications, 2010, Pp 312-319.
- S. Kiranyaz, T. Ince, A. Yildirim and M. Gabbouj, "Fractional Particle Swarm Optimization in Multi-Dimensional Search Space", IEEE, 2010, Pp 298-319.
- Kirti Jain, Dr. Sarita Singh and Dr. Gulab Singh "Partial Feature Based Ensemble of Support Vector Machine for Content based Image Retrieval", International Journal of Innovative Research in Computer and Communication Engineering, 2013, Pp 622-625.
- KirtiJain andDr.Sarita Singh Bhadauria" Enhanced Content Based Image Retrieval Using Feature Selection Using Teacher Learning Based Optimization" in International Journal of Computer Science and Information Security (IJCSIS), Vol. 14, No. 11, November 2016