International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-8 Issue-11, September 2019

PSO Optimized Log Gabor QBIC System

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Abstract*: *In modern years, there is substantially technical progression in research area pertaining to image retrieval, in specific Query By Image Content (QBIC) system. It has turned out to be essential to deliver adept and effective method to retrieve images from the gigantic collections of images utilized in heterogeneous applications. In this paper, a hybrid QBIC retrieval system known to be PSO optimized Log Gabor QBIC system that retrieves color features, texture features and shape features of the images in three consecutive stages has been developed. In the proposed system, color features are retrieved by means of color histogram in the first stage. In subsequent stage, the texture features are extracted by tuning Log Gabor filters using Particle Swarm Optimization(PSO). Lastly, shape features are retrieved by polygonal fitting algorithm. The recommended method displays enhanced retrieval rate in terms of mean recall and mean precision when compared to the prevailing standard systems.

Keywords*: *Particle Swarm Optimization, mean recall and mean precision.

I. INTRODUCTION

Research on image retrieval has evolved to be considerably significant during the preceding years and has become dictating propensity in the area of information retrieval [1, 2]. Retrieval of images is a very exciting area of research in numerous applications like databases related to multimedia, Google retrieval and digital libraries. Abundant techniques, many algorithms and different systems have been proposed to resolve the hitches that publicized indexing and retrieval perceptions, which gave rise to evolution of Query by Image Content retrieval. QBIC retrieval system conceivably can derive traceable features of images and retrieve anticipated image from the repository of numerous images. The main principle of QBIC retrieval is organizing digital picture archives by making use of their visual content. This can be achieved using image processing and feature extraction. The key features chosen for extraction are color, texture and shape which dictate meaningful image retrieval. Wang *et al.*[3] has accentuated an image retrieval scheme by the integration of color features, texture features and shape features and comparison among these features is taken for retrieval. Shrivastava *et al.* [5] epitomized the extraction order at each stage to be color, texture and shape so that competence of the retrieval system can be improved after conducting numerous simulation experiments. Even though most of the real life textures are colored, substantial research has been focused on grayscale texture analysis [13] for the reason that even for grayscale textures, existing descriptors are still not dominant to represent textural properties of an image. Haridas *et al.* [11] grasped Gray Gabor wavelet in texture analysis and their classification for extracting texture information in given orientation and scale. Gabor wavelet has been shown to be very effective in image retrieval systems by Madhavi *et al.* [6]. The technique where a different orientation, frequency and scale of Gabor wavelet are preferred to obtain the feature of every image is triggered by Tsai *et al.* [8] since it has separable property and texture invariance to extract texture features from repository for retrieval of images. Chisti *et al.* [7] expounded an optimized Gabor filter by means of PSO in addition to GA for minimizing the Gabor energy by changing scale, frequency as well as orientation parameters. Arrspide *et al.* [4] highlighted Log Gabor filter descriptor for image centered vehicle authentication that has been considered as a supervised classification problem. The image retrieval scheme exemplified by Agarwal and Maheswari [9] using Log Gabor wavelet transform has shown better performance than using Gabor wavelet transform. Kumar *et al.* [10] authenticated use of Log Gabor filter for vehicle authentication and obtained a better retrieval performance. Ashraf *et al.* [12] prompted a retrieval method employing bandelet transform and artificial neural networks.

Chaorong *et al.* [16] postulated a proficient color texture extraction method based on copula model that utilize Gabor wavelets. The foremost concern regarding the usage of color histograms for image retrieval includes selection of color space, color space quantization into number of color bins as well as similarity metric [17].There exist even more complex methods [18] to measure similarity between color histograms. Casti *et al.* [19] devised an unusual technique for the assessment of breast skin-line centered on multi directional Gabor filtering. Madhavi *et al.* [15] recommended a tuned color Gabor wavelet employing genetic algorithm to obtain the texture features. The Gabor wavelet constraints in the quantified range are tuned to obtain minimum energy. Gu *et al.* [20] conceptualized vocal emotion recognition using Log Gabor filters. The approaches for shape depiction can be classified into boundary based or region based methods [21]. The boundary based methods comprise rectilinear shapes, finite element prototypes [22] besides Fourier based shape descriptors .

II. PROPOSED METHOD

A hybrid PSO optimized QBIC retrieval method utilizing Log Gabor filter is proposed by combining three descriptors namely color, texture and shape of an image. The recommended hybrid Log Gabor based retrieval system has chronological process of three stages.

Manuscript published on 30 September 2019.
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The block diagram illustrating the structural design of recommended system is shown in Fig.1. Retrieval is implemented in three successive stages in this system. The best matched retrieved imageries of every single stage are considered as input imageries to the subsequent phase to derive 'N' best retrieved imageries out of 'R' repository imageries. Features are obtained based on the three descriptors of an image namely color, texture and shape.

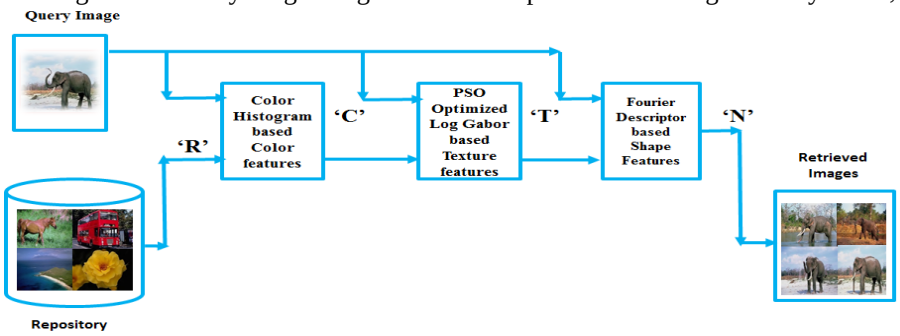

Fig. 1. Proposed PSO optimized Log Gabor QBIC system

Considering 'R' repository images as input, the color based feature extraction process is done by choosing appropriate 'C' images for certain query image in stage1. The color feature extraction is done by means of HSV color space through color histogram. The 'C' images are considered as input repository set for stage 2. The Log Gabor filter energy is minimized in three different orientations using particle swarm optimization algorithm by maintaining the remaining two parameters scale and frequency constant to reduce the number of convolutions. This tuning suits well to the texture structure present in the query image and assists in retrieving texture features to identify suitable matched 'T' images through calculation of minimum energy in second stage. These 'T' repository images are chosen as repository for stage 3. In stage 3, retrieval depends on extraction of shape features employing polygonal curve fitting algorithm. The retrieved 'N' images from last stage are the utmost possible pertinent images to particular query image.

The relationship among number of images obtained in each and every stage of the recommended retrieval system and initial total repository database is given by R > C >T> N.

III. RESULT AND DISCUSSION

This section demonstrates investigational estimation of recommended PSO optimized Log Gabor QBIC system. The accomplishment of the model is completed by means of COREL repository [14] in MATLAB. The repository encompasses 100 natural imageries incorporated in each of 10 categories creating it a whole of 1000 consistent images. It includes 1000 images that are classified into ten different categories of images that include Buses, Foods, Horses, Buildings, Elephants, Beaches, African people, Flowers, Dinosaurs and Mountains respectively. The query image is displayed in Fig. 2.

Fig. 2. Query image

The rightness of proposed PSO optimized Log Gabor QBIC system is limited to considered assumptions of C, T and N and therefore appropriate concern is necessary in taking these factors. The value of R is considered as number of total imageries in the repository. The factors C, T and N are preferred as 10, 8 and 4 respectively. The factors C, T and N are fixed substantially by user. The method can be enhanced by choosing factors C, T and N through changing values and considering outcomes in terms of mean precision and mean recall. The obtained results at each phase are portrayed in Fig. 3, by taking factors C, T and N to be 10, 8 and 4 respectively.

The inappropriate imageries are filtered markedly at each stage thereby thinning down the exploration. This results in creating the elementary level characteristics to portray the purpose of user. The enactment of the proposed PSO optimized Log Gabor QBIC system is assessed specifically in terms of mean precision and mean recall for each category by means of the retrieval outcomes.

Table I and Table II demonstrate the experimental results obtained using proposed PSO optimized Log Gabor QBIC system and other prevailing models namely Ashraf model [12], Shrivastava model [5], Youssef model [13].

The recommended PSO optimized Log Gabor QBIC system is measured by treating every image in each set as query image and thereby the extracted results of every query image can be used to measure the retrieval outcomes. The performance metrics is assessed for every set in the repository by considering 20 as the numerical value of output images. It is witnessed that the recommended system has shown enhanced precision and recall than other existing standard models for all sets. Fig. 4 depicts the comparison of precision and recall of the recommended PSO optimized Log Gabor QBIC system.

The performance metrics for retrieval performance specifically mean precision and mean recall of recommended PSO optimized Log Gabor QBIC system and other prevailing models under identical conditions by changing the values of L from 20 to 100 are shown in Fig. 5 and Fig. 6.

Retrieval Number: K19140981119/19©BEIESP
DOI: 10.35940/ijitee.K1914.0981119
Journal Website: www.ijitee.org

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Fig. 3.1(a). Transitional computation results of initial stage with C = 10

Fig. 3.2(b). Transitional computation results of next stage with T = 8

Fig. 3.3(c). Transitional computation results of final stage with N = 4

Table I: Evaluation of Mean precision of the recommended PSO optimized Log Gabor QBIC system with prevailing standard systems

Group ID	Group	PSO optimized Log Gabor QBIC	Ashraf Exemplary [12]	Shrivastava Exemplary [5]	Youssef Exemplary [13]
1	Buildings	0.82	0.75	0.60	0.70
2	Food	0.85	0.80	0.80	0.81
3	African people	0.85	0.80	0.75	0.64
4	Beaches	0.82	0.75	0.60	0.64
5	Elephants	0.92	0.90	0.75	0.78
6	Horses	0.96	0.90	0.90	0.95
7	Buses	0.94	0.90	0.80	0.92
8	Flowers	0.95	0.80	0.92	0.95
9	Dinosaurs	1.00	1.00	1.00	0.99
10	Mountains	0.79	0.70	0.58	0.74
	Mean	0.89	0.83	0.77	0.812

Table II: Evaluation of Mean recall of the recommended PSO optimized Log Gabor QBIC system with prevailing standard systems

Group ID	Group	PSO optimized Log Gabor QBIC	Ashraf Exemplary [12]	Shrivastava Exemplary [5]	Youssef Exemplary [13]
1	Buildings	0.160	0.150	0.120	0.140
2	Food	0.166	0.160	0.160	0.160
3	African people	0.166	0.160	0.150	0.130
4	Beaches	0.16	0.150	0.120	0.130
5	Elephants	0.184	0.180	0.150	0.160
6	Horses	0.184	0.180	0.180	0.190
7	Buses	0.184	0.180	0.160	0.180
8	Flowers	0.182	0.160	0.180	0.190
9	Dinosaurs	0.200	0.200	0.200	0.200
10	Mountains	0.154	0.140	0.120	0.150
	Mean	0.174	0.166	0.154	0.163

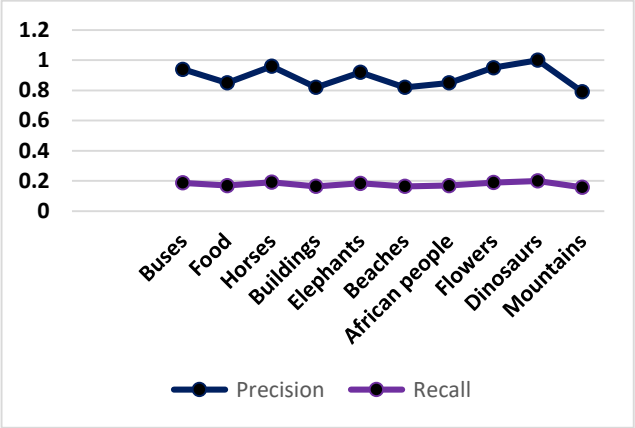

Fig. 4. Comparison of Precision and Recall of the recommended PSO optimized Log Gabor QBIC system

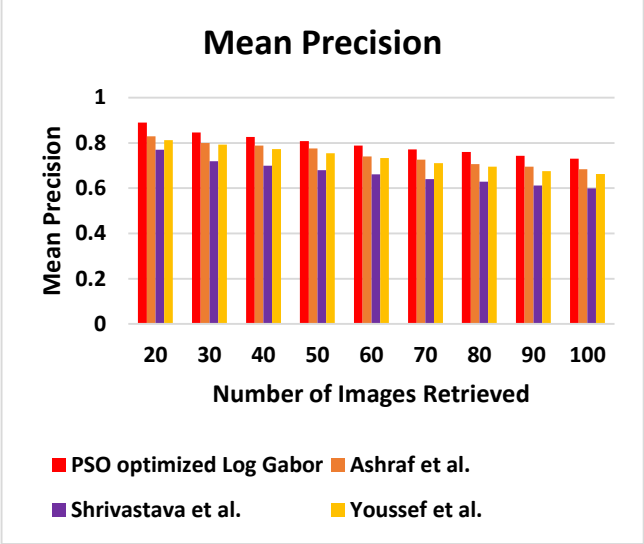

Fig.5. Evaluation of Mean precision of the recommended PSO optimized Log Gabor QBIC system with prevailing standard systems

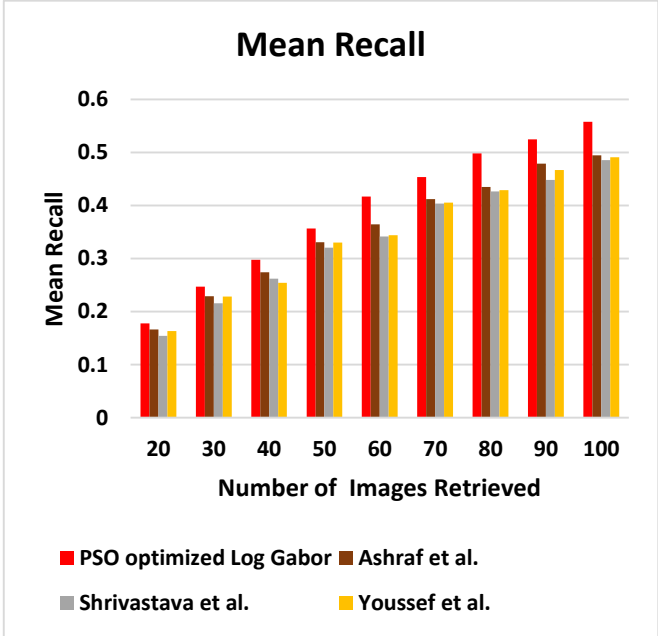

Fig.6. Evaluation of Mean recall of the recommended PSO optimized Log Gabor QBIC system with prevailing standard systems

IV. CONCLUSION

The proposed PSO optimized Log Gabor QBIC system has the advantage of tuning Log Gabor filter dynamically using particle swarm optimization for texture feature extraction which has pronounced impact on retrieval performance when compared to standard and customary Gabor filter methods. Moreover, the existing models utilized only a kind of visual features for extraction. In addition, the Log Gabor wavelet is utilized for texture retrieval which has prodigious effect on retrieval performance. The novelty of proposed PSO optimized Log Gabor QBIC system is that it can exploit global minima features that results in high accuracy without affecting the computation.

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DOI: 10.35940/ijitee.K1914.0981119
Journal Website: www.ijitee.org

Published By:
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