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Content Based Image Retrieval Using Interactive Genetic Algorithm with Relevance Feedback Technique-Survey

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***Abstract*— In field of image processing and analysis Content-based image retrieval is a very important problem as there is rapid growth in storing and capturing multimedia data with digital devices. Although extensive studies, conducted and image finding is desired from multimedia databases and it is very challenging and open issue. This paper provides an review of the relevance feedback (RF), interactive genetic algorithm and neural network in content-based image retrieval (CBIR) . Relevance feedback enhance the capacity of CBIR effectively by reducing the semantic gap between low-level features and high levelfeatures. Interactive genetic algorithm is a branch of evolutionary computation which makes the retrieval process more interactive so that user can get refined results from database matching to Query Image with his evaluation . Neuro-fuzzy logic based implicit feedback get better results as compared to traditional implicit feedback. The paper covers the current achievements in relevance feedback , interactive genetic algorithm, neural network in CBIR, various relevance feedback techniques and applications of CBIR.**

***Keywords*— CBIR, Neuro-fuzzy logic, Relevance Feedback, Interactive Genetic Algorithm.**

I. INTRODUCTION

A. *Content Based Image Retrieval*

To diminish the lack of consistency problem, the image retrieval is carried out according to the image features. Such scheme is the so-called content-based image retrieval (CBIR). The main challenge of the CBIR system is to construct meaningful descriptions of physical attributes from images to expedite efficient and effective retrieval. CBIR has become an dynamic and fast-improving research area in image retrieval in the last few years. Due to this CBIR have improved in lots of way such as region-level features based, relevance feedback, semantic based etc.

Content based features are mainly divided into two domains; Common visual features and Field Specific visual features like face recognition, task dependent applications etc. On the other hand, high level features include semantic based image retrieval computed from text description or by complex algorithms of visual features. The mixture of these content based features is required for better retrieval of image according to the application. Following are the some features of the image.

Color: Color is a dominant and discernible feature for image retrieval. Mostly CBIR systems use color space, histogram, moments, color coherence vector and dominant color descriptor to represent color.

Texture: Texture feature is described as a information of local shape and color feature or in a more descriptive way it is called as structure and randomness. Structural schemes contains graphical method which considered to be more efficient when applied to the texture. Randomness methods represent Tamura features, Markov random field, wavelet transform, dual tree complex wavelet and contour lets. Texture can be represented by Grey Level Co-occurrence matrix. Texture is an essential feature for general images but its comprehensive definition does not exist still yet.

Edge:-Edge detection defined as to the process of checking and locating sharp ambiguous in an image. This ambiguous or discontinuities are discriminate as boundaries of objects in a scene that is sudden changes in pixel intensity. Mostly Classical edge detection schemes involve the image with an operator (a 2-D filter), which is constructed to be influences to large gradients in the image while returning values of zero in uniform regions. There are many edge detection operators available , each designed to be sensitive to certain types of edges. Variables involved in the selection of an edge detection operator include:

- Edge orientation: The geometry of the operator determines a characteristic direction in which it is most sensitive to edges. Operators can be optimized to look for horizontal, vertical, or diagonal edges.
- Noise environment: Edge detection is difficult in noisy images, since both the noise and the edges contain high-frequency content. Attempts to reduce the noise result in blurred and distorted edges. Operators used on noisy images are typically larger in scope, so they can average enough data to discount localized noisy pixels. This results in less accurate localization of the detected edges.

B. *Relevance Feedback*

The difference between the user's information need and the image representation is called the semantic gap in CBIR systems. The limited retrieval accuracy of image nuclear retrieval systems is essentially due to the intrinsic semantic gap. In order to reduce the gap, relevance feedback is very helpful into CBIR system.

The basic idea behind relevance feedback is to integrate human perception subjectivity into the query and involve user to evaluate the retrieval results. Then depending upon user's integration the similarity measures are automatically refined. There are lots of CBIR algorithms has been proposed and most of them work on the finding effectively specific image or group of relevant image to that query image using similarity computation phase. But it is necessary to have usre's interaction to get better results. Thus in order to achieve a better approximation of the user's information need for the following search in the image database, involving user's interaction is necessary for a CBIR system.

C. *Interactive Genetic Algorithm*

GAs within the field of evolutionary computation, are robust, computational, and stochastic search procedures modelled on the mechanics of natural genetic systems. In general, a GA contains a fixed-size population of potential solutions over the search space. These potential solutions of the search space are encoded as binary or floating-point strings, called chromosomes. The initial population can be created randomly or based on the problem- specific knowledge.

IGA is a branch of evolutionary computation. The main difference between IGA and GA is the construction of the fitness function, i.e., the fitness is determined by the user's evaluation and not by the predefined mathematical formula. A user can interactively determine which members of the population will reproduce, and IGA automatically generates the next generation of content based on the user's input. Through repeated rounds of content generation and fitness assignment, IGA enables unique content to evolve that suits the user's preferences. Based on this reason, IGA can be used to solve problems that are difficult or impossible to formulate a computational fitness function, for example, evolving images, music, various artistic designs, and forms to fit a user's aesthetic preferences

D. *Neuro-fuzzy logic*

Neuro-fuzzy inference system implements fuzzy inference system in the framework of Adaptive networks. NFIS is a feedforward neural network, in which the parameters of the square nodes need learning. The learning of fuzzy inference system is the adjustment about the antecedent parameters and consequent parameters.

II. RELATED WORK

A. *CBIR USING INTERACTIVE GENETIC ALGORITHM*

Chin-Chin Lai et.al .[2] have proposed an interactive genetic algorithm (IGA) to reduce the gap between the retrieval results and the users' expectation .They have used Color attributes like the mean value, standard deviation, and image bitmap .They have also used texture features like the entropy based on the gray level co-occurrence matrix and the edge histogram.

Sung-Bae Cho and Joo-Young Lee [4] have proposed A Human-Oriented Image Retrieval System to extracts the feature from images by wavelet transform, and provides a user-friendly means to retrieve an image from a large database when the user cannot clearly define what the image must be.

Linying Jiang et.al[5] have proposed CBIR algorithm oriented by Users' Experience in order to improve the storage efficiency, retrieval speed and accuracy of the existing CBIR algorithm as well as to improve the quality of user experience.

B. *CBIR USING NEURO-FUZZY LOGIC*

N.Srikrishna, K.Vindhya and P.Satyanarayana[6] have proposed A neuro- fuzzy approach to content based image retrieal in which both fuzzy logic techniques and neural networks are utilized separately to establish two decoupled subsystems which perform their own tasks in serving different functions in the combined system. A *Feed Forward Back Propagation Neural Network* (FNN) is adopted for Image Classification.

V. Balamurugan and P. Anandhakumar [7] have proposed Neuro-fuzzy based clustering approach for CBIR using 2D-wavelet transform in which they developed color and texture based neural network-fuzzy logic approach for content based image retrieval using 2D-wavelet transform. The system performance improved by the learning and searching capability of the neural network combined with the fuzzy interpretation. This overcomes the vagueness and inconsistency due to human subjectivity.

Kulkarni et al[8] proposed a neuro–fuzzy technique for CBIR. It is based on fuzzy interpretation of natural language, neural network learning and searching algorithms.

III. ANALYSIS OF CBIR SYSTEMS BASED ON RF TECHNIQUES

Analysis and comparison of various CBIR systems based on relevance feedback technique is provided in the following table

S.NO	AUTHOR	YEAR	PROPOSED METHOD	RESULTS
1	Benitez, Beigi, & Chang	1998	Meta seek	Average Precision= 0.70
2	Vasconcelos & Lippman	2000	Bayesian Learning Algorithm	Precision/ Recall curve were plotted.
3	JormaLaaksonen et al.	2001	Self Organizing Maps	The average ' t ' value = 0.174
4	Sean D. MacArthur, Carla E.Brodley, and Avinash C. Kak	2002	Using decision trees Relevance feedback	Average retrieval precision curve were plotted
5	Su, Zhang, Li,and Ma	2003	Bayesian classifier	Accuracy increase in top 10 results =2.6 % in top 20 results = 13.4 % And in top 100 results=7.8%
6	Slobodan Čabarkapa et al.	2005	Relevance feedback based adaptive retrieval approach	Average Retrieval rate =89.5%
7	C. D. Ferreira et al.	2009	Genetic programming based relevance feedback	Precision/ Recall curve were plotted.
8	Quanzhong Liu et al.	2008	Real-code genetic RF	Precision=75% Recall=69%
9	Peter Auer ,Zakria Hussain et al.	2010	Implicit relevance feedback	Average precision =15.0
10	Lining Zhang, Lipo Wang et al.	2010	Generalized Biased Discriminant Analysis	Average precision in top 20 results=**83.35 %** in top 140 results **=30.73 %** Average Recall in top 20 results= 14.18 % in top 140 results =**35.27 %**
11	Chih-Chin Lai and Ying-Chuan Chen	2011	Interactive genetic algorithm	Precision=80.6% Recall=15.8%
12	Manish Chowdhury, Sudeb Das, and Malay Kumar Kundu	2012	Ripplet Transform & fuzzy relevance feedback	Average Precision=0.55
13	P. M. Pawar & A .N. Holambe	2013	Navigation Pattern Mining	Precision= 80%

IV. RELEVANCE FEEDBACK SCHEMES

CATEGORY	RF METHODS	ADVANTAGES	LIMITATIONS
Statistical Based RF Methods	Delta Mean algorithm	Determines which features can efficiently differentiate between the relevant and irrelevant image examples .	As small size cannot calculate exact variance of data set, so it is receptive to data set size.
	Standard Deviation and Variance	Bunch of relevant images exhibit the specific features and are inversely proportional to the relevant image set variance	It assumed irrelevant sample to be unimodal which is not actually possible.
	QPM	Estimates the perfect query point from which the ideal relevant images can be retrieved.	QPM unable to make better use of irrelevant samples when images are not unimodal.
Kernel Based RF Methods	Bayesian Frame work	Textual based image retrieval method is used extensively in this scheme . User interaction is always computed in terms of probabilities of a random variable.	whenextraction of texture, shape and color features is done individually for retrieval of image performance evaluation using Bayesian models decreases considerably
	SVM	SVM derived better results for pattern identification without dealing with the filed information.	SVM sensitive to small sample data sizes.
	BDA	Calculates the linear transformation for the scattered negative and positive images.	Gaussian distribution methods for relevant data set are the main flaw for the efficient results
Entropy Based Methods	KL Distance	Makes few difference measures on the basis of entropy due to which derivation of KL Distance calculated between two distributions is done.	On the distributions of data there is lacks of the constraints

V. PARAMETERS USED FOR EXPERIMENTAL EVALUATION OF CBIR SYSTEMS

The standard parameters which are used for the experimental evaluation of the results by the above stated systems are convergence ratio ,precision and recall. Convergence ratio is calculated as weighted relevant count divided by the ideal weighted relevant count of the images. Precision is defined as number of retrieved relevant images divided by total number of retrieved images and the recall is number of retrieved relevant images divided by total number of relevant images in the database.

VI. APPLICATION

1. **Crime prevention:** Automatic face recognition systems, used by police forces.
2. **Security Check:** Finger print or retina scanning for access privileges.
3. **Medical Diagnosis:** Using CBIR in a medical database of medical images to aid diagnosis by identifying similar past cases.
4. **Intellectual Property:** Trademark image registration, where a new candidate mark is compared with existing marks to ensure no risk of confusing property ownership.
5. ***Architectural and engineering design:D***esigner needs to be aware of previous designs, particularly if these can be adapted to the problem at hand. Hence the ability to search design archives for previous examples which are in some way similar, or meet specified suitability criteria, can be valuable.

VI. CONCLUSIONS

In past, content based image retrieval is done using one or two low level features such as shape, color and texture. The conventional Content Based Image Retrieval (CBIR) systems display the large amount of results at the end of the process this will drove the user to spend more time to analyze the output images.

In this paper survey of the relevance feedback techniques, advantages and disadvantages of relevance feedback algorithm, content based image retrieval using interactive genetic algorithm and neuro-fuzzy logic used for content based image retrieval are discussed.

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