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Content-Based Image Retrieval Using Differential Evolutionary Algorithm

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Abstract
Content-based image retrieval (CBIR) is a bottleneck of the multimedia system. In contempt of attempts have been made to perform CBIR on an efficient basis based on low level features like shape, color, edge, texture etc…This paper focuses on using spatial features of texture primitive and edge detection by a differential evolution method that optimizes a problem iteratively improve the solution with respect to quality of an image. Experimental results show that the proposed method has increased the cost of precision based on the point of mutation.

Keywords: Texture Primitive, Edge detection, Differential Evolution algorithm.

Prelude

Content-based image retrieval (CBIR) system based on the low-level image content feature. It is considered as the process of retrieving desired images from huge volume of database based on extracted features from image themselves without resorting to a keyword [1]. This paper focuses on spatial feature of texture primitive and edge detection based on Differential evolutionary algorithm. DE optimizes a problem of image retrieval by maintaining and creating new images solution by combining existing once according to its simple formulae and then keeping whichever solution has best accuracy or fitness of an image.

The block diagram of CBIR is shown Fig 1. According to the examines of the texture primitive and edge detection is proposed to illustrate the image query.

Texture Primitive: Texture is an attribute representing the spatial arrangement of the gray level of the pixel in a region or image [2].There is two kinds of texture according to the spatial frequency or a large number of edges per unit area. Coarse texture has low spatial frequencies or a small number of edges per unit area

Edge Detection: Edge defined as to the process of checking and locating sharp ambiguous in an image. Edge that are due to discontinuities between the regions are generally of strong value and variation within regions and also due to defects of imaging give rise to week edges [4].

The rest of the paper is organized as follows. Section 2 describes related works section 3 describes Fundamentals of Differential evolutionary algorithm, section 3 describe Proposed methodology, section 4 describes experimental results, Conclusion and future scope of research in section 6.

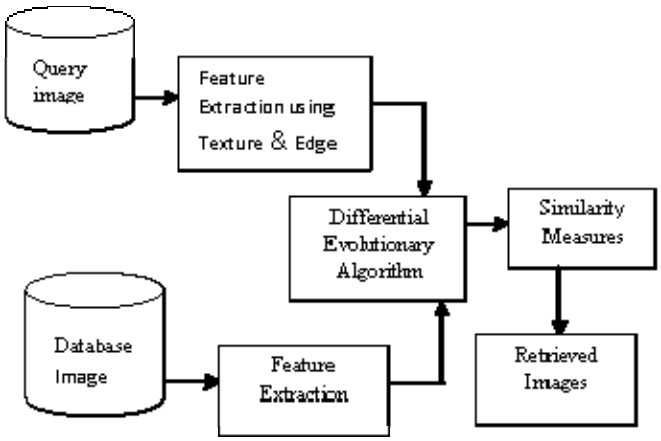


Fig.1. Architecture diagram for CBIR

Related Works

Content based visual information retrieval is the application of computer vision techniques to retrieve the image that is the problem of searching for the images in large dataset. Raghupathi Gali, M.L.Dewal, R.S.Anand[5] suggest the genetic algorithm significantly improved significantly all the evaluation measures including average precision and average recall for the combined features method.

Anita N.Ligade Manisha R. Patil [3] discussed the advantage and disadvantage of relevance feedback algorithm, CBIR using interactive genetic algorithm and neural network.

M.Venkat Dass, Mohammed Rahmath Ali, Mohammed Mahmood Ali [6] proposed the evolution stage of CBIR, the most relevant images were retrieved by using IGA. The system is based on 10000 WANG color image database. The result demonstrates the feasibility of an image.

Mohammed A.Tahoun, Khaled A.Nagaty, Taha I.EI-Arief, Mohammed A-Megeed[7] suggest that the combination of GCH and 2-D Haar wavelet transform using the cosine distance gives good results while when adding the color layout feature to the combination using the Euclidean distance gives the best result.

P. Sankara Rao.et.al [8], discussed a neural network for CBIR to performs the clustering of the images in database using hierarchical and k-mean clustering. This clusters obtained is then supplied to the neural network which uses radial basis function to derive the relevant images supplied through user query.

P.S. Hiremath and Jagadeesh Pujari proposed the images are partitioned into non-overlapping tiles. These titles at two

different resolutions in two grid framework. Feature is drawn from conditional co-occurrence histograms computed by using image. An MSHP principle and adjacency matrix of a bipartite graph constructed between image titles is implemented for image similarity.

Fundamentals Of Differential Evolution Algorithm

Differential Evolution (DE) is a method that optimizes a problem by iteratively trying to improve a candidate solution with regard to a given measure of quality. Such methods are commonly known as met-heuristics as they make few or no assumptions about the problem being optimized and can search very large spaces of candidate solutions. In this paper they retrieve closest image from database according to user's query image.

A basic variant of the DE algorithm works by having a population of candidate solution (image).

Let $\mathbf{x} \in \mathbb{R}^n$ designate a candidate solution (image) in the image database. The basic DE algorithm can describe as

Step 1: Initialize all images $\mathbf{X}$ with random positions in the search-space.

Step 2: Until a termination criterion is met (e.g. number of iterations performed, or adequate fitness reached), repeat the following:

Step 3: For each image **X** in the image dataset do:

- Pick three images as **a, b** and **c** from the image database at random, they must be distinct from each other as well as from image **X.**
- Pick a random index **R** □**{1,….,n}** (**n** being the dimensionality of the problem to be optimized).

Step 4: Compute the images potentially new image dataset as **Y= [y_1,….,y_n]** as follows:

- For each **i**, pick a uniformly distributed number $\mathbf{r_i} \equiv \mathbf{U(0,1)}$
- If $\mathbf{r_{i < CR\ or}}$ **i=R** then set $\mathbf{y_{i=}\ a_i + F_{x(}b_i - c_{i)}}$ otherwise set $\mathbf{y_i = x_i}$
- (In essence, the new position is outcome of binary crossover of image **X** with intermediate image Z= a +F X (b –c))

Step 5: If **f(y) < f(x)** then replace the image in the dataset with the improved candidate solution (image), that is, replaces **X** with **Y** in the image database.

Step 6: Pick the image from the image dataset that has the highest fitness or lowest cost and return it as the best found candidate solution (image).

Proposed Methodology

Algorithm is start with a set of intensity value represented by images called population. In this paper the intensity value from one image (query image) are taken and used to form a new image. Then the new image will be better than the older one. This process is repeated until some condition is satisfied.

Step 1: The user provides a query image

Step 2: The descriptors of the CBIR are computed and n most similar images are retrieved using only intensity value of the image similarity on the visual descriptors and form the initial image at random.

Step 3: Initial the training image dataset made of the query image.

Step 4: DA provides fitness value to whole image in the dataset

Step 5: Then the decision boundary and similarity measure are used as fitness value. This DA generates n new encoding vectors from the previous generation using GA operators as

Selection: It gives preference to better individuals, allowing them to pass on their genes to the next generation.

The goodness of each individual depends on its image fitness.

Crossover: The distinguished factor of GA from other optimization techniques.

The two individuals are chosen from the population using selection operator.

The intensity value of the two images are exchanged up to this point

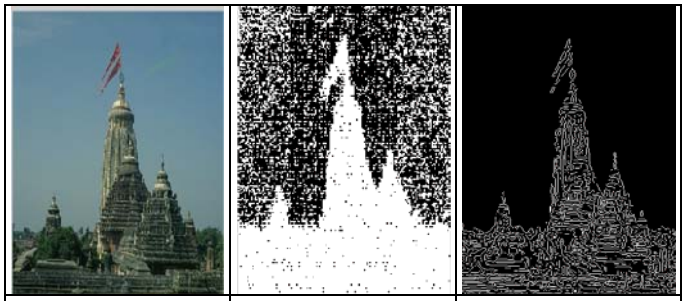
If S1=000000 and S2=1111111 and crossover point is 2 then S1'= 110000 and S2'=001111

The two new offspring created from this mating are put into next generation of the image

By recombining portions of good individuals, this process is likely to create even better individuals.

Crossover :

Crossover is a genetic operator used to vary the programming of a images from one generation to the next. It is analogous to reproduction and biological crossover, upon which genetic algorithms are based. Cross over is a process of taking more than one image solutions and producing a image solution according to the query image.



(a) (b) (c)

Fig.2. (a) Query image (b) Retrieved Texture Primitive (c) Retrieved Edge Feature.

Mutation:

Mutation alters one or more intensity values in a image from its initial state. In mutation, the solution may change entirely from the previous solution. Hence GA can come to better solution by using mutation. Mutation occurs during evolution according to a user-definable mutation probability. This probability should be set low. If it is set too high, the search will turn into a primitive random search of an image.

Step 6: Then 'n' images are displayed to the user as the results of image query.

Step 7: (K≤ n) are difficult to be classified are selected and presented to the user for evaluation of selected image for k closest images.

Step 8: Update this process until to get the related image from the database depends upon the image query.

Experimental Results

This experiment is performed on the database which consists of 777 images. The test database consists of 120 images belonging to 20 categories. Its obtained from the concept CBIR research project image dataset [10].All images includes plants, landscapes etc… Then the retrieval accuracy is measured in terms of precision.

The precision re[presents the ratio of number of images in retrieved images relevant to the query to the number of retrieved images. The cost of precision is

$$\text{Precision} = \frac{\text{Number of relevant images selected}}{\text{Total number of retrieved images.}}$$

Query Image

Retrieved Images

Fig.3. Query with Retrieved Images

Table 1: Cost of Precision in Texture Primitive with Edge Features

Cost of Precision		
Images	Texture Primitive with Edge Features	
	Density Based Clustering	Differential evolution
1	0.84	0.89
2	0.82	0.89
3	0.85	0.92
4	0.92	0.95
5	0.87	0.91

Postlude

In this paper we implemented a new approach using differential evolutionary algorithm for content based image retrieval system by combining the texture primitive and edge feature. The proposed algorithm result shows increase in cost of precision based on the mutation when compare with the existing density based clustering algorithm. Using the proposed methodology the steps for computation gets reduced and the speed to retrieve an image gets increased. In future this can be enhanced by adding the image features such as contours, boundaries and regions.

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