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Fusion Approach for Content Based Image Retrieval by Utilizing Content and Model Annotations

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Abstract: Photography and television are playing a major role in facilitating the capture and communication of image data. Computers are the real engines of the imaging revolution bringing a range of techniques for digital image capture, processing, storage and transmission. In disparity to the text-based approach of such systems, CBIR maneuvers on a totally diverse attitude, salvaging stored images from a collection by matching features automatically mined from the images. Portrayal of content as well as its semantics is important in content based image retrieval. Even though the latest form of the CBIR System incorporates additional competent indexing techniques an improved user interface, the accuracy of retrieval is still low. Plentiful CBIR applications still depend on human categorized keywords for retrieval and deteriorating to emphasis on human interest point. This study proposes a fusion approach using neural network and genetic algorithm which exploits content and model annotations in to query refinement process. In order to reduce the semantic gap between the retrieved results and the user interest point, this study advises a two step approach which effectively incorporates the human interest point. Experimental results indicate that the fused approach doubled the accuracy and produced adequate results.

Key words: Neural network, Genetic algorithm, population, crossover, mutation

INTRODUCTION

Image retrieval can be categorized into two brands: text based and content based. Of text based system drawback like manual image annotation and bridging the gap between different keywords, Content Based Image Retrieval (CBIR) deal with users view point. Examples of such systems are given (Wang, 2009; Su *et al*., 2011).

Peng *et al*. (1999), Cox *et al*. (2000) and Rui and Huang (2000) have proposed various systems to bear out the perseverance of bridging the gap between the user point and retrieval system. In general, CBIR System works by providing an example image to search for similar images using a visual index. But customary methods are not ample for retrieving righteous results. Instinctive annotation is the merely elucidation for easy visual representation. Because of complex visual representations and annotations, the retrieval results often annoy users because those results are irrelevant.

Query reformation and user point of interest are two main causes to improve the query results. Some of the CBIR Systems provide slight assistance to the user to modify the query. Relevance feedback is the key solution which mends the quality of search results. Various Relevance Feedback (RF) modus operandi were used by researchers to bridge the gap between human perception and semantic annotation (Peng *et al*., 1999; Cox *et al*., 2000; Rui and Huang, 2000). To address the above problem, a fusion approach using Unsupervised Neural Network and genetic algorithm is proposed in this study. This method addresses the human perception by identifying his interest point and salvage according to his subjectivity.

Initially image segmentation and annotation is adopted by a method (Ambika and Samath, 2012) which analyzes image by subdividing the image to entities, choosing primitive entities and finally extracting feature signifiers possessed by these entities. Then, the system adopts RF to improve the retrieval efficiency. The important reason of using feedback is to find out the precise and exact image from the reteieval. Because retrieval result may also have irrelevant images with some similarity. First stage of this study uses (Ambika and Samath, 2013) an unsupervised neural network to cluster the images in to two distinct groups (relevant and irrelevant) based on the chracteristics of the user interest

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point. Genetic algorithm (Holland, 1992) provide a framework for studying the effects of such biologically inspired factors as mate selection, reproduction, mutation and crossover of genetic information. In the world of image processing, GA is used to compare the result fitness of various potential solutions. Many of business and research problems are computationally parodist the process by which regular selection drives and apply them to solve.

Evolutionary algorithm such as Genetic algorithm works based on natural biology (mutation, crossover and selection) used as an optimization technique for image retrieval. Optimization of Genetic algorithm is implemented by selecting the initial population called chromosomes which evolves a better solution. Evolution takes random generated individual from the initial population and will be repeated until evolution reaches its fitness. GA is an evolutionary learning algorithm capable of recognizing the preeminent distinctive direction associated with an object of every image and its importance through adaptive construct.

MATERIALS AND METHODS

Content analysis and annotation: Content analysis include preprocessing (Ambika and Samath, 2012) the image by fractioning in to individual segments with object and selecting key module from all the entities which will serve like a envoy element. Second step of preprocessing is assigning semantic annotations for all the objects by using the extracted visual descriptors of each image. The extracted visual descriptors are color histogram, grid based color histogram, edge histogram and texture descriptors which then are interpreted and labeled discretely.

This content analysis system accelerates finding resemblance among uncertainties. Rui and Huang (2000) termed a refinement process called Relevance Feedback (RF) to recuperate relevant images according to his point of interest. Outcome of the RF Method is then used for further refinement which is by fusion approach to optimize the result of retrieval process based on user point of interest. Further refinement using proposed approach described.

Fused approach (NN and GA): Architectural diagram for the proposed approach is illustrated in Fig. 1. This proposed approach assists the user to search images in large scale database with reasonable efficiency. Images are labeled in the content analysis and annotation system which then classified as R-relevant and IR-irrelevant.

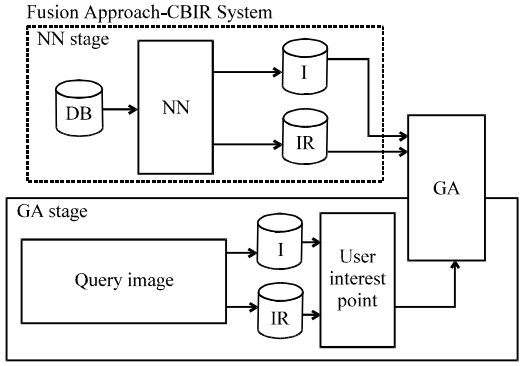

Fig. 1: Architectural diagram for fused approach

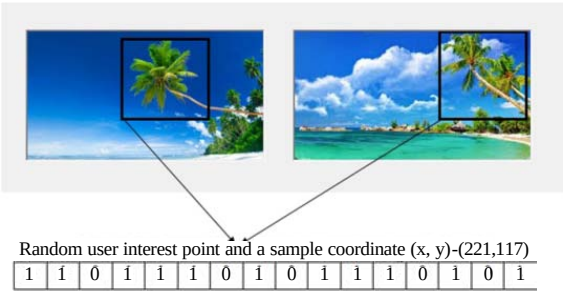

Fig. 2: User interest point and (x, y)

The proposed approach has two steps. In the first step, database images are classified in to two distinct groups such as R and IR. In this step, researchers used an unsupervised neural network (Ambika and Samath, 2013) to classify the images in to two different classes. After the classification user interest point is identified in the second step.

Sample of user interest point and (x, y) binary chromosome is shown in Fig. 2. Genetic algorithm is used to locate the exact image matching with the user interest point. Genetic algorithm is implemented by selecting every image from the classified class and performs a random search.

User interest point of an image random position x, y is initialized as initial population chromosomes of genetic algorithm. Because of random x, y position, researchers have used binary chromosomes to initial population and Single Point Crossover Method (Goldberg, 1989) has been used. Since, user interest is a fixed rectangle with size height and width (h×w).

A fitness function based on its association has been fixed and all the coordinates of the initialized chromosome will be identified as (x+h, y), (x, y+w), (x+l, y+w) where h and w are the height and width of the initial user interest point is fixed. Fitness function is defined as follows Eq. 1:

$$F = \frac{\sum_i \sum_j \left(Q_{ij} - \overline{Q}\right)\left(D_{ij} - \overline{D}\right)}{\sqrt{\left(\sum_i \sum_j \left(Q_{ij} - \overline{Q}\right)^2\right)\left(\sum_i \sum_j \left(D_{ij} - \overline{B}\right)^2\right)}} \quad (1)$$

Where:

Q_{ij} = The user interest point selected

D_{ij} = A point of the image on which the user interest point is bounded based on (x, y)

Complete block diagram of the CBIR System is shown in Fig. 3.

Algorithm for the proposed approach:

- Classification of data bases images based on analyzing the content and assigning labels based on annotations
- User interest point identification from the query image
- Each point is selected from the two distinct classes and random search is applied
- Random search based on matching location and check the similarity with user interest point
- Repeat step 4 until it reaches n no of iterations
- Check whether the fitness value is greater than the threshold value and rank it according to their fitness value
- Return the best closest matches as output of retrieval
- Stop the process

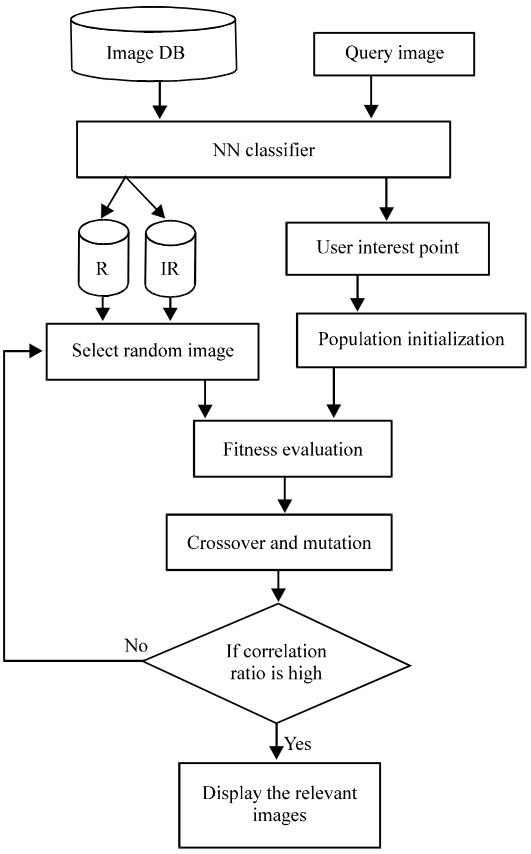

Fig. 3: Block diagram of the overall system

RESULTS AND DISCUSSION

The proposed fused approach for content based image retrieval by utilizing content and model based annotations has been implemented using MATLAB Version 7.8. The proposed system has been evaluated with different query images and higher order relevant images are retrieved from the image database. To achieve this process during preprocessing content analysis system annotates the images using content and model based annotation. Once the ontological captions are derived and further classified using unsupervised neural network.

In the experiment, total number of images taken for analysis was T =160 and categorized in to 3 classes. After the classification, Genetic algorithm was applied to retrieve the higher order relevant images. The parameters to perform the GA process were initial population size = 10, cross over rate = 0.5, mutation level = 0.2, maximum No. of generations = 20. After the mutation and crossover operations optimal chromosomes were selected based on user interest point. Maximum number of iterations I_{ij} = 100 to stop the process. To showcase the effectiveness of the proposed approach, one sample category image is shown in Fig. 4.

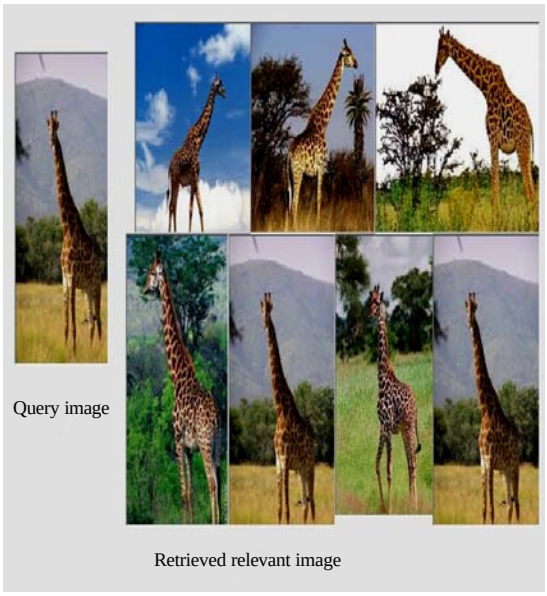

Fig. 4: Result of category giraffe

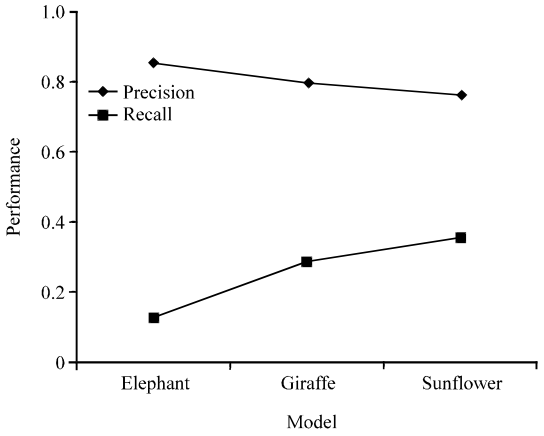

Fig. 5: Performance of the proposed system

Table 1: Relevancy performance measure

Model category	Precision	Recall
Elephant	0.80	0.16
Giraffe	0.75	0.30
Sunflower	0.72	0.36

Retrieval accuracy is defined by the usual precision and recall method. Precision and recall rate for 3 categories of images are displayed in Table 1 and Fig. 5.

CONCLUSION

In this study, researchers have proposed a fusion approach based on unsupervised neural network and Genetic algorithm to retrieve the relevant images by utilizing content and model based annotations. The retrieval performance of the system has been tested with different kinds of input query images. The results depicted that the fused approach shows the effectiveness by the retrieval of higher order images from the image database and be visualized by the precision recall value determined by the retrieval. In the future research, researchers will implement this fusion approach to create a digital photo management system for an educational institution.

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