

Image Retrieval Using Relevance Feedback Model

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Abstract— Content-based image retrieval systems (CBIR) have become very popular for browsing, searching and retrieving images from a large database of digital images. This system proposes clustering based Relevance Feedback to achieve high effectiveness and efficiency. In terms of efficiency, the iterations of feedback are reduced substantially by using the navigation patterns discovered from the user query log. In terms of effectiveness, system makes use of the discovered navigation patterns and query refinement strategies. Usage of data mining techniques like Apriori algorithm, KNN approach, K-Means clustering not only improved the efficiency of the CBIR systems, but also improved the accuracy of the overall process. Content-based image retrieval with relevance feedback, based on the clustering algorithm is a novel approach.

Keywords — Clustering, Relevance Feedback, indexing, Content based image retrieval, Frequent itemset mining

I. INTRODUCTION

Content-Based Image Retrieval (CBIR) is the main stay of current image retrieval systems. In a typical content-based image retrieval approach, a user submits an image based query which is then used by the system to extract visual features like shape, color or texture from images. These features are examined in order to search and retrieve similar images from image database.

The similarity of visual features between query image and each image in a database is calculated based on their distance by comparing the feature vectors of two images. The image retrieval system displays images, as the result of an image query that has the closest similarity according to the predefined threshold value in the system. The predefined threshold value is usually set in order to restrict the number of results that the content-based image retrieval system displays.

II. BACKGROUND STUDY

Ela Yildizer and Ali Metin Balci [2] proposed an approach to find a good similarity measure between images, which is one of the major difficulties of image retrieval systems. Similarity between two images is a subjective decision and many researchers

have used class labels of the images during the evaluation of image retrieval systems. This class label of images can be used to make use of this valuable information. Two images are said to be similar, when they belong to same class. Similar images belong to predefined classes with close probabilities. This research article uses Support Vector Regression (SVR) model to find the class probabilities. SVR is mainly defined for two class problems. System multi-class SVR handle multi-class image databases. This method reduces dimensions of feature vectors dramatically while enabling one to find a good similarity measure between images.

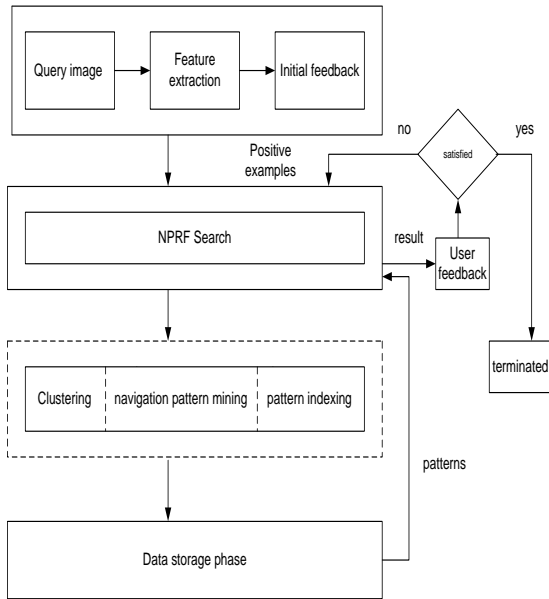
Ruofei Zhang et. al. [9] proposed an approach based on novel indexing and retrieval methodology that integrates color, texture and shape information for effective and efficient content based image retrieval. Samuel Rota Buló et. al. [11] proposed a novel approach for content-based image retrieval with relevance feedback, which is based on the random walker algorithm. This system proposes a novel method; Navigation Pattern based Relevance Feedback (NPRF) with user navigation pattern mining. By using NPRF method, the problem of exploration convergence and redundant browsing are solved and high quality of image retrieval on relevance feedback is achieved in a small number of feedbacks. Relevance feedback approach allows a user to interact with the retrieval algorithm by providing the information of which images user thinks are relevant to the query.

The proposed approach (NPRF) integrates the discovered navigation patterns and three relevance feedback techniques (Query Reweighting, Query Expansion, Query Point Movement) to achieve efficient and effective exploration of images. The solution takes advantage of exploited knowledge (navigation patterns) to assist the proposed search strategy in efficiently hunting the desired images.

III. FRAMEWORK

The proposed framework consists of a Corel database, Feature extraction, Knowledge Discovery Phase and NPRF search algorithm. Feature extraction involves extracting the meaningful information from the images, so that it reduces the storage required and hence making the system faster

and effective in CBIR. Once the features are extracted, they are stored in the database for future use. The degree to which a computer can extract meaningful information from the images is the most powerful key to the advancement of intelligent image interpreting systems. One of the biggest advantages of feature extraction is that, it significantly reduces the information (compared to the original image) to represent an image for understanding the content of that image. Proposed architecture diagram is given below.



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One of the biggest advantages of feature extraction is that, it significantly reduces the information (compared to the original image) to represent an image for understanding the content of that image. Color, texture and shape features are extracted from corel image database. The extracted pixel values are stored in the form of matfile. Three different feature extraction methods are used in the system and they are:

A. Color Histogram:

The most commonly used color model is RGB, where each component represents red, green and blue. A histogram of an image is produced first by discretization of the colors in the image into a number of bins, and counting the number of image pixels in each bin. The colour histogram provides meaningful information for measuring the similarity between two images. High effectiveness, simplicity, low storage requirements and real time application

possibility makes it the best among others.[3].A color in an RGB color space is represented by a vector with three Coordinates. When all three values are set to zero, the corresponding color is Black. When all three values are set to one, the corresponding color is white.

B. Gabor filter:

Is a linear filter used for edge detection. Its impulse response is defined by a harmonic function multiplied by a Gaussian function. Because of the multiplication-convolution property, Fourier transform of a Gabor filter's impulse response is the convolution of the Fourier transform of the harmonic function and the Fourier transform of the Gaussian function. The filter has a real and an imaginary component representing orthogonal direction. The two components may be formed into a complex number or used individually. A set of Gabor filters with different frequencies and orientations are helpful for extracting useful features from an image.

C. Edge orientation histogram:

Edge orientation histogram: Shape information of objects in images is also a very important image visual feature. Usually in a CBIR system, shape features of all images in the database are extracted and indexed including the query images also. The system then searches the database to find images with a similar shape features to the query image. Segmentation is the most important step during image shape feature extraction and includes many procedures such as noise removal and edge detection.

The algorithm used for edge orientation histogram is given below.

1. Input image should be a single-band image, but if it's a multiband image, only the 1st band will be used.
2. Compute 4 directional edges and 1 non-directional edge.
3. The output is a 4x4x5 matrix.
4. The image is split into 4x4 non-overlapping rectangular regions.
5. In each region, a 1x5 edge orientation histogram is computed. (Horizontal, vertical, 2 diagonals and 1 non-directional).

Relevance feedback is a powerful query modification technique in the field of content-based image retrieval. The key issue that arises in relevance feedback is how to effectively utilize the feedback information to improve the retrieval performance. This system presents a relevance feedback with user mining navigation pattern.[6] Relevant images that arise during the previous iterations are reasonably incorporated into the current iteration and the chosen relevant images can better capture user's information need. User selects a query image from the corel image database.

For that particular query image, positive examples will be displayed by calculating the similarity measures by Euclidean distance [7]. From the positive examples, user can select some relevant images. Similarly, different users can give different feedback for the same image. This will be stored in the database. These pixel values will be clustered by K means clustering algorithm which is an iterative technique that is used to partition an image into K clusters. Each K cluster is picked, either randomly or based on some heuristic. [1]

1. Assign each pixel in the image to the cluster that minimizes the distance between the pixel and the cluster center.
2. Re-compute the cluster centers by averaging all of the pixels in the cluster.
3. Repeat steps 2 and 3 until convergence is attained. (e.g. no pixels change clusters)

In this case, distance is the squared or absolute difference between a pixel and a cluster center. The difference is typically based on pixel colour, intensity, texture, and location, or a weighted combination of these factors. K can be selected manually, randomly, or by a heuristic [5]. This algorithm is guaranteed to converge, but it doesn't return the optimal solution. Quality of the solution depends on the initial set of clusters and the value of K .

C. Offline Knowledge Discovery Phase

This system proposes navigation-pattern based data structure permeated by the query point movement aspect, which has never been proposed by past studies. Through this data structure, the user's intention can be caught more quickly and precisely. The data structure can be viewed as a hierarchy, including positive images, query points, and clusters. A query session contains a set of iterative feedbacks (iterations), which is referred to as a navigation path. During each feedback, positive examples, which indicate the results picked up by the user, are used to derive a referred visual query point by averaging the positive visual features. Finally the query sessions, iterations, positive examples, and visual query points are stored into the original log database. If the original log data are ready, the next task is to discover navigation patterns from the original log data.

1) Data Transformation: Data transformation for visual content is a fundamental and important operation as it can simplify both the description of visual query points and the discovery of navigation patterns. Without the data transformation, all positive images of each query session have to be considered in the log database. If all positive images

are considered for navigation pattern mining, too many items make the frequent item set (navigation patterns) hard to find. Also, the mining cost is expensive.

2) Navigation Patterns Mining: This step aims to discover the relations among the users' browsing behaviors on relevant feedback. Frequent patterns mined from the user logs are regarded as useful browsing paths to optimize the search direction on RF, which will be stored in the database. In NPRF approach, the users' common interests are represented by the discovered frequent patterns (also called frequent item sets). Through these navigation patterns, the user's intention can be precisely captured in a shorter query process.

In this phase, Apriori-like algorithm is performed to exploit navigation patterns using the transformed data. The task for establishing the navigation model can be decomposed into two steps as:

1. Construction of navigation transaction table.
2. Generation of navigation patterns

3) Pattern Indexing: Navigation patterns can be regarded as the branches of the navigation pattern tree. Once the navigation patterns are generated, the query item in each navigation pattern is used as a seed (called query seed) to plant the navigation pattern tree. Therefore, if the cardinality of the clusters is 7, there are seven navigation trees generated in this stage. A tree contains a number of navigation paths, and each node of the path stands for an item consisting of several visual query points.

A visual query point indicates a set of positive images. In particular, to decrease the complexities of pattern search and pattern storage, the redundant navigation patterns have to be pruned further. Redundant patterns are eliminated by pattern redundancy checking. The trimmed navigation pattern tree reduces the search cost significantly. Based on the navigation pattern tree, the desired images can be captured more promptly without repeating the scan of the whole image database at each feedback, especially for the large-scale image data.

D. NPRF Search

NPRF Search is proposed to reach the high precision of image retrieval in a shorter query process by using the valuable navigation patterns. NPRF Search algorithm is triggered on reception of the following input:

1. Set of positive examples G and negative examples N determined by the user at the preceding feedback.
2. Set of navigation patterns
3. Accuracy threshold (thrd)

1. Generate a new query point by averaging the visual features of positive examples.
2. Find the matching navigation pattern trees by determining the nearest query seeds (root).
3. Find the top s relevant visual query points from the set of the nearest leaf nodes.
4. Finally, the top k relevant images are returned to the user.

1) *Query Point Generation:* The basic idea of this operation is to find the images with the specific similarity function. By recursively modifying the query point, the search direction can move towards the targets gradually. Assume that a set of images is found by the query point (qpol) at the preceding feedback. Next, the visual features of the positive examples, G, picked up by the user are first averaged into a new query point.

2) *Query expansion:* Exploration convergence problem is solved by performing a weighted KNN search. The proposed method first determines the nearest query seed to each of G, called positive query seed, and the nearest query seed to each of N, called negative query seed. A set of positive query seeds is selected to be the start of potential search paths. Additionally, the slight loss of the information embedded in the negative examples is also deliberated.

query seed set and the negative query seed set at each feedback. Dropping the negative query seeds

IV. CONCLUSIONS

The research scope of this paper focused on the development of CBIR systems for effective and efficient retrieval of images. The results of the proposed approach are very promising. The proposed approach is unique in integrating several aspects of data mining. We used a very well known clustering algorithm K Means clustering and KNN approach for classifying the features. The experimental results reveal that the proposed approach, 'NPRF' is very effective in terms of precision and coverage. Within a very short term of relevance feedback, the navigation patterns can assist the users in obtaining the global optimal results. Moreover, the new search algorithm NPRF Search can bring out more accurate results than other well-known approaches.

REFERENCES

- [1] IAlami M.E, (2011) "A novel image retrieval model based on the most relevant features," Elsevier Science , Knowledge-Based Systems,vol 24,pp 23–32.
- [2] Ela Yildizer, Ali Metin Balci, Mohammad Hassan and Reda Alhajj, (2012) " Efficient content-based image retrieval using Multiple Support Vector Machines Ensemble," Elsevier science , Expert Systems with Applications,vol 39,pp 2385–2396.
- [3] Jun Yue, Zhenbo Li , Lu Liu and Zetian Fu, (2011) "Content-based image retrieval using color and texture

would lead to the loss of positive query seeds. These dropped negative seeds may be the start of good search paths. Both positive and negative information are taken simultaneously, every seed has its own token rth.chk. If the seed owns the maximum number of negative examples or owns no positive example, it will be tokenized as a bad manner. search. The proposed method first determines the nearest query seed to each of G, called positive query seed, and the nearest query seed to each of N, called negative query seed. A set of positive query seeds is selected to be the start of potential search paths. Additionally, the slight loss of the information embedded in the negative examples is also deliberated.

In theory, if the negative query seeds are all dropped at each feedback, the desired results could be captured more precisely. However, there exists some query seeds belonging to both of the positive query seed set and the negative query seed set at each feedback. Dropping the negative query seeds would lead to the loss of positive query seeds. These dropped negative seeds may be the start of good search paths. Both positive and negative information are taken simultaneously, every seed has its own token rth.chk. If the seed owns the maximum number of negative examples or owns no positive example, it will be tokenized as a bad manner.

fused features," Elsevier Science, Mathematical and Computer Modelling ,vol 54, pp 1121–1127.

- [4] Kim D.H and Chung C.W, (2003) "Qcluster: Relevance Feedback Using Adaptive Clustering for Content-Based Image Retrieval," Proc.ACM SIGMOD.