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Re-Ranking Web Images

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Abstract: ***Image Search engines mostly use keywords and they rely on text for searching images. The search based on only keywords fire by the users is not efficient and may results in imprecise output. The major bottleneck is likely mismatch between the image content and the given text. Image search reranking attempts to resolve this bottleneck by relying on both the text information and visual information during the image search process. This paper reviews the trends in image search reranking, discusses the problems found along the way, and identifies the ideas that should guide future activities in this research. According to the paper by Xiaogang Wang, Shi Qiu, Ke Liu, and Xiaoou Tang, images are re-ranked by comparing their semantic signatures and the query keyword [1]. The query-specific semantic signatures, in the reviewed paper, improve both the accuracy and efficiency of the re-ranking process. In literature, experimental result shows that by using the re-ranking technique they can improve the web image search. In this reviewed paper, different types of web image search re-ranking techniques are explained.***

Keywords: image re-ranking, framework, query image, query keyword, image search, semantic signature.

1. Introduction

Most of web image search engines use keywords as queries and rely on the text to search images. Thus, suffer from the ambiguity of query keywords, because it is hard for users to accurately define the visual content of target image only using keywords. For example, using "apple" as a query keyword, the retrieved images belong to different categories also called concepts in this paper, such as "red apple," "apple logo," and "apple laptop." In order to solve the ambiguity, different techniques are is widely used. In the method reviewed in this paper, a query keyword is first used to retrieve a set of images. Then the user is asked to select an image from these retrieved images. Also, the remaining of the images is ranked based on their visual similarities. The major challenge is the correlation of similarities of visual features and images' semantic meaning, which are needed to interpret users' intention to search. Recently, it has been proposed to match images in a semantic space that used attributes or reference classes closely related to the semantic meanings of images as basis. However, characterizing the highly diverse images from the web is difficult because it is impossible to learn a universal visual semantic space. The main objective of this paper is to provide accurate result based on keyword as well as comparing the semantic signatures of images to provide re-ranked images for the users. Query Specific Semantic Signatures technique gives the proper way to search the web images.

2. Literature Survey

Recently, for general image recognition and matching, there have been a different works on using projections over predefined concepts, attributes or reference classes as image signatures. The classifiers of concepts, attributes, and reference classes are trained from known classes with examples. But the knowledge learned from the known classes can be transferred to recognize samples of novel classes which have few or even no training samples. Since these concepts, attributes, and reference classes are defined with semantic meanings, the projections over them can well capture the semantic meanings of new images even without further training. Rasiwasia *et al*. [2] mapped visual features to a universal concept dictionary for image retrieval. Attributes with semantic meanings were used for object detection and recognition, face recognition, action recognition, image search and 3D object retrieval. Lampert *et al*. [3] predefined a set of attributes on an animal database and detected target objects based on a combination of human-specified attributes instead of training images. Parikh and Grauman [4] proposed relative attributes to indicate the strength of an attribute in an image with respect to other images. Some approaches transferred knowledge between object classes by measuring the similarities between novel object classes and known object classes called reference classes. For example, Torresani *et al*. [5] proposed an image descriptor which was the output of a number of classifiers on a set of known image classes, and used it to match images of other unrelated visual classes.

3. Techniques for Image Re-ranking

Computing the visual similarity that shows the semantic relevance of images which is the key component of image re-ranking. Many visual features have been developed in recent years. However, the effective low-level features are different for different query images. Therefore, Cui *et al*. [6], [7] classified the query images into eight predefined categories and gave different feature weighting schemes to different types of query images. But to cover the large diversity of all the web images was difficult for the eight weighting schemes. And also possibility of query image to be classified to a wrong category. Query-specific semantic signature was first proposed to reduce the semantic gap. There is a lot of work on to re-rank images which are retrieved by initial text-only search using visual features, however, without requiring users to select query images. Jing and Baluja proposed Visual Rank to analyze the visual link structures of images and to find the visual themes for re-ranking. Cai *et al*. re-ranked images with attributes which were manually defined and learned from manually labeled training samples. These approaches assumed that there was one major semantic category under a query keyword. Images were re-ranked by

modeling this dominant category with visual and textual features.

Re-Ranking without Query Images

Query-specific semantic signature can be applied to image re-ranking without giving query images. This application requires the user to input a query keyword. But it assumes that images returned by initial text-only search have a given topic and images belonging to that topic should have higher ranks. This approach typically addresses two issues: (1) how to compute the similarities between images and reduce the semantic gap between them; (2) how to find the dominant topic with any ranking algorithms based on the similarities of images. The query-specific semantic signature is effective in this application since it can improve the similarity measures of images and also it is crucial to reduce the semantic gap when computing the similarities of images. Due to the ambiguity in query keywords, there may present multiple semantic categories under one keyword query. These approaches cannot capture user's search intention accurately without query images selected by users.

4. Conventional Image Re-Ranking Framework

Major web image search engines have adopted one-click feedback strategy [8]. It is an effective way to improve search results and its interaction is simple enough. Its diagram is shown in Fig. 1. Given a query keyword input by a user, a bunch of images relevant to the query keyword is retrieved by the search engine according to a stored word-image index. The size of the returned image pool is fixed, e.g., containing 1000 images.

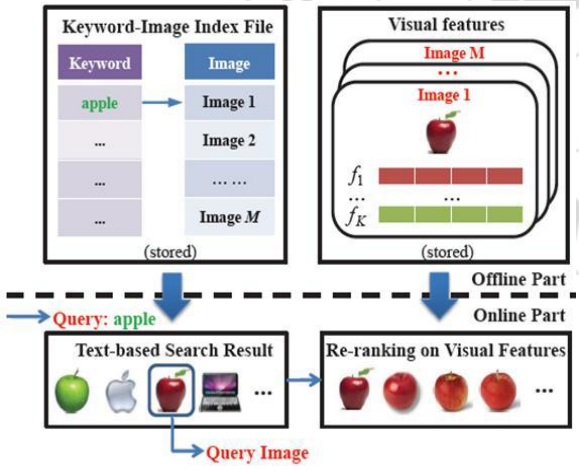

Figure 1: The conventional image re-ranking framework

The user is asked to select a image which is query from the pool of image. This image tells the user's search intention and the remaining images in the pool are re-ranked based on their visual similarities with the given query image. The word-image index file and visual features of images are pre-computed and stored at offline stage. The main online computational work is comparing visual features. To achieve good efficiency, the visual feature vectors need to be short and their matching needs to be fast. Some visual features are in high dimensions and efficiency is not satisfactory if they matched directly. In this approach, reference-classes are applied to all the images and they are defined manually. They are suitable for offline databases such as animal data-bases and face databases, since image classes in these databases may share similarities in a better way.

5. Image Re-Ranking Framework Using Semantic Signature

The image re-ranking focuses on the semantic signatures of the required images. These semantic signatures needed for the re-ranking are derived from the visual features of the images. The diagram of the approach is shown in Fig. 2. It has offline and online parts. At the offline stage, the reference classes which represent different concepts related to query are automatically discovered and their related images are automatically collected in several steps. For a query keyword apple, automatic selection of a set of most relevant keyword expansions such as red apple and apple laptop is performed utilizing both textual and visual information. This set of keyword defines the reference classes for the given query keyword. In order to obtain automatically the training examples of a reference class, the keyword expansion for example red apple is used to retrieve images by the search engine again based on textual information. Images retrieved by the keyword expansion red apple are much less diverse than those retrieved by the original keyword apple.

Examples of a reference class, the keyword expansion for example red apple is used to retrieve images by the search engine again based on textual information. Images retrieved by the keyword expansion red apple are much less diverse than those retrieved by the original keyword apple. To better measure the similarities of semantic signature, and the correlation between reference classes is estimated with a web-based kernel function. By a query keyword, the semantic signature of an image is pulled by computing the similarities between the image and the reference classes of the query keyword using multiclass classifier. If there are K types of visual/textual features, like color, shape and texture, one could combine them together to make a single classifier, which pulls one semantic signature for an image. There also can be separate classifier for each type of feature. Then, the K classifiers based on different features extract K semantic signatures of the image, which are combined at the other stage of image matching. An image may be associated with several query key-words, which have different semantic spaces according to the word-image index file. Therefore, it may have different semantic signatures. The query keyword input by the user is important in deciding which semantic signature to choose. As an example shown in Fig. 2, an image is associated with three keywords apple, mac and computer. When using any of the keywords from apple, mac, or computer as query, image will be retrieved and re-ranked. However, by different query keywords, different semantic spaces are used. Therefore an image could have several semantic signatures obtained in different semantic spaces. They all are computed and stored at offline stage. At the online stage, according to the query keyword, the search

engine retrieves a pool of images. Since all the images in this bunch are associated with the query keyword, they all have pre-computed semantic signatures in the same semantic space specified by the query keyword. When the user chooses a query image, these semantic signatures are used to compute similarities of the images for re-ranking. The conventional framework compares images based upon their visual features. Compared with the conventional image re-ranking diagram in Fig. 1, the new approach is much more efficient at the online stage, because the main online computational cost is on comparing semantic signatures and the lengths of semantic signatures are much shorter than those of low-level visual features.

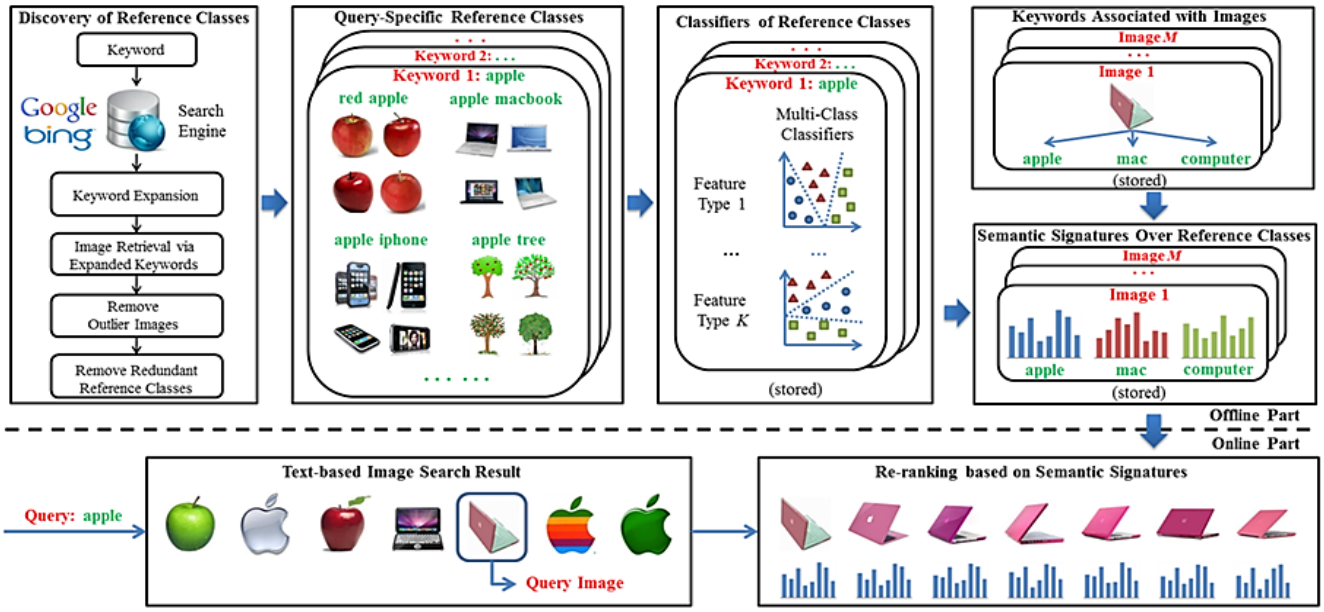

Figure 2: New image re-ranking framework.

6. Conclusion

This paper reviewed an Internet based image search approach, also discussed the conventional web-based image search techniques. The reviewed image re-ranking framework overcomes the shortcomings of the previous methods and also improves both the accuracy and efficiency of the re-ranking process. It captures user's intention using a query image. It takes query-specific semantic spaces to improve the effectiveness and efficiency of online image re-ranking. Visual features of the images are combined with their related semantic spaces automatically learned through keyword expansions offline. The extracted semantic signatures are shorter than the original visual features of the images. In future work, image re-ranking can be improved by adding other metadata and log data along with the textual and visual features for finding the keyword expansions which are used for defining the reference classes. The log data of user queries provides useful co-occurrence information of keywords for keyword expansion. Finally, in order to further improve the quality of re-ranked images, they should be re-ranked not only by content similarity but also by the visual quality of the images.

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