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Improved Web Image Re-ranking using Query-Specific Semantic Signatures and Hashing

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Abstract

Nowadays, a very significant feature of web image search engine is image re-ranking to improve the search results. In this paper, a new technique is proposed for web-scale image re-ranking. The mentioned technique is very useful in giving specific results to users in just one click. In this, different semantic spaces for different query keywords can be found offline independently and automatically. Semantic signatures of the images are acquired by projecting their visual features into their related semantic spaces and these semantic signatures are compacted using Hashing techniques. At the online stage, these compacted semantic signatures of images are to be compared to re-rank images. It considerably betters the efficiency and accuracy of web-image search and re-ranking.

Keywords*: Image re-ranking, query keyword, query image, keyword expansion, visual query expansion, image search, semantic space, semantic signature, Hashing.*

I. Introduction

In the past few years, internet has been spread widely all over the world and because of it image database on the internet has become huge. Searching the right image from such a huge database is a very difficult task. Mainly there are two approaches used by internet scale search engines. First is text-based image search. Many commercial internet scale image search engines use this

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approach. They use only keywords as queries. Users type query keywords in the hope of finding a certain type of images. The text-based search result is ambiguous. Because keywords provided by the users tend to be short and they cannot describe the actual visual content of target images just by using keywords. The text-based search results are noisy and consist of images with quite different semantic meanings. For example, if "apple" is entered by the user to a search engine as a query keyword, the search results may belong to different categories such as "green apple," "red apple," "apple logo," "apple laptop" and "apple iphone" because of the ambiguity of the word "apple". To overcome this problem of ambiguity of keywords, text-based image search alone is not enough. Additional information has to be used to capture users search intention. As a solution to this problem, the second approach, content based image search with relevance feedback is then introduced. For this multiple relevant and irrelevant image examples are to be selected by the users. Through the online training, the visual similarity metrics are learned from them, from which re-ranking of images is performed. But a lots of user interventions is needed in this approach and hence it is very time consuming and not appropriate for commercial web-scale search engines. A combination of both above approaches is useful. But to effectively improve the search results, online image re-ranking should limit users' effort to just one-click feedback. In this a major challenge is that sometimes the visual feature vectors are large in size and thus it slows down their matching speed. Also, to acquire the users' search intentions, the resemblance of low-level visual features and images' high-level semantic meanings should correlate, but it does not happen always. However, there have been many studies to decrease this semantic gap.

II. Related Work

W. Ma and B. S. Manjunath proposed NeTra, which is a prototype image retrieval system. It utilizes color, shape, texture and spatial location information in fragmented image section for searching and extracts similar section from the database. The search based on object or region is permitted in this system and the quality of image retrieval is also improved when images include many complex objects [2].

Most of Pseudo-Relevance feedback techniques limit users' effort by extending query image with maximum visually similar images. R. Yan et al. introduced a concept to give user approiate images in just a one click. Semantic gap between query image and other visual inconsistent images results into poor performance. In this, top N images which mainly visually match with the query image are considered as extended positive examples for obtaining a resemblance metric. But the top N images are not essentially semantically related to the query image, thus the

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obtained resemblance metric may not always show the semantic relevance and may even deteriorate re-ranking performance [4].

Cui et al. did classification of query images into eight pre-identified intention classes and different types of query images are given different feature weighs. But the huge variety of all the web images was difficult to cover up by the eight weighting schemes. In this, a query image was to be categorized to a wrong class [5].

Cai et al. recommended matching the images in semantic spaces and re-ranking them with attributes or reference classes which were manually defined and learned from training examples which were manually labeled. They supposed that there was one main semantic class for a query keyword. Re-ranking of images is done by using this main category with visual and textual features. Still it is tough and inefficient to learn a universal visual semantic space to express highly varied images from the web [7].

III. Existing System

In the existing system, there is given a novel framework for web-scale image re-ranking. It learns query-specific semantic spaces to considerably advance the success and efficiency of online image re-ranking. It derives query-specific semantic signatures of images by projecting their visual features into their related semantic spaces. It gives relevant results to users in just one-click.

Although the existing system is very good, there are some limitations of it. Even if the semantic signatures are already short, still they require much place to store. So they can be further reduced to increase their matching efficiency. The method to find the keyword expansions to describe the reference classes can be improved.

IV. Proposed System

The proposed method requires less time and acquires less memory as compared to existing method. It gives more relevant results to users than the existing system in just one click. In the proposed system, the semantic signatures are compacted using Hashing method. The visual query expansion is introduced to obtain more positive image examples which are more specific

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to a query image and can give more relevant results. Also in the keyword expansion synonyms are added to get better results.

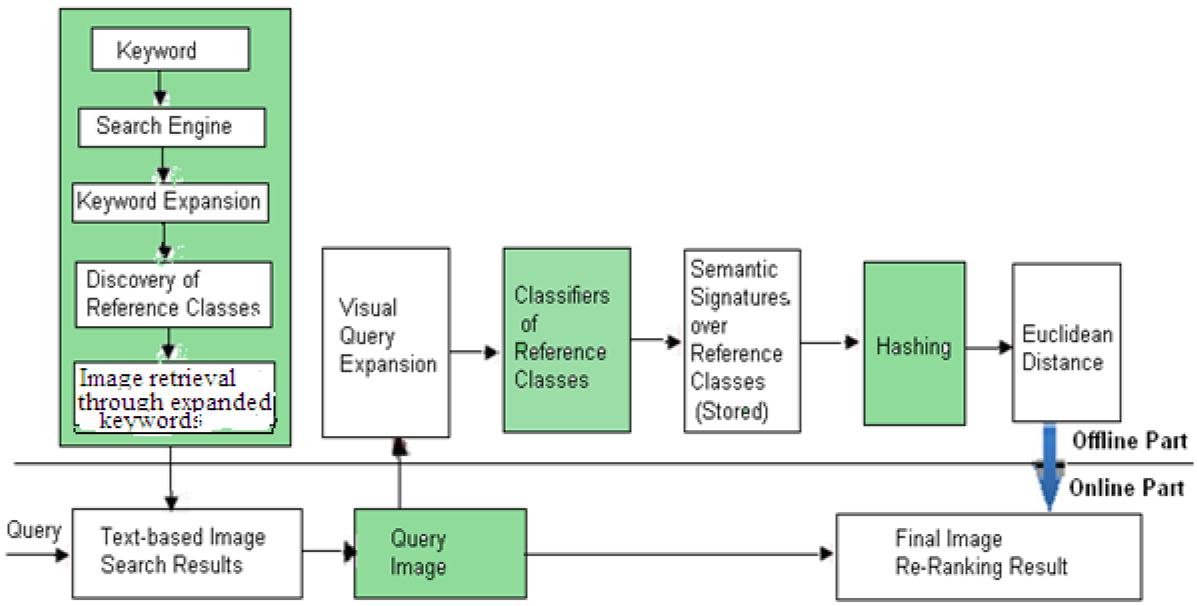

Fig.1.Proposed image re-ranking framework

The proposed system works as follows:

1. There are two parts: offline part and online part as shown in above Fig. 1.
2. Firstly, a user has to submit a text query for searching images. This text will be taken as a query keyword by the search engine.
3. Then at the offline stage, Keyword Expansion is done to accurately capture the user's search intension by considering the words frequently co-occurring with the query keyword and synonyms and meaning of query keyword. These keyword expansions will be taken as reference classes of the query keyword.
4. Then images of expanded keywords will be retrieved.
5. After that, a user has to select one query image. And at the offline stage, the visual query expansion is done automatically just by one click on query image to get multiple positive example images specific to the query image to accurately users' intention.
6. The new image re-ranking framework focuses on the semantic signatures associated with the images derived using a trained multiclass classifier. The semantic signatures of the query

image and visually expanded images are acquired by comparing their visual features with the reference classes of the query keyword using this trained multiclass classifier.

7. Also the semantic signatures of the remaining images in the image set are derived in similar manner in the same semantic space of the query keyword.
8. These semantic signatures are further reduced by using DCT-based perceptual hashing techniques to further increase their matching efficiency. The study says that Perceptual hash is reliable and fastest algorithm for web-based applications.
9. As all the images in the image set have pre-computed hash values. So at the online stage, the images in this set are re-ranked by comparing their hash values, using Euclidean Distance formula to compute image similarities with the query image.
10. And these finally re-ranked images are displayed to user.

V. Results and Discussions

The images for testing the performance of the proposed system can be collected from different search engines. Given a query keyword, 120-125 images can be retrieved from the whole web using a search engine. We used many query keywords which includes different topics such as object, plants, food, scene, animals, etc. We took averaged top m precision as the estimation measure because users are more interested in knowing the quality of top ordered images than the number of related images retrieved in the entire resultant set. The proportion of significant images upon the top m re-ranked images is called the top m precision. The images belonging to the same class of query image are the relevant images. Averaged top m precision is acquired by taking average of all the queries.

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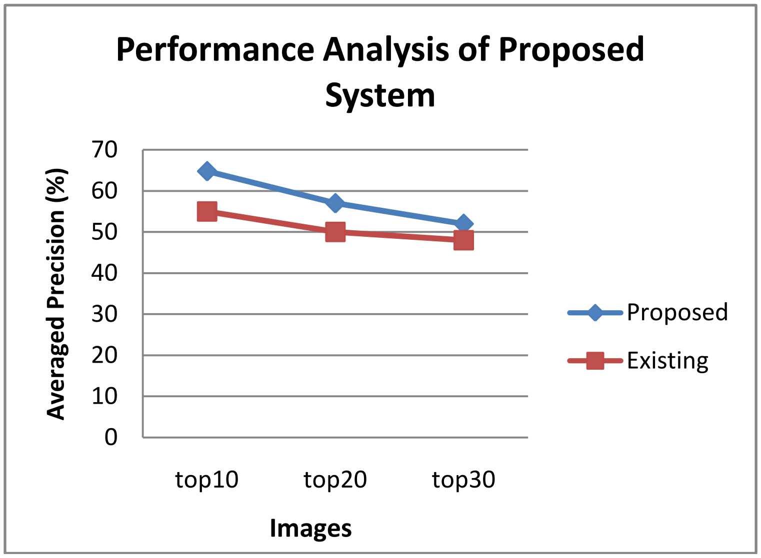

Fig.2 Comparison of Existing System and Proposed System

From the above graph, it is clear that averaged top m precision of proposed system is better than the existing system. Averaged top 10 precision of the proposed system is 64.78% while for the existing system, it is 55% and so on for top 20 and top 30 precision. Thus proposed system is more accurate and efficient than the existing system.

VI. Conclusion

The proposed system gives better results of web-scale image re-ranking than the existing system and also considerably gets better in both the accuracy and efficiency of the re-ranking method. It can capture users' intention just by one click on a query image and more positive example images can be obtained for more relevant results. Query-specific semantic spaces can be used to get more improvised re-ranking of images. The extracted semantic signatures can be reduced using Hashing methods to reduce concerned time complexity of comparison of image contents.

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