

Review on Image Based Re-ranking of Web Pages to Improve Search Results

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ABSTRACT: Pictures are easy to understand, but still modern Web search engines ignore the pictures in HTML pages. They retrieve the documents merely by comparing the query keywords with the text in the documents. Of course this text includes the words in image captions and markup tags, but they ignores the pixels themselves. Traditional Web search engines do not use the images in the HTML pages to find relevant documents for a given query. Instead, they typically operate by computing a measure of agreement between the keywords provided by the user and only the text portion of each page. So we can use the content of the pictures appearing in a web page to enrich the semantic description of an HTML document and consequently boost the performance of a keyword-based search engine using re-ranking technique.

KEYWORDS: search engine, image retrieval, Web Pages, re-ranking.

I. INTRODUCTION

By giving a textual query in traditional text-based image retrieval (TBIR), relevant images are to be re-ranked using visual features after the initial text-based search. In the last few years large-scale image retrieval has attracted a lot of attention from the multimedia community. Usual approaches addressing this task first generate an initial ranking of the reference images using fast approximations that do not take into consideration the spatial arrangement of local features in the image. Retrieving relevant images from a large collection of database images has become an important research topic. Over the past decades, many image retrieval systems have been developed, such as text-based image retrieval (TBIR) and content-based image retrieval. Web image search using text queries has received considerable attention. However, current state-of-the-art approaches require training models for every new query, and are therefore unsuitable for real-world web search applications. Automatically finding images relevant to a textual query remains a very challenging task.

Various systems and search engines are available for easy access and retrieval of relevant multimedia content, most of them rely on textual data associated with the visual contents. Despite being efficient and fairly successful, such systems suffer vastly from the well-known semantic gap in addition to being highly noisy and ambiguous. In order to address such problems, content-based image retrieval and in particular, partial or near-duplicate image search where a query image is used to retrieve images that share certain visual elements have become a key element in many image and video search systems. Inspired by natural language processing methods, most state-of-the-art image retrieval techniques rely on the Bag of Words (BoW) model. Typically, visual words are used to efficiently encode the visual appearance of salient local features, initially described using high-dimensional descriptors, such as SIFT. The exclusive reliance on text-based technology to search the Web is explained by the challenges posed by the handling of image data. Automatic image understanding is still today computationally expensive and prone to mistakes. In this paper we propose a novel document retrieval approach that uses the content of the pictures in the Web pages to boost the accuracy of pure text-based search engines.

II. RELATED WORK

For large-scale TBIR(text-based image retrieval) Lixin Duan, Wen Li, Ivor Wai-Hung Tsang, and Dong Xu[2], propose a new bag-based re-ranking framework. Specifically, it first cluster relevant images using both textual and visual features. By treating each cluster as a “bag” and the images in the bag as “instances,” thus it formulate this problem as a multi-instance (MI) learning problem. It gives an automatic bag annotation method to automatically find positive and negative bags for training classifiers, using which it can achieve the best performance, as compared with other traditional image re-ranking methods on WIDE data set.

Marius Muja and David G. Lowe[6], addresses the problem of fast nearest neighbor search in high dimensional spaces, a core problem in many computer vision and machine learning algorithms and which is often the most computationally expensive part of these algorithms. They present and compare the algorithms we that found to work best at fast approximate search in high dimensional spaces: the randomized k-d trees and a newly introduced algorithm, the priority search k-means tree. It introduce a new algorithm for fast approximate matching of binary features. It also addresses the issues arising when scaling to very large size data sets by proposing an algorithm for distributed nearest neighbor matching on compute clusters.

Lingxi Xie, Jingdong Wang, Bo Zhang, and Qi Tian[4], formulates fine-grained image search, a challenging topic which is less studied in the multimedia community. It proposes a new and interesting problem named fine-grained image search, which means that we prefer those images containing the same fine-grained concept with the query. It construct a new database and suggest a hierarchical scoring function to evaluate different search engines.

Zhong Ji, Yanwei Pang, and Xuelong Li[3], proposes an idea based on the hypersphere in one-class classification, the feature extraction and ranking function problems in image search re-ranking have been addressed in this paper. This paper proposes a feature extraction algorithm named Hypersphere-based Relevance Preserving Projection (HRPP) and a ranking function called Hypersphere-based Rank (H-Rank). Specifically, the proposed HRPP algorithm transforms the original visual features space into an intrinsically low-dimensional space by preserving the manifold structure and relevance relationship among the images. The proposed H-Rank algorithm sorts the images with their distances to the hypersphere center.

Xiaopeng Yang, Tao Mei, Yongdong Zhang, Jie Liu, and Shin'ichi Satoh[7], this paper addresses the issue of leveraging click-through data to reduce the intent gap of image search. It propose a novel image search re-ranking approach, named spectral clustering re-ranking with click-based similarity and typicality (SCCST). In this proposed re-ranking scheme, click information is fully adopted to guide the image similarity learning and image typicality learning.

III. APPROACH OVERVIEW

The architecture of our system is schematically illustrated in Fig. 1. Let D be the database of Web pages. In order to produce the list of relevant documents for an input query q , we use a re-ranking strategy combining traditional text-retrieval methods with the visual classifier learned for query q :

- 1) The query q is provided as input to a text-based search engine S operating on D to produce a ranking list r of K candidate pages (Fig. 1a).
- 2) In parallel, the query q is issued to a keyword-based image search engine (in this work the visual search service of Bing Images is used); the top M image results I^+ are used as positive examples to train a visual classifier recognizing the query in images.
- 3) The list of pages r is resorted (Fig. 1c) by taking into account several image features including the classification scores produced by evaluating the visual classifier on the pictures of the K candidate pages.

The key intuition is that when the query represents a visual concept, i.e., a concept that can be recognized in images, the learned visual classifier can be applied to increase or decrease the relevancy of a candidate page in the ranking list depending on whether the document contains pictures exhibiting that visual concept.

a. Re-ranking of Documents using Images

We now describe in detail our re-ranking model, including our learning approach and the features used by it. Let q denote the input query, corresponding to the keywords issued by the user for the search. We use a query-relative

representation of the documents: let $x^{(q,i)} \in \mathbb{R}^d$ the feature vector describing the i^{th} document in the database D relative to query q . Given an input query q , our approach enables real-time computation of the vector $x^{(q,i)}$ for each document i .

The Query-Document Features

It present query-document features for image-based re-ranking. For clarity only those features are present that found to be beneficial in terms of improving the ranking accuracy.

- Text features: ‘relevance score’ and ‘ranking position’ of document i in the ranking list r produced by the text-based engine S for input query q . The ‘relevance score’ feature is a numerical value indicating the relevancy of the document i for query q , as estimated by S , purely based on textual information. The ‘ranking position’ is the position of i in the ranking list r . By including these two features we can leverage the high-accuracy of modern text-based search.
- Visual metadata features: ‘linked images’ and ‘valid images’. These attributes are used to describe whether the document contains many images. We expect that this information can be useful to the image-based re-ranker as it reveals whether the page contains a good amount of visual information. The feature ‘linked images’ is simply the number of images linked in the Web page. The feature ‘valid images’ gives the total number of images in the page.
- Query visualness features: ‘visual classifier accuracy’ and ‘visual concept frequency’. These entries are features dependent only on the query (i.e., they are constant for all documents) and describe the general ability of the visual classifier learned for query q to recognize that concept in images.

Based on these features of images the re-ranking of web pages can be performed.

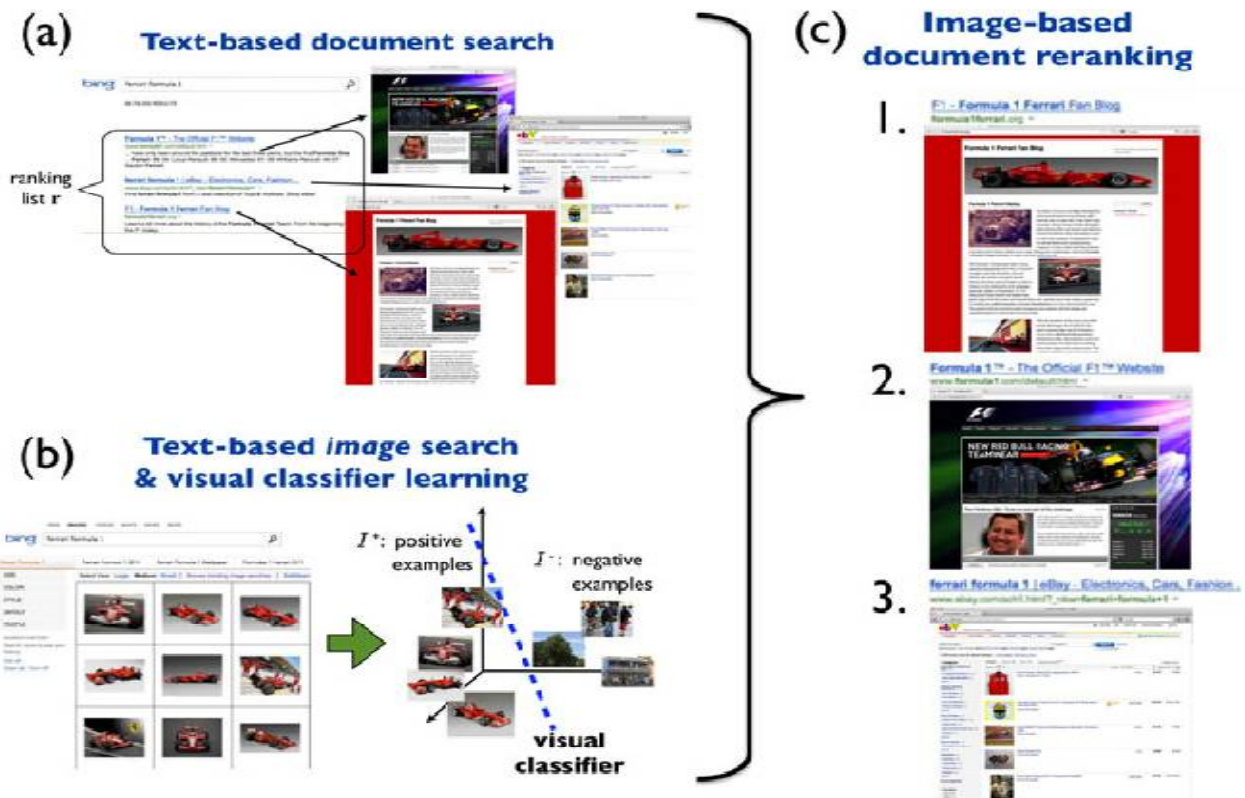


Fig. 1. Method overview: the query q is issued (a) to a document search engine producing a ranked list r of Web pages and (b) to a text-based image search engine yielding positive training image examples to learn a query-specific visual classifier. Finally, (c) the visual classifier is used to re-rank the pages in the ranking list r .

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b. Image Search Re-Ranking with Click-Based Similarity and Typicality

In order to overcome the semantic gap and the intent gap simultaneously, we can integrate multiple visual modalities and click-through data with learning image similarity and typicality, and present a novel image search re-ranking approach, named spectral clustering re-ranking with click-based similarity and typicality (SCCST). To mine implicit feedback from users, i.e., click-through data, for reducing intent gap, we develop two click-based assumptions (assumption 1 and 2), and combine them with the traditional assumption (assumption 3) as follows:

- 1) Images with more clicks have higher typicality than the ones with no or relatively less clicks,
- 2) Clicked images are more similar with each other than a clicked image with an unclicked one, and
- 3) Visually similar images should be close in a ranking list.

Based on the above assumptions and the commonly used strategy images with higher relevance should be ranked higher than others, so the propose novel image search re-ranking approach, named spectral clustering re-ranking with click based similarity and typicality (SCCST).

IV. CONCLUSION

In this paper different methods are discussed for how to use images to improve Web document search. We have demonstrated that by using modern methods and representations for image understanding, it is possible to enrich the semantic description of a Web page with the content extracted from the pictures appearing in it. While in this work we have focused on a re-ranking strategy also it addresses the issue of leveraging click-through data to reduce the intent gap of image search. We propose a novel image search re-ranking approach, named spectral clustering re-ranking with click-based similarity and typicality (SCCST).

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