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Image Search by Using Various Reranking Methods

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Abstract :*The Image reranking is one of the effective methods for improving the web image search. The search engines are mostly based on text and constrained as the user search by keyword which results into uncertainty among images. Due to which noisy or irrelevant images may be present in the retrieved results. The purpose of image search re-ranking is to reorder retrieved elements to get optimal rank list. The existing visual reranking methods improve text-based search results by making the use of visual information present in them. These methods are based on low-level visual features, and do not take into account the semantic relationship among images. A main challenge in the research of image re-ranking is that the similarities of visual features do not well associate with semantic meanings of images which infer users search goal. Various reranking methods are developed which are used for image search techniques for different queries. Each method is differentiated with other method and comparative analysis of methods is presented. This paper presents a detail review of different image retrieval and reranking approaches. The purpose of the survey is to provide an overview and analysis of the functionality, advantages, and disadvantages of the existing image reranking methods, which can be useful for researchers for developing effective system with more accuracy.*

Key Words: Image Re-ranking, Search Engines, Visual Features, Image Retrieval

1. INTRODUCTION

The image Reranking is an efficient technique to improve the results of web based image search [1]. It has been implemented by existing industrial search engines like Google, Bing and so many. For a given query keyword, search engine re-ranks the group of images based on the query. Then the user pick a particular image from the set, the rest of the images are re-ranked based on the user selected image.

The huge growth of digital images over the web required the best image retrieval technique that can improve the retrieval accuracy of the images. Hence research focus has been shifted from designing of complicated algorithms that can reduce the semantic gap between visual features and the richness of human semantics. Thus many image re-ranking techniques has been proposed to enhance the text based image results by taking the advantage of visual information contained in the images.

Image search is a broadly growing feature of well-known search engines namely `Google', `Yahoo', `Bing', etc. For a given text query, the search engine has to search for millions of images for retrieving the significant images as early as possible. Generally the search engines are based on using text meta-data namely keywords, tags or text descriptions close to the images. As the meta-data do not constantly be in associate to the visual term of the images, the retrieval of images is normally grouped with unwanted non-relevant images. Still, it has been examined that the retrieved images include adequate relevant images which they are organized for users that are in common more noticed by precision than recall. Then the precision and accuracy can be improved by re-ranking the original set of retrieved images.In recent times users efforts are reduced by online image re-ranking method in which just one-click feedback is used which is a useful way to improve search results.

A process in which images are retrieved, arranged as per their features and user need is called web image re-ranking. To facilitate access to the rapidly growing collection of images on the Web and exploit their benefit for the users, image search has become an increasingly important research topic. Web scale image search engines mostly use keyword as queries and depend on the surrounding text to search the images. An image search engine generally operates in two main steps: the offline index generation and the online index serving step. Meaningful and significant image retrieval is a challenge for effective web search. By using existing technique uncertainty is occurred in image retrieval. Sometimes accurately describing the visual content of target images using keyword only is difficult for user. Due to lack of query and visual features images obtained are less relevant as per user need.

2. LITERATURE SURVEY

In last few decades, there was lot of research done on the image retrieval. The huge number of available images on the web makes image retrieval a challenging task. There

are a variety of techniques used by image retrieval to retrieve the most relevant image. The quality of results generated by the image retrieval system still not meets the user requirement. Due to lack of visual features and semantic signature quality [1] results reduces drastically. Hence to overcome this drawback visual query expansion and keyword expansion [2] is necessary.

2.1 Image Retrieval

Numerous search engines are available now a day, such as Bing, Google, Cydral, Yahoo, AltaVista, Ask etc. which fulfills image search queries. Users express their needs in search engines, and related images are displayed as output. For improvement in the search results two methods are used they are image annotation and web image search re-ranking. The ever-growing large amount of digital images on the Internet, retrieving relevant images from a large set of databases has become an important research study. Over the past years, many image retrieval systems have been developed [3]; those are Text-based image retrieval, Content-based image retrieval and Hybrid approach.

2.2.1 Text-Based Approach

Text-based search technique is more effective and efficient in document and for image search. User's gives text query as an input. These text-based queries can be formulated as free-text and it can be compared to such text descriptors as description, subjects, title or the text surrounding an embedded image, using the text retrieval techniques. Text data present in multimedia contain useful information useful for automatic annotation, indexing. The main problem and difficulty of web image search is the variance between the image content and the web page text. The TBIR has been widely used in popular image search engines e.g. Google, Bing and Yahoo![4]. A user gives an input as a textual query to the retrieval system, then the system returns the ranked images whose adjacent texts contain the given query keyword, and the ranking score is obtained according to some similarity and corresponding measurements between the query keyword of user and the textual features of relevant images. Text-based search techniques have been established to perform well in textual documents; they often result in variance when applied to the query image search as the metadata cannot represent the semantic content of images.

2.2.2 Content-Based Approach

Most search engines works on Text Based Approaches but there exist alternative. In Content based image retrieval (CBIR) [5] the visual features are extracted, such as color, texture and shape of images automatically and detect the similarity between images by distances in the features.

Implementation is simple and retrieval is fast here. Appropriate feature representation and a similarity measure for ranking images, given a query, are necessary here. Most of the Content based image retrieval systems performs feature extraction through images as a preprocessing step. It shows the procedure of CBIR. Features may include both text based features such as key words, annotations, tags and visual features like color, texture, shape, faces. Content based image retrieval that requires a user to put forward a query image, and return images that are similar and relevant in content Google is one of the search engines that works on this image re-ranking. The extracted visual information through this is natural and objective, but completely ignores the role of human understanding or knowledge in the interpretation process.

2.2.3 Hybrid approach

Recent research combines both the visual content of images and the textual information of images obtained from the Web for the WWW image retrieval. These methods make use of the usage of the visual information for enhancement of the initial text-based search result. Especially, through user's relevance feedback, that is, the giving in of desired query images or visual content-based queries, the re-ranking for image search results can achieve significant and good quality performance improvement [6].

3. RE-RANKING METHODS

The existing visual re-ranking methods can be categorized into three categories as clustering based, classification based and graph based methods [3].

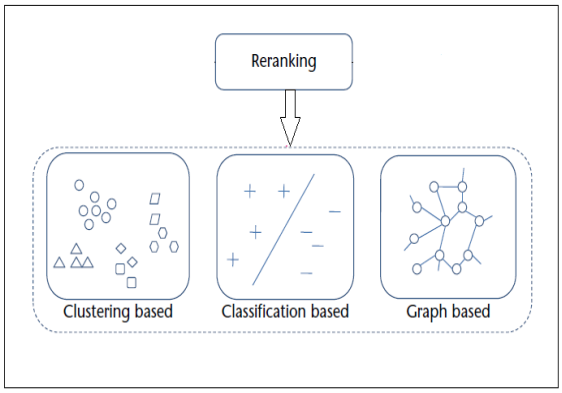

Fig-1: Classification of Reranking Methods

3.1 Clustering Based Reranking

Clustering based methods are based on the observation that query-relevant images frequently share high visual similarity. By using various clustering algorithms, this kind of methods sort out the initial text search result by grouping visually similar samples together.

3.1.1. Bag-Based Reranking

In traditional text-based image retrieval, significant images are to be re-ranked using visual features after the initial text-based search. In this paper [7], a new bag-based reranking approach is proposed for large-scale TBIR. The significant images are clustered using both textual and visual features. Each cluster is treated as a bag and the images in the bag as instances and the problem is formulated as multi-instance (MI) learning problem. The pseudo positive training bags are the top ranked bags, while pseudo negative training bags can be obtained by sampling a few irrelevant images randomly that are not associated with the textual query. Advantage is that for large scale TBIR automatic bag annotation method can achieve the best performance as compared with other traditional image reranking methods. Disadvantage is that it ambiguity may occur in the labels of instances. Performance can be improved by Visual features and user search intentions.

3.1.2. Intent Search Reranking

To utilize visual information in order to solve the ambiguity in text-based image retrieval, novel Internet image search approach i.e. Intent search [8] is proposed that only requires the user to click on one query image with least efforts and images from a group retrieved by text-based search are re-ranked based on both visual and textual content of that images. The main contribution is to capture the users' search intention from this one-click query image and all these things are automatic, without any extra effort from the user. Besides this contribution, a set of visual features which are together effective and efficient in Internet image search are designed. Disadvantage is that more user burden is required for labeling the regions that the user things more important. Clustering methods are suitable for queries that have noticeable near-duplicate images in the initial text-based results. Limitation is that, for these queries that return visually dissimilar images without salient patterns, cannot achieve good performance.

3.2 Classification Based Reranking

Reranking can be simplified using binary classification, instead of using multiple clusters. There are in general three steps: firstly select the pseudo-positive and pseudo-negative samples from the initial text-based search results; then train a classifier using the chosen samples; and rearrange the samples according to the relevance scores predicted by the trained classifier. In the first step, pseudo relevance feedback (PRF) is typically used to select training samples is a concept introduced from text retrieval. It assumes that a portion of the top ranked images in the initial search results are pseudo-positive. The pseudo-negative samples are selected from any least-relevant samples in the initial ranking list or the database, with the assumption that a small amount of samples in the database are relevant to the query. In the second step, various classifiers, like support vector machine can be used.

3.2.1 Active Reranking

The visual information is not enough to gather the user's intention, in particular when the query term is ambiguous. The reranking with user interaction [9] is proposed in which some images are selected according to an active sample selection approach, and then user is required to label them. With the information of user's intention including both the labeling information and the learned discriminative sub manifold, the reranking process is conducted. Advantage is that, compare to Intent search [4] it can learn the user's intention more extensively and completely. Limitation is that more user burden is required for labeling the samples of images.

3.2.2 Prototype Based Reranking

The earlier methods for image search reranking suffer from the unreliability of the assumptions due to which the initial text-based image search result is used in the reranking process such as labeling of samples by user. A prototype-based reranking method [10] is proposed to address and tackle this problem in a supervised, but scalable fashion. By applying different Meta re-rankers to an image from the initial result, reranking scores are generated, which are then aggregated using a linear model to build the final relevance score and the new rank position for an image in the re-ranked search result. Advantage is that the prototype-based reranking method is hardly affected by outliers, since the weights for various images are learned from human-labeled data. However it has limitations on user as it needs labeling the samples by users.

3.2.3 Multimodal Sparse Coding Reranking

Instead of labeling, user click information can
been used in image reranking, as clicks have been shown to more accurately describe the relevance of retrieved images to search queries. On the other hand, a critical problem for click-based methods is the lack of click data, as only a small number of web images have actually been clicked on by users. As a result, for predicting image clicks multimodal hyper graph learning-based sparse coding method [11] is proposed, and applied to obtained click data to the reranking of images. Thus, click predictions are used to improve the performance. But semantic spaces are not used here.

3.2.4 Query-Specific Semantic Signatures Reranking

A major challenge in user click based approach is that the similarities of visual features do not well correlate and associate with images semantic meanings which understand users search intention. In recent times researchers proposed to match images in a semantic space which used attributes or reference classes robustly related to the semantic meanings of images. However, learning a universal visual semantic space to distinguish highly diverse images from the web is complex and inefficient. A novel image re-ranking structure [2] is proposed, which automatically offline learns different semantic spaces for different query keywords of images. The visual features of images are projected into their correlated semantic spaces to get semantic signatures. Images are re-ranked at the online stage by comparing their semantic signatures. Advantage is that semantic spaces show better performance along visual features.

3.3 Graph Based Reranking

In the graph methods, graph is constructed to extract the relations between the images. The graph is constructed with the samples as the nodes and the edges between them being weighted by visual likeness. After that, reranking is performed on the graph by propagating the ranking scores through the edges. In these methods, the relationships and associations of all samples are represented by the graph. Thus, the graph construction plays the key role in this method.

3.3.1 Visual Rank

It is a framework [12] to efficiently model similarity of Google image search results with graph. The framework casts the reranking problem as random walk on an affinity graph and reorders images according to their visual similarities. The final result list is obtained via sorting the images based on graph nodes weights. The advantage of this is for quantifying the effectiveness and efficiency of visual features by using bias vector visual rank. It is not showing the relationship between the image similarity and likelihood for transaction more extensively is the disadvantage.

3.3.2 Bayesian Reranking

It is a framework [13] formulating the reranking formulating the reranking process as an energy minimization problem. The aim is to optimize the consistency of ranking scores over visually similar samples and reduce the inconsistency between the optimal list and the initial list. Thus, performance is significantly dependent on the statistical properties of top ranked search results which consider only feature vectors.

3.3.3 Multimodal Graph-Based Reranking

It is a web image search reranking approach [14] that explores multiple modalities in a graph based learning scheme. Different from the conventional methods that usually accept a single modality or integrate multiple modalities into a long feature vector, this approach can effectively put together the learning of relevance scores, weights of modalities, the distance metric and its scaling for each modality into a unified scheme for reranking. Limitation is that semantic spaces are not taken into account which narrows down the semantic gap between low level visual features and high level semantic meanings.

4. COMPARATIVE ANALYSIS

Table-1: Comparative analysis of various Reranking Methods

Authors	Method	Advantage	Disadvantage
Lixin Duan, Wen Li, Ivor Wai-Hung Tsang, and Dong Xu	Bag based Reranking [7]	Achieve best performance as compared with other traditional image reranking methods for large scale TBIR	Ambiguity may occur in the labels of instances
Xiaoou Tang, , Ke Liu, Jingyu Cui, Fang Wen and Xiaogang Wang	Intent Search Reranking [8]	Solve the ambiguity in text-based image retrieval	More user burden is added for labeling the regions that the user things more important.
Xinmei Tian, Dacheng Tao, Xian-Sheng Hua and Xiuqing Wu	Active Reranking [9]	Compare to Intent search it can learn the user's intention more extensively and completely	More user burden for labeling the samples.
Linjun Yang and Alan Hanjalic	Prototype Based Reranking [10]	Hardly affected by outliers, since the weights for different images are learned from human-labeled data	It needs labeling the samples by users.
Jun Yu,Yong Rui and Dacheng Tao	Multimodal Sparse Coding Reranking [11]	Click predictions are used to improve the performance	Semantic spaces are not taken into account.
Xiaogang Wang, Shi Qui, Ke Liu, and Xiaoou Tang	Query-Specific Semantic Signatures Reranking [2]	Semantic spaces show better performance along visual features	Matching efficiency is low
F. Jing and S. Baluja	Visual Rank [12]	It quantify the effectiveness of visual features by using bias vector visual rank	It does not show the relationship between the image similarity and likelihood for transaction more extensively
X. Tian, L. Yang, J. Wang, X. Wu, and X. Hua	Bayesian Reranking [13]	Improve the accuracy	Searching methodology is not efficient
Meng Wang, Hao Li, Dacheng Tao, Ke Lu, and Xindong Wu	Multimodal Graph-Based Reranking [14]	Effectively integrate the learning of relevance scores, weights of modalities, the	Semantic spaces are not taken into account which narrows down the semantic gap between low level

		distance metric and its scaling for each modality into a unified scheme for reranking	visual features and high level semantic meanings

5. CONCLUSION

Image search Reranking method is used to refine text based image search by its visual content. It is used mainly to get a refined image search as per the fulfillment of the user. Here, various image retrieval methods and the reranking methods which are proposed by earlier researchers for the better development in the web image search are discussed along with their advantages and disadvantages. These methods are categorized in different reranking strategies depending on the used approaches such as clustering based reranking, classification based reranking and graph based reranking. The different strategies and techniques used in reranking are given. From all these above discussion the Image reranking is an effective method for improving the image search results.

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