Global Journal of Computer Science and Technology: C
Software & Data Engineering
Volume 14 Issue 6 Version 1.0 Year 2014
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

Enhanced Re-Ranking and Semantic Similarity Algorithm for Image Search Goals Using Click-Through Logs

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Keywords : *image search, click-through log, re-ranking algorithm, semantic similarity algorithm.*

GJCST-C Classification : *I.4.1*

ENHANCEDRERANKINGANDSEMANTICSIMILARITYALGORITHMFORIMAGESEARCHGOALSUSINGCLICKTHROUGHLOGS

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Enhanced Re-Ranking and Semantic Similarity Algorithm for Image Search Goals Using Click-Through Logs

Shamali Kishor Kherdikar [α] & Rajesh Kulkarni [σ]

Abstract- The objective of the proposal is to analyze the user search goals for a query which can be very useful in improving search engine relevance and user experience. Although the research on inferring user goals or intents for text search has received much attention, little has been proposed for image search with visual information. In this project, we propose a novel approach to capture user search goals in image search by exploring images which are extracted by mining single sessions in user click-through logs to reflect user information needs. Moreover, we also propose a novel evaluation criterion to determine the number of user search goals for a query. Modified re-ranking and semantic similarity algorithm are part of this proposal. Experimental results demonstrate the effectiveness of the proposed method.

Keywords: image search, click-through log, re-ranking algorithm, semantic similarity algorithm.

I. Introduction

Search engine services are a popular means for information searching. They provide a simple and direct way of searching information for various resource types, not only textual resources, but also multimedia [1][2][3]. In image and web search applications, users submit queries (i.e., some keywords) to search engines to represent their search goals. However, in many cases, queries may not exactly represent what they want since the keywords may be polysemous or cover a broad topic and users tend to formulate short queries rather than to take the trouble of constructing long and carefully stated ones [1]–[3]. Besides, even for the same query, users may have different search goals. We find that users have different search goals for the same query due to the following three reasons considering apple as a query for search:

a) Multi-concepts

A query may represent different things. For ex, besides a kind of fruit, "apple" is established with new concepts by Apple Inc.

b) Multi-forms

Different forms can be there for a same thing. Taking Bumblebee in the film Transformers for an ex, it has two modes, car mode and humanoid mode.

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These two modes are the two forms of "Bumblebee".

c) Multi-representations

In image search, the same thing may be shown with different angles of view such as the query "leaf". It can be represented in a real scene or by a close-up.

Most search engines present similar interfaces allowing people to: submit a query; receive a set of results; follow a link; explore the information space; and modify a query [4][5][6]. This process is generally repe - ated during interactive searching. The popular use of search engine services has led to many investigations of general search habits on the Web. Querying behavior– query formulation and reformulation has especially been an active area of research in information retrieval. Inferring user search goals is very important in imp - roving search engine relevance and user experience. Normally, the captured user image-search goals can be utilized in many applications. For example, we can take user image- search goals as visual query suggestions [4] to help users reformulate their queries during image search. Besides, we can also categorize search results [5] for image search according to the inferred user image-search goals to make it easier for users to browse. Furthermore, we can also diversify and re-rank the results retrieved for a query [6], [7] in image search with the discovered user image-search goals. Thus, inferring user image search goals is one of the key techniques in improving users' search experience. However, although there have been many researches for text search [8]–[12], few methods were proposed to infer user search goals in image search [4], [13]. Some works try to discover user image-search goals based on textual information (e.g., external texts including the file name of the image file, the URL of the image, the title of the web page which contains that image and the surrounding texts in image search results [14] and the tags given by users [4]). However, since external texts are not always reliable not guaranteed to precisely describe the image contents) and tags are not always available (i.e., the images may not have their corresponding tags that need to be intentionally created by users), these textual information based methods still have limitations.

It should be possible to infer user image-search goals with the visual information of images (i.e., image features) since different image-search goals usually have particular visual patterns to be distinguished from each other. However, since there are semantic gaps [15] between the existing image features and the image semantics, inferring user image-search goals by visual information is still a big challenge Therefore, in this paper, we propose to introduce additional information sources to help narrowing these semantic gaps.

Digital image is nowadays the second most prevalent media in the Web only after text. Image search engines play an important role in enabling people to easily access to the desired images. A variety of search interfaces have been employed to let users submit the query in various forms, e.g., textual input, image input, and painting based input, to indicate the search goal. To facilitate image search, query formulation is required not only to be convenient and effective for users to indicate the search goal clearly, but also to be easily interpreted by image search engines. Therefore, recently more and more research attention has been paid on search interface design in developing image search engines.

II. Review of Related Works

The existing methods for image searching and re-ranking suffer from the unreliability of the assumptions under which the initial text-based image search result. However, producing such results contains a large number of images and with more number of irrelevant images.

a) TBIR – Text Based Image Retrieval

The text-based image retrieval (TBIR) can be traced back to the late 1970s. A very popular framework of image retrieval then was to first annotate the images by text and then use text-based database management systems (DBMS) to perform image retrieval. Many advances, such as data modeling, multidimensional indexing, and query evaluation, have been made along this research direction. However, there exist two major difficulties, especially when the size of image collections is large (tens or hundreds of thousands). One is the vast amount of labor required in manual image annotation. The other difficulty, which is more essential, results from the rich content in the images and the subjectivity of human perception. That is, for the same image content different people may perceive it differently. The perception subjectivity and annotation impreciseness may cause unrecoverable mismatches in later retrieval processes.

b) CBIR – Content Based Image Retrieval

The emergence of large-scale image collections, the two difficulties faced by the manual annotation approach became more and more acute. To overcome these difficulties, content-based image retrieval (CBIR) was proposed. That is, instead of being manually annotated by text-based key words, images would be indexed by their own visual content, such as color and texture. Since then, many techniques in this research direction have been developed and many image retrieval systems, both research and commercial, have been built. The advances in this research direction are mainly contributed by the computer vision community.

III. Problem Statement

Image search engines apparently provide an effortless route, but currently are limited by poor precision of the returned images and also restrictions on the total number of Images provided. While several studies reveal general characteristics of image searching based on transaction log data, little has been investigated concerning whether or not image searching behavior, especially querying behavior – query iterations and query length – differs based on a user‘s contextual aspects and different sources of collections on Web search engines. The existing methods for image searching and ranking suffer from the unreliability of the assumptions under which the initial text-based image search results. However, producing such results containing a large number of images gives more number of irrelevant images.

IV. System Architecture

Figure-1 describes the system model for Image Classification and Grouping based on User Query and Click through Data process. The model consists of elements as Query Handler, Query Formulation, Event Handler and Result. It has log repositories which stores user query logs and click through data. A Semantic similarity-based Matching algorithm will be implemented for classification and Grouping the search image results.

In general, when a user pose a query, the user usually navigates the entire result links list from top to bottom in a page. User generally clicks one or more result link that looks appropriate and relevance and skips those links which are not relevant. Effective information retrieval is achieved when a precise personalization approach perform re-ranking of the relevant links and place it in higher in results list. Therefore, we utilize user clicks as relevance decision measure to evaluate the searching accuracy. Since click through data can collect straightforward with less effort, it is possible to do required behavior and interest evaluation implementing this framework. Moreover, click through data shows the actual real world distribution of user search interest queries, and searching scenarios. Therefore, using click through data makes a closer real time personalization requirement cases in compare user feedback survey.

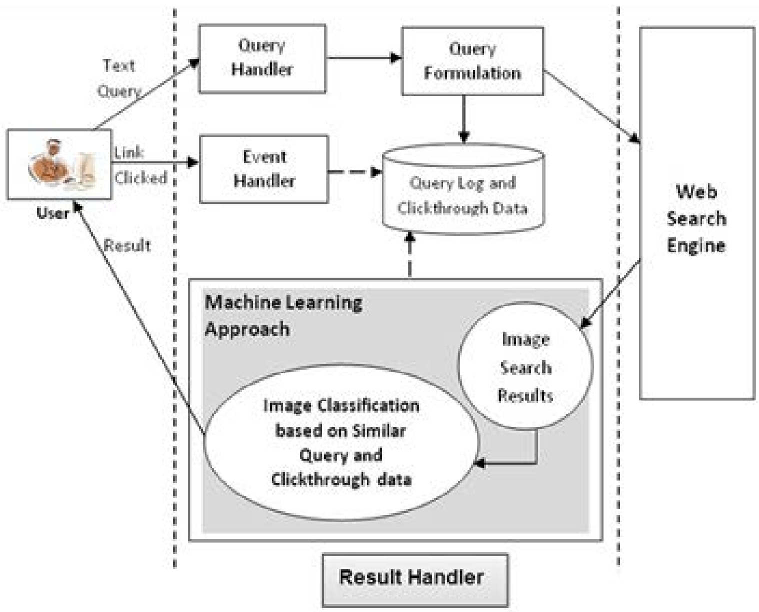

Figure 1 : System Architecture

V. Algorithm Design

A Semantic similarity-based Matching algorithm will be implemented for classification and grouping the search image results and a re-ranking algorithm is introduced to re-arrange the search results as per the click through log. Semantic similarity algorithms are data and content depended. Existing semantic similarity might tune according there data set requirements. The proposed algorithm based on existing text processing and mining techniques for effectively find the semantic similarities. We design our algorithm using Clustering Technique and Association Rule Mining. We first cluster the results based on the Density-based method from the database in relate to the user query. Density-based method implements Term frequency (TF) Similarity in the clickthrough data to decide the semantic relation of the query with the records. Secondly, based on the association rule we find the relation depth of each record in cluster in relate to the user query. These two approach combine provides the semantic similarity for our requirement. Ranking is done based on the some parameter and features of objects.

a) Semantic similarity based Algorithm

Input:
User input Query *(Q)*, and
click through data *(C)* from the database
Output: Semantically Associated and Cluster Results (S_R)
In relevance to the user queries
Begin
Create an empty cluster vector as E_C
Create keywords, *K* from Q.
For each keyword of (*K*) ***do***
Select $K(i) \rightarrow k_w$
For each click through data in (C_j ***do***
Select $C(i) \rightarrow C_w$
If Compute Association ($k_w \in C_w$) *== true*
If Cluster E_C does not contain $k_{w} =$*= true*
Add C_w to Cluster E_C
End if
End if
End for
End for
Create an empty object vector as S_R
For each objet in Cluster E_C ***do***
Object Count (O_C) ->0
Select $E_C(i) \rightarrow O_w$
For each click through data in (*C*) ***do***
Select $C(i) \rightarrow C_w$
If Compute ($O_w \in C_w$) *== true*
$O_C = O_C + 1$
End if
End for
Update $S_R(i) \rightarrow O_C$
End for
End

If we reprocess a ranked result for better result it is known as Re-Ranking. Support Vector Machine (SVM) is best approach for ranking any object. SVM do ranking based on multiple parameter or feature vectors in multidimensional. In our project we have only one best feature vector for ranking. So, we implement a greedy algorithm for re-ranking.

b) Re-Ranking Algorithm

Input:
Cluster Results (S_R)
Output:
Re-Ranked Results (R_{Rank})
Begin
Create an empty Object_Rank vector as, R_{Rank}
For each record in S_R ***do***
Select $S_R(i)$ -> $FR_{(i)}$
Intial_Top_Rank (T_{Rank}) -> $FR_{(i)}$
For each record in S_R ***do***
$k = i+1$
Select $S_R(k)$ -> $NR_{(k)}$
If $NR_{(k)} > FR_{(i)}$
$T_{Rank} = NR_{(k)}$
End if
End for
Update R_{Rank} -> T_{Rank}
Remove T_{Rank} object from S_R
End for
End

VI. Result Discussions

The proposed method is compared with the search result from precision and recall method.

Precision and recall are the basic measures used in evaluating search strategies. There is a set of records in the database which is relevant to the search topic. Records are assumed to be either relevant or irrelevant.

Recall is the ratio of the number of relevant records retrieved to the total number of relevant records in the database. It is usually expressed as a percentage. Precision is the ratio of the number of relevant records retrieved to the total number of irrelevant and relevant records retrieved. It is usually expressed as a percentage.

Let's say an image database contains 80 records on a particular topic. An image search was conducted on that topic and 60 images were retrieved. Of the 60 records retrieved, 45 were relevant. Precision and recall scores for the search can be calculated as

- A = the number of relevant records retrieved,
- B=the number of relevant records not retrieved
- C = the number of irrelevant records retrieved.

In this example A = 45, B = 35 (80-45) and C = 15 (60-45).

Recall = (45 / (45 + 35)) * 100% => 45/80 * 100% = 56%

Precision = (45 / (45 + 15)) * 100% => 45/60 * 100% = 75%

Table 1 : Without click through Data

Query	Top Retv_ Result	No Of Assoc	Relv Result	Precision	Recall
1	10	5	2	0.2	0.133333333
2	10	7	3	0.3	0.176470588
3	10	6	3	0.3	0.1875
4	10	6	2	0.2	0.125
5	10	6	2	0.2	0.125
6	10	6	2	0.2	0.125
7	10	8	3	0.3	0.166666667
8	10	6	3	0.3	0.1875
9	10	8	3	0.3	0.166666667
10	10	7	3	0.3	0.176470588
1	10	5	2	0.2	0.133333333

Table 2 : With click through Data

Query	Top Retv_ Result	No Of Assoc	Relv Result	Precision	Recall
1	10	7	5	0.5	0.294117647
2	10	7	6	0.6	0.352941176
3	10	8	6	0.6	0.333333333
4	10	8	6	0.6	0.333333333
5	10	7	5	0.5	0.294117647
6	10	8	7	0.7	0.388888889
7	10	9	6	0.6	0.315789474

8	10	8	6	0.6	0.333333333
9	10	8	6	0.6	0.333333333
10	10	9	8	0.8	0.421052632
1	10	7	5	0.5	0.294117647

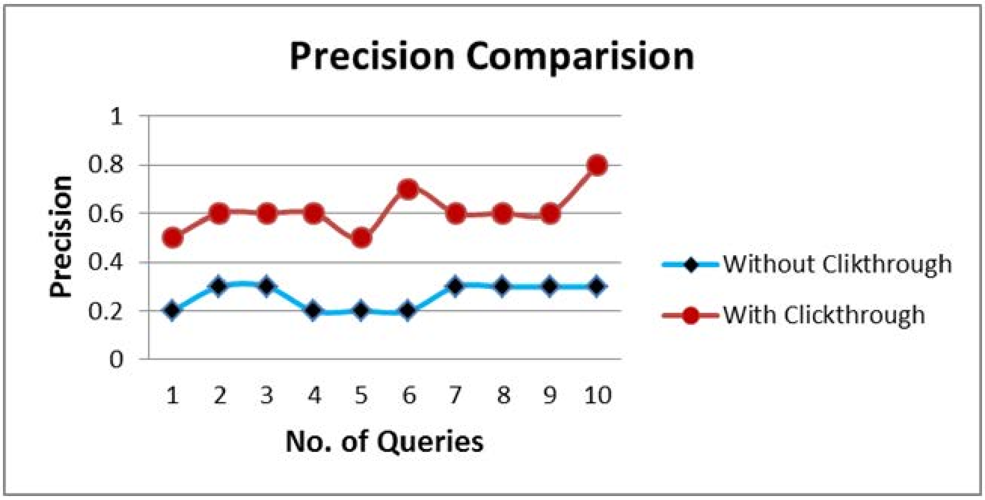

Figure 2 : Precision Comparison

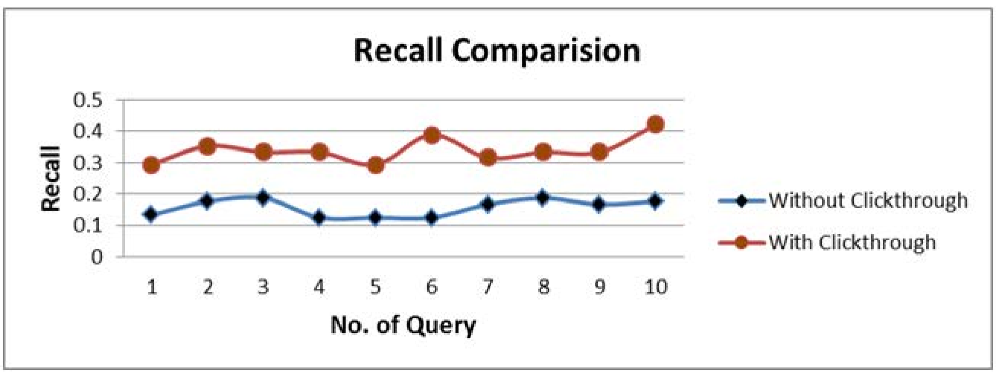

Figure 3 : Recall Comparisons

Fig2 shows the image searching method comparison with click through data and without click through data against precision. Certainly the efficiency and relevancy of image search results with click through data looks is more correct compared to image searching approach without click through data whereas Fig3 shows the image searching method uses click through data and without click through data against Recall.

VII. Conclusion

Image classification is vital field of research in computer vision. Increasing rate of multimedia data, remote sensing and web photo gallery need a category of different image for the proper retrieval of user. Existing commercial image search engines provide a textbox for users to type one or more keywords to indicate the search goal. This type of search interface is easy to use. However, besides the limitation that the associated texts may not reveal the image content, it is not easy to perform image search. We propose a machine learning approach for automatically classification and grouping similar user query for image search and to analyze the user search goal using user query and its relevant click through data in different browsing session. We classify the images semantically using density-based method on click through database related to user query and re-rank the search result based on the image classification and query similarity. We perform a query evaluation to determine the number of user search goals for a query and evaluate the performances of different user search goal. The experiments show that our method is able to infer user image-search goals effectively. It shows that inferring user image-search goals using user click information is better to meet the user image-search.

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