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Image Re-ranking Using Hashed Semantic Signature

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ABSTRACT

The Content-based image re-ranking system retrieves the images by evaluating the visual features of the images. As there is a gap between visual concept and semantic meaning, the result does not show accuracy. To deal with this problem, the image re-ranking using semantic signature is used. The universal data set is reduced to semantic space, hence contains less images for computation. Also by calculating semantic meanings, it captures the user intension and gives accurate results. The duplicate images may occur in the re-ranked result. We have overcome the disadvantage of the image re-ranking using the semantic signature system by removing the duplicate images at the time of re-ranking. Also, we compact the semantic signature by using the hashing technique. It results in the improvement of matching efficiency. The re-ranking technique using hashed semantic signature shows better results than the re-ranking technique using semantic signature.

Key words: Content-based, Semantic Space, Semantic Signature, Hashed Semantic signature, re-ranking

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INTRODUCTION

Searching information on the web is old idea of information retrieval but faces different challenges when it is compared to general information retrieval. Different search engines return different search results due to the variation in indexing and search process. Web image search engines search the images which are based on the query keyword as a text entered by the users [1]. Users faces the difficulty to describe the visual contents of required image using keyword because most users use the short keywords to search the images or they found difficulty to accurately describe the visual content of target images using the keywords. Hence it suffers from the ambiguity of query keyword. For example, using apple as query keyword, the retrieved images belonging to different categories as 'apple tree', 'apple fruit', 'apple logo' etc. Content-based image retrieval with relevance feedback [2] is widely used to solve the ambiguity. In the relevance feedback method, users are required to select multiple relevant and irrelevant images as an example and the visual similarity metrics are learned through online training. Images are re-ranked according to the learned visual similarities. Also, it requires continuous user interaction to give relevant and irrelevant images until the user does not get the required image. But for web-scale commercial systems, the user's feedback has to be limited to the minimum without online training.

Online image re-ranking limits the user's effort to just one-click feedback. This is an effective way to improve search result and its interaction to be simple enough. This strategy adopted by major web image search engines. The user gives a query keyword as input and set of images relevant to the given query keyword are retrieved by the search engine according to stored word-image index file. The user selects one query image that matches with the user's search intension from the retrieved image pool. After clicking on the query image, remaining images in the image set are re-ranked according to their visual similarities with the query image. The visual features of images and word-image index file are pre-computed offline and stored. The main online computational cost is on comparing visual features [3]. To obtain high efficiency, the visual features need to be short and their matching needs to be fast. Some visual features are highly in dimensions and their efficiency is not satisfactory if they are matched directly. But, major challenge is without online training, the similarities of low-level visual features may not be well correlated with high-level semantic meanings of that image, which interpret user's search intention. Low-level features are inconsistent with visual perception. For example, if the images of the same object are captured under different lightings or in different view then their low level features may change. But user thinks that their visual feature does not change much. This creates the semantic gap and inconsistency with visual perception.

In re-ranking using hashed semantic signature technique, the image re-ranking is done by using semantic signatures. Query-specific semantic signature was first proposed in Kuo et al [4]. In this method, a set of images is retrieved by using the query keyword. The semantic space of the images to be re-ranked can be narrowed down by using the query keyword. For example, if the query image is 'Eiffel Tower' then the images related to the category 'apple' or 'ball' are irrelevant and these images do not display when the search for 'Eiffel Tower'. The semantic space related to the query keyword excludes the irrelevant concepts that help to improve accuracy and computational cost. Then ask the user to select the one image from retrieving image pool as query image. Extract the feature of query image which is the semantic signature of that image. We extract the color and texture feature of the image to get semantic signature. We combine both features in one semantic signature. But one can calculate the different semantic signature for different features. Then compare that semantic signature with the pre-computed semantic signature of the pool images. The semantic signatures are small in size, but it is possible to make them more compact using other technologies such as hashing. This helps to improve the matching efficiency of re-ranking result. We use the locality sensitive hashing function to hash the semantic signatures. Also, we removed the duplicate images at the time of re-ranking by comparing the semantic signature of images. Because of this the accuracy of image re-ranking improves. If there are K types of visual/textual features, such as color, shape, and texture, by combining them together a single classifier can be formed, which extracts one semantic signature for an image.

LITERATURE REVIEW

Lot of work is done so far in proposing image re-ranking system. Different techniques are used to get the re-ranked result of search image more accurately. Also the techniques are defined to improve the accuracy and efficiency of the image ranking system such that it reduce the time required to search for required images.

Yan et al [5] explain the pseudo-relevance feedback method for image re-ranking.This method helps to reduce the user's burden in relevance feedback method. In this method consider only top N images from the image pool that obtained from text-based image search. Because of this, it reduces the no of images for feedback. Traditional methods for content-based image retrieval are based on a vector model. These methods represent an image as a set of features and the difference between two images is measured through a Euclidean distance between their feature vectors. In [6] Kovashka proposed the image search technique with relative attribute feedback. In this method user describes which properties of exemplar images should be adjusted in order to more closely match his/her mental model of the images sought. At query time, the system presents an initial set of reference images, and the user selects among them to provide relative attribute feedback. Using this reference images it updates the relevance function and images in the pool get re-rank. This method iterates repeatedly until the top ranked images are close to the users required image. Tang et al [7] describe another image search technique by just one-click. The Intent Search technique uses the visual information of image for image search. First user search the image by using the text and that retrieves the image pool. From the image pool user selects one query image and re-ranked the images based on both visual and textual content. Query keywords are expanded using the weight schema to capture the users search intension. Expanded query keywords are used to get the further positive example image set.

Table-1 Summery of Existing System

S. No.	Image re-ranking System	Description	Merits	Demerits
1	Intent Multimedia search with pseudo-relevance feedback [5]	Get the relevant and irrelevant images from the user for re-ranking.	Retrieves the exact match image.	User interaction is more. Hence, more time required for re-ranking.
2	Whittle Search: Image Search with Relative Attribute Feedback [6]	Exampler images are used to get feedback from user.	Retrieves the exact image in multiple iterations.	Takes more time for searching as the feedback is taken from user iteratively.
3	Intent Search: Capturing User Intention for One-Click Internet Image Search [7]	The image re-ranking framework uses the visual features of image for re-ranking.	Gives better result than text-based image search as the search is done by using the image visual features.	The visual feature does not interpret semantic meaning of image.
4	Web Image Re-Ranking Using Query-Specific Semantic Signature [8]	The image re-ranking framework uses the semantic signature for image re-ranking.	Improves the accuracy and efficiency of image re-ranking system.	Though semantic signatures are small in size but there is chance to improve efficiency.

Wang et al [8] proposed different technique of image re-ranking which uses the semantic signatures for web image re-ranking. These semantic signatures are captured from the expanded keyword of query image selected by user which closely matches with the users search intension. Then by calculating the distance between the semantic signature of query image and other images in the image pool retrieved by text search, images are re-ranked. The semantic signatures are already stored in the system. Hence the computational cost relates to calculating the distance between semantic signatures and re-ranks the image pool.

From table -1 it is observed that different image re-ranking methods are proposed but they have their merit and demerits. Hence large scope is available in the image re-ranking techniques. In this view we are discussing our proposed system which uses the hashed semantic signature for image re-ranking. We have divided the table into four columns; image re-ranking system, description, merits and demerits.

PROPOSED WORK

There are many systems which uses different techniques for image search. But some system gives the less accurate result or some system gives accurate result in more time. Our purpose is to get the accurate image search result which is required to the user in the less time. The efficiency of the system is increases by hashing the semantic signature. Though the semantic signatures are small in size but hashing makes them more compact, hence reduce the time for calculating the distance between two semantic signatures.

Architecture Model of the Proposed System

Figure 1 shows the proposed system architecture of the image re-ranking system using hashed semantic signature. Its various components are described as follows –

Text based Image Search

This module is at the user side. In this user gives the keyword as query for image search [9]. Then searching result retrieves the images which are related to the query keyword. The result obtained from the keyword search contains the images from a diverse area. Some images which are labelled with query keyword, but visually dissimilar from the query keyword may appear in the result set. From this result set user selects one query image that matches with the users required image. Then, the images are re-ranked using this query image.

Feature Extraction

In image processing, feature extraction takes initial set of measured data and gives features of that data. Feature extraction is link with dimensionality reduction**.** When the input data is redundant and too large to be processed, then it can be converted into a reduced set of features. The extracted features contain the relevant information from the large input data, hence the expected work can be performed by using this reduced set of data instead of large initial data .Feature extraction also reduce the amount of resources required to describe a huge set of data. In this system we use the FCTH feature extraction algorithm [10]. This algorithm extracts the color feature and texture feature of image and combining the values of both features in single histogram. The histogram is of 192 bins where each bin of size 3 bytes.

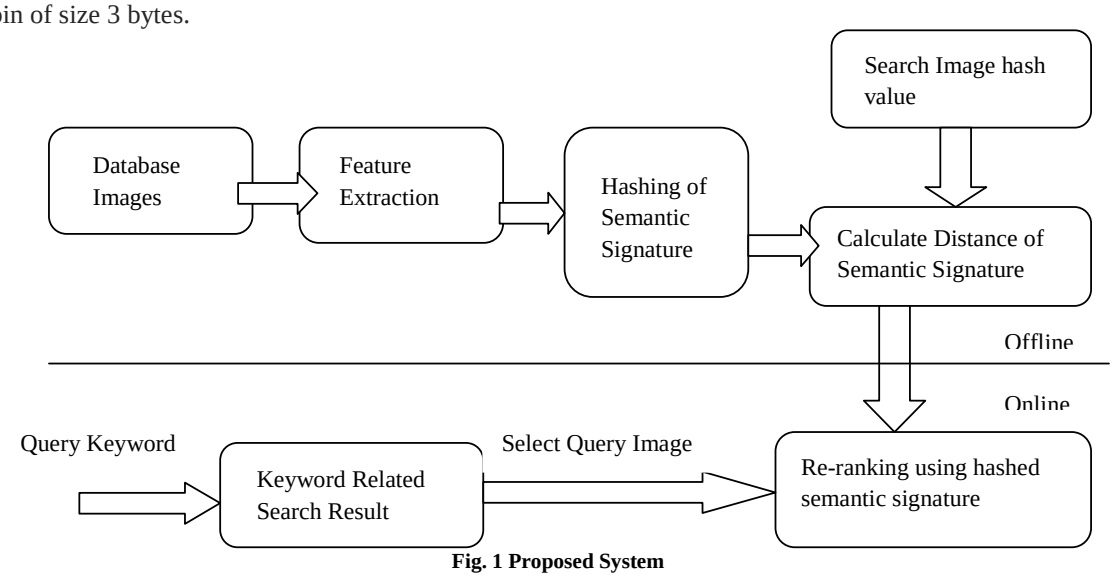

Fig. 1 Proposed System

Hashing of Semantic Signature

In our project, we extract the color and texture feature of image and combine both feature value in one. This gives the histogram of the size 192 bin. The size of this histogram affects on the time required for re-ranking process. So next step is to, compact the semantic signatures. We use the locality sensitive hashing function to hash the semantic signatures [11]. Locality sensitive hashing reduces the dimensionality of high dimensional data. LSH hashes the

images and gives the result in integer vector. This hash function takes the image histogram as input and gives the hash value of each image. The hashed semantic signatures are smaller in size than the actual semantic signature. Hence it reduces the time required to re-rank the image set and gives better efficiency.

Image Re-Ranking

The image selected by the user is taken as search image and the semantic signature for this image is calculated. The semantic signatures are the visual features of image. Many visual features have been developed in recent years [12]. One or more visual features are used to get the semantic signature. We consider the colour and texture of image as visual feature and by combining both calculate the semantic signature for every image. The distance between the search image semantic signature and the semantic signature of other images in semantic space are calculated using the Euclidean distance. The distance of the search image semantic signature to the same image in semantic space is zero and the distances are minimum for those images which are similar to the query image. By using this result we, get the re-ranked set of images.

EXPERIMENT AND ANALYSIS

Input to the System and Dataset Used

The data corpus that is used for experiments consists of bing image dataset. The dataset images are divided into 10 different categories. The categories are as – Apple, Ball, Paris, Jasmine, Mouse, Bell, Cougar, Lincoln, Peach and rice. Each category contains the images with diverse meanings. Also the input is given by the user as keyword for image search to the system. The system retrieves the image set which is labelled with the query keyword.

Experiment 1: Keyword for User

The images from bing image dataset are uploaded into the databse. When user uploaded the image, he gives the label to each image. That label is used for the keyword expansion. The labels are stored for every image. The labels are separated into single tokens. Each user has their label list. When the user gives the query keyword, then the images which are labeled with that keyword are retrieved and stored in one list. This is the semantic space for that query keyword. After this, all operations are done on semantic space only. The semantic space contains limited no of images than the actual dataset, the time required for computation is less. Also the semantic space is less diverse then this helps to improve accuracy of ranking system.

Experiment 2: Text Based Image Search

In this experiment user gives the input as keyword for image search. Labels are stored as separate token and if the search keyword matches with the token then retrieved that image. The result set contains diverse images of apple category. This is the semantic space for apple. The ranking is done on this semantic space. Also user selects one query image from this semantic space that closely matches the users required image. When the user selects a particular image as a query image than his search intension is to get all the images similar to the query image.

Experiment 3: Re-ranking Result

The re-ranking of the text based image set is done in this experiment with respect to query keyword. When the user selects one query image in text search, first extract the features of that query image. That feature value is the semantic signature for that image. The system searches for the similar images which have similar feature to the query image. The semantic signature of each image is already calculated and stored in the system. The re-rank result set is calculated using the Euclidian distance.

In proposed architecture of image re-ranking using hash semantic signature, we performed different experiments step by step and from those experiments we analysed different aspects for different image categories as shown in Fig. 2. The averaged top 10 precision of 5 different categories has been shown. This shows the accuracy of each category.

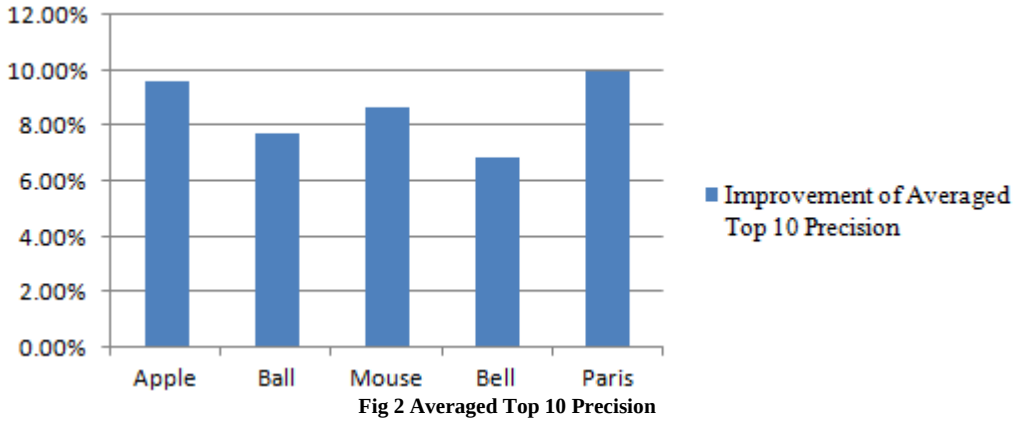

Fig 2 Averaged Top 10 Precision

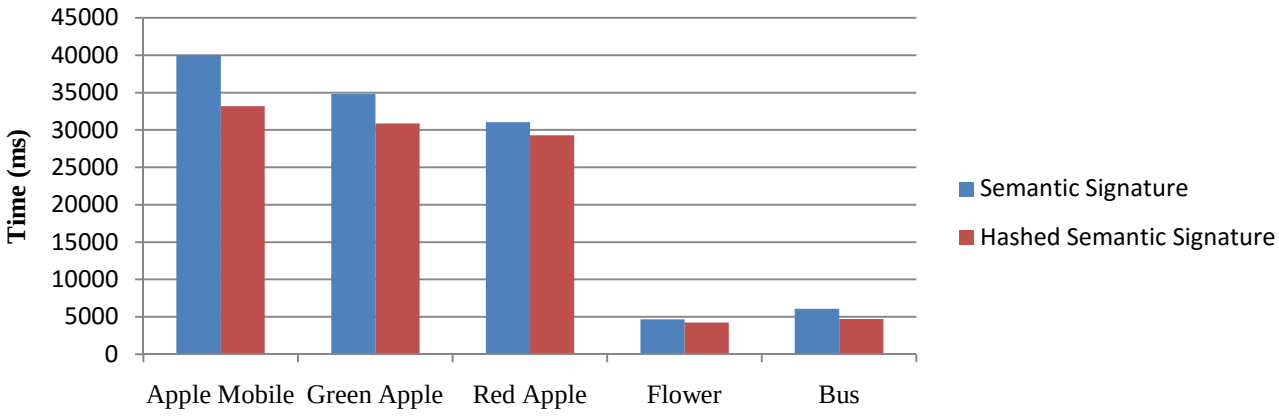

Fig. 3 Time required for Re-ranking using semantic signature and hashed semantic signature

In Fig. 3 the time required for re-rank the text based search result using the semantic signature and hashed semantic signature has been given. As the hashed semantic signatures are compact than the semantic signature, less time required to re-rank images using hashed semantic signature.

CONCLUSION

Most search engines use keywords and visual images for retrieval. The keyword based searches and content based search lacks the semantic meanings of images. In this research work, hashed semantic signature based image re-ranking system is proposed. It gives better accuracy as compared to the text-based image search and the content based image search. As an advantage, without additional feedback, the hashed semantic signatures are calculated. Using semantic signature for image re-ranking reduces the semantic gap between image visual features and users search intention. The accuracy of image re-ranking technique using the hashed semantic signature is same as that of image re-ranking using semantic signature but the matching efficiency is improved. The semantic signature improves the matching efficiency because of the hashing technique. The FCTH algorithm is used for feature extraction. This system uses the semantic space for the image comparison. Semantic space contains limited no of images. Hence, it reduces the comparison for ranking.

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