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Effective Image retrieval through User Clicks and Query Semantic Signature: an Offline Approach

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ABSTRACT: Effective way of improving the results of web-based image search is Image re-ranking which has been implemented by current commercial search engines like Google, Bing, etc. For given set of query keywords, pools of images were retrieved based on textual information. But if we observe the retrieved images, then it may have some irrelevant images also. So it's a big challenge for the user to get only relevant result for the given query. In proposed system, Once the user select a query image from the pool, the remaining images get re-ranked based on their visual similarities with respect to query image and semantic signatures. This is offline approach of image re-ranking. In order to get semantic signatures, the visual features of images are projected into their associated semantic spaces. A major challenge in image re-ranking is to match similarities of visual features with the query image. Recently mechanism has evolved to match images in a semantic space which uses attributes or reference classes which are closely related to the semantic meanings of images as basis. Learning a universal visual semantic space to describe the distinctive nature of highly diverse images from the web is difficult and incompetent. This paper includes a new image re-ranking framework, which automatically offline learns images in semantic space for user query keywords. This work will significantly improve both the accuracy and effectiveness of image re-ranking.

KEYWORDS: Image re-ranking, Query Semantic signature, User clicks, Visual feature extraction, CBIR, offline learning.

I. INTRODUCTION

Web image search engines mostly uses keywords as query and they depend on surrounding text to search images. It is difficult for the users to fetch target images by only using Keywords as they suffer from the uncertainty of the given query keywords. For example, If we enter Samsung as a query keyword, then the images get retrieved belongs to this keyword in different category, such as Samsung phone, Samsung laptop, Samsung TVs, etc. In order to resolve the ambiguity or irrelevant retrieval of images, we propose a new ranking model which is based on visual features and click features. This features are simultaneously get utilized to obtain the ranking model [1]. In this paper, we propose a new image re-ranking framework, which automatically offline learns images in semantic space for user query keywords. In order to get semantic signatures, the visual features of images are projected into their related semantic spaces. This query-specific semantic signature significantly improves both the accuracy and effectiveness of image re-ranking [2].

Using relevance feedback anyone can easily go through the images in which many users may chooses the same image, out of which the highest feedback is received by the particular image will seem first. Images are re-ranked based on the learned visual similarities. Online image re-ranking limits the user's effort to one-click feedback, which is an operative way to improve search results, accuracy and the interaction between the user and web.

Content based image retrieval i.e. CBIR is an adaptive retrieval approach, which is based on the concept of relevance-feedback, as it forms a link between high-level and low-level features of the images, using the user's feedback. Image representation is based on firm visual features like Color, Texture and shape[3][8].Weather forecasting, remote sensing, data mining, medical imaging, crime prevention and management of earth resources, education, etc. are the most popular domains where content-based image retrieval technique is on demand. In this paper

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we proposed new image re-ranking model which makes a use of this CBIR algorithm in order to extract visual features of query image and to mapped with all available images in database.

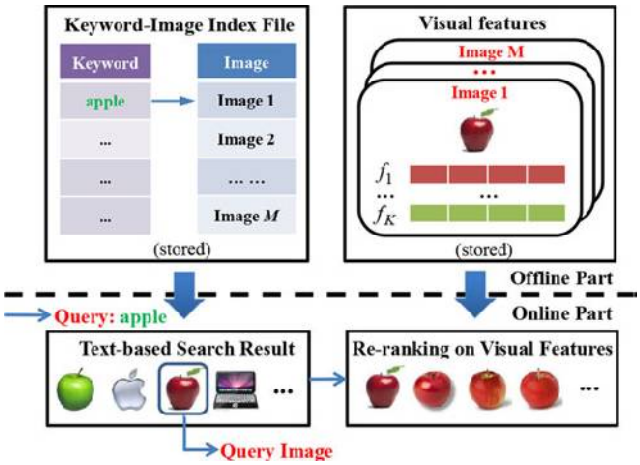

Fig. 1 General framework for image re-ranking system

Fig. 1 shows the general framework of image re-ranking system. Image search include two approaches i.e. online and offline. In online approach user first provide the keyword and for which search engine retrieves related images. But offline approach focused on "how to improve this search result?" This can be achieved with the help of matching visual features of images. The proposed system not only considers visual features of query image but also it generates and compares semantic signature of all available images in dataset. And find best match for the query image.

II. LITERATURE SURVEY

In the field of data mining, image re-ranking is widely adopted concept. In order to extract visual information, we require various parametric information like color, texture, shape and alphanumeric information i.e. textual information. This textual information is not as trustworthy as equated to visual information. The variation between textual features and visual contents can cause inadequate image search results. To solve this problem, click features are more consistent than textual information in explaining the relevance between a query and clicked images, are implemented in image ranking model [1][8].

Recently people expected to match images in a semantic space which uses attributes or reference classes closely associated to the semantic meanings of images. In order to provide best solution to this problem, different techniques are get used. One of it, is projected in this paper, which offline learns image behaviour in semantic space and based on their features extraction and query semantic signatures it generate relevant images for the user query. The visual features of images are projected into their associated semantic spaces to get semantic signatures and images are re-ranked by comparing their semantic signatures received from the semantic space specified by the query keyword [2][6][8][9][11].Content based image retrieval i.e. CBIR is an adaptive retrieval approach, which is based on the concept of relevance-feedback, as it forms a link between high-level and low-level features of the images, using the user's feedback. By considering various features of images, it forms image vector which get matched with the visual features of all available images. Once the similarity gets matched, that images retrieved in the system [4][10][12].

Keyword expansion is the most promising technique which captures user intention. Expanded keywords are used to broaden the image pool to contain more appropriate images [5]. If we add this feature with CBIR then it works more fairly and provides top k relevant images for the user query. Some demonstration has already done in the field image retrieval which shows that Google Image Search and Microsoft Live Image Search is a practical and effective way to dramatically improve the user experience [7]. It uses query image which is selected by user and by referring intension model it provides the resultant and appropriate images to the user. So most of the users are using this commercial search engine to search images. In CBIR, histogram features are get considered like mean, standard deviation, skew, energy, entropy, etc. which is more efficient and much faster method than any other commonly used methods[13][14].

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This paper makes a use of these methods along with some other techniques like user clicks, visual feature extraction through CBIR, query semantic signature in order to derive relevant images as an output to the user [11].

III. MOTIVATION AND OBJECTIVES

In today's world, with growing technology, efficient image retrieval is a big challenge. As there is discrepancy between textual features and visual contents which may generate poor image search results. To solve this problem, click features of images are more trustworthy than the textual information while justifying the relevance between a query and clicked images. This paper aims at providing new image re-ranking model which will consider user clicks to extract visual features and semantic signature of image to provide better result for the user query while working at offline mode.

This new image re-ranking model has following objectives:

a. To provide more relevant and accurate results.
b. To improve the search relevance for user query.
c. To enhance performance of system.
d. To reduce the time and work of manually selection of images.
e. To improve effectiveness and efficiency of search results.

IV. PROBLEM DEFINITION

Currently most of the search engines uses keywords as queries in order to retrieve the relevant images and depends on the text to search images. So it's a big challenge for the user to accurately describe the visual content of target images only using keywords. The proposed system will retrieve more relevant images through single user click and visual feature of an image in semantic space by getting their respective semantic signature. Also this is one of the offline learning approaches which minimize dependency on internet facility. This will improve accuracy and efficiency of image re-ranking.

V. METHODOLOGIES

Query semantic signature:

This new image re-ranking framework, which automatically offline finds diverse semantic spaces for different query keywords. At the offline stage, images are re-ranked by comparing their semantic signatures received from the semantic space mentioned by the query keyword. The visual features of images are projected into their associated semantic spaces to get semantic signatures.

Image re-ranking:

A novel image re-ranking is proposed in the given system which aims at providing relevant result to the user query. Most of the users provide keyword as a query to the search engine and may obtain result accordingly. E.g. If user enters keyword like, "apple", then for this keyword, search engine gives result in terms of images like "apple phone", "apple trees", "bitten apple", "red apple", "apple laptops", "green apple", etc. Here search engine can't catch the user's intension so it may produce ambiguous result, if user is thinking for red apple or any specific category of apple. So, this ambiguity reduced by proposed solution. It takes the help of reference classes which are already trained by the system. When user select query image, at that time system offline learns the visual features of that image. It checks various reference classes and semantic signature of images. For the best matched features, images get retrieved and re-ranking of images gets done.

User clicks:

Working of given system is based on user clicks only. At the early stage user has to enter some keyword. Then for that keyword, search engine provides pool of images. From this pool, user select query image. This will be considered as feedback or intention of user. It will reduce ambiguity. Once the system knows what the user wants, then it provides resultant images for user query.

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Visual feature extraction:

Biggest challenge and main task in the proposed system is to extract and match visual features of query image with the images available in database. Visual features can be matched with the help of reference classes. Different trained reference classes includes various categories e.g. “apple” is the keyword, then reference class\es can be constructed based on their shape, colour, texture, etc. These trained classes get used and combined when user select any one of the query image based on “apple” keyword to extract visual feature of the same.

VI. PROPOSED SYSTEM

A. DESIGN AND SYSTEM ARCHITECTURE:

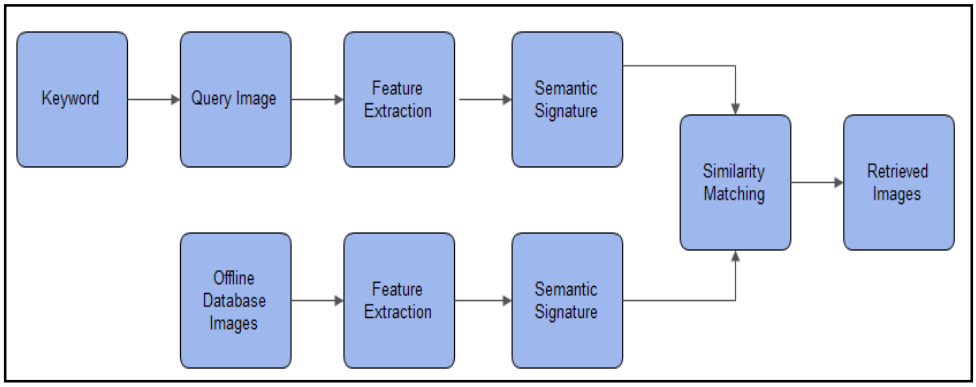

Fig.2 Block diagram of proposed system

Fig.2 shows the block diagram of proposed system. It clearly indicates that, at initial stage, user has to select the keyword and one query image. Features of query image get extracted with the help of CBIR and by matching semantic signatures of query image with all available images in specific dataset; user will get top k relevant images by re-ranking.

Some key terms which come along with CBIR are as follow [13][14]:

i. The histogram of an image is a plot of the gray level values of a color Chanel versus the no. of pixels at that value.
ii. The mean is the average value, so it provides the information about brightness of the image. A bright image indicate high mean, while dark image have a low mean.
iii. The standard deviation is also termed as the square root of the variance, which provides knowledge about the contrast of image. If image have high contrast, then it will have high variance, and if it is low, then it will have low variance.
iv. The skew measures the irregularity about the mean in the intensity level distribution of an image.
v. The energy measure focused on, how the intensity levels are distributed. The image with a constant value which has maximum value of 1, and it gets smaller, as the pixel values are distributed among more intensity level values.
vi. The entropy is a measure provides the details of an image in terms of how many bits of an image need to be code.
vii. The distance between two vectors evaluated by the square root of the sum of the squares of the differences between vector components.

Fig.3 given below, illustrates system architecture of new image re-ranking system. In this architecture, system has 3 main components i.e. User, Search engine and Offline database (where no. of datasets are stored w.r.t keywords). This search engine is specially designed by administrator of system, which can be used for image searching and retrieving purpose. System totally runs at offline mode, no internet connection is required. At the initial stage, user enters one keyword to the search engine and search engine retrieves pool of images from the precise dataset (by referring keyword which is entered by user), which is available in offline database. If, keyword related images available in database, then only it retrieves pool of images otherwise, it merely provide message as “no such an image available”.

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From this pool, user has to select any single image as a query image. Now, CBIR starts working. It extracts visual features of query image and matched with all available images in dataset. Here no. of trained reference classes is available along with its semantic signature. As the CBIR generate image vector for query image and assign semantic signature for it, this semantic signature get matched with all dataset images. Here CBIR uses some formulas like mean, standard deviation, energy, entropy, skew and distance. By calculating these values, images which are closer to the query image are get re-ranked.

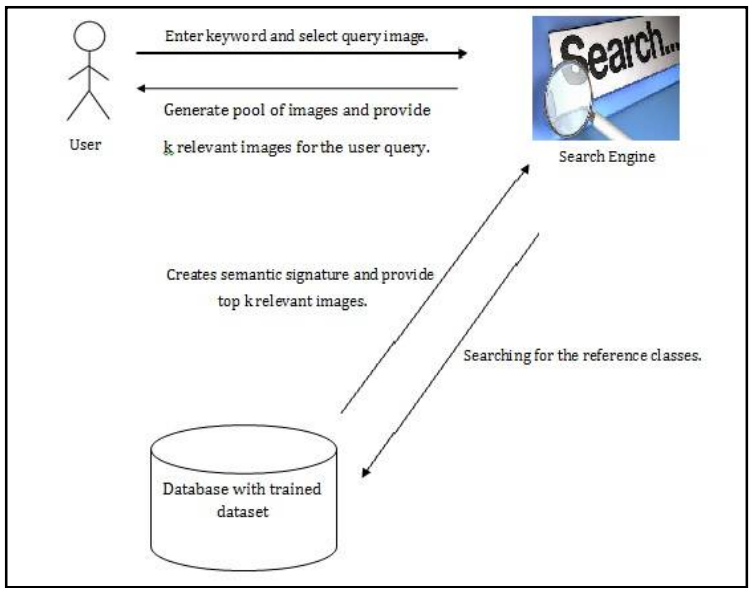

Fig.3 System Architecture for proposed system

B. ALGORITHM AND MATHEMATICAL MODEL:

Content Based Image Retrieval (CBIR) Algorithm:

CBIR is a technique which automatically extracts visual features like color, shape, texture and spatial information of an image based on its pixel values. It extracts all low level image features and to some extent it describes the image in a more detail as compared to the text based approach. CBIR works in following way:

1. When user enters any keyword and selects the query image, Search engine send request to offline database where dataset is available w.r.t. that keyword (If it is not available, then it simply provide message as “no such an image available”).
2. CBIR takes that query image, extract visual features of it, generate image vector and assign semantic signature for the same. Then, it compares query image with all images available in the specific dataset. Here it refers trained reference classes. (These reference classes can be constructed based on text, shapes, colors, etc.).
3. It combines images from various reference classes where best features are getting matched. And calculate mean, SD, energy, skew, entropy, distance, etc. for re- ranking the images.
5. The images which are closer (nearer distance) to the query image get re-ranked and displayed (according to distance in ascending order).

Mathematical Model:

Mathematical Model for this new image re-ranking model is as follow:

Input:

Let us consider, Keywords={K1,K2,K3,...Ki}
Images={I1,I2,I3,.....Ij}
Reference classes={RC1,RC2,RC3.....RCp}

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Query images= {QI1,QI2,QI3,....QIm}
Semantic Signatures = {S1,S2,S3,….Sk}

Processing:
Enter Keyword K1 and select query image QIm.
Extract features of QIm and assign Semantic Signature S.
Match QIm with RCp.
Integrate features from RCp.
If, Ij belongs to RCp then, generate Semantic signature w.r.t RCp.
Compare semantic signature of images to QIm
Compare distance of QIm with Ij.

Output:
Ranked images Ij w.r.t query images QIm.

VII. IMPLEMENTATION

The working of proposed system is shown below with experimentation.

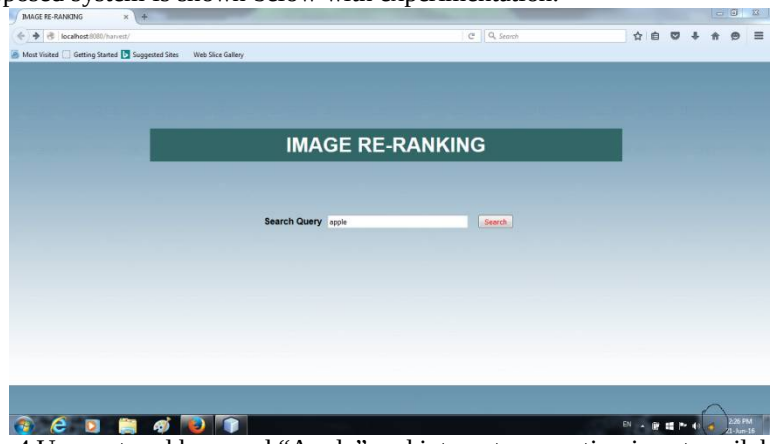

Fig.4 User entered keyword “Apple” and internet connection is not available.

In fig.4 shows that, user has entered keyword “apple” to the search engine. Net connection is also not available (turn off). So this system only runs at offline stage and it refers offline database where “apple” keyword related dataset is available, which is stored on the machine.

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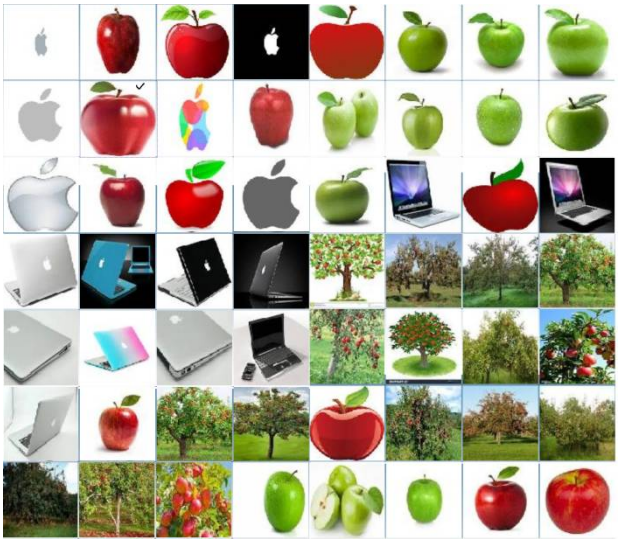

Fig.5 Pool of images get generated from dataset “apple”

Fig. 5 shows generated pool of images, from which user has selected one image. Now these images are available at offline dataset with reference to keyword “apple”. It shows that, there are many images in dataset belonging to different categories like “apple phone”, “apple laptop”, “green apple”, “red apple”, “apple tree”, etc. Out of which, user has selected one image of category “red apple”. So for this user query, following result is generated by system.

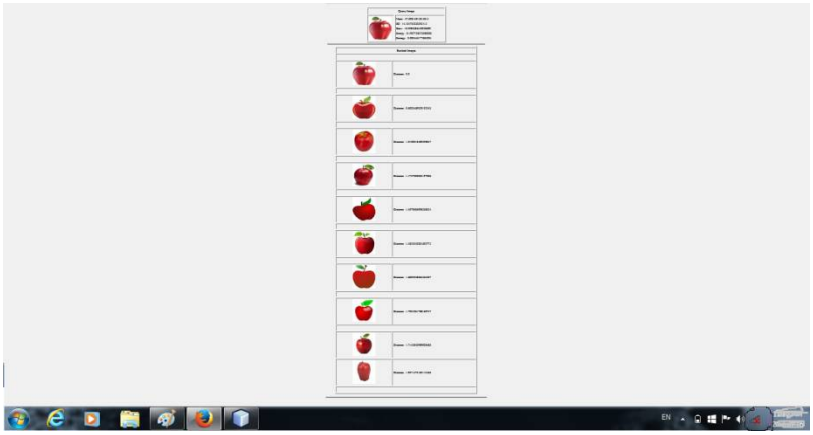

Fig.6 Output/ resultant images for user query keyword and query image “Apple”

Fig.6 Shows output for the user query keyword “apple” and image which has selected as a query image for the same. This system learns at offline stage where CBIR mainly performs its task. Also query image vector and their semantic signature get refer to match with all dataset images. Trained reference classes compare features of query image to check where it belongs. It compares feature of all available images along with its semantic signature w.r.t. query image and finally images get re-ranked and displayed for the user.

VIII. RESULTS AND DISCUSSION

This novel image re-ranking model measures the performance or relevance of system by using some formulae, they are as follow:

i) Precision= No. of relevant images retrieved / Total No. of images retrieved

ii) Recall = No. of relevant images retrieved / Total no. of relevant images in dataset

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Based on this, following results have generated for dataset "Apple":

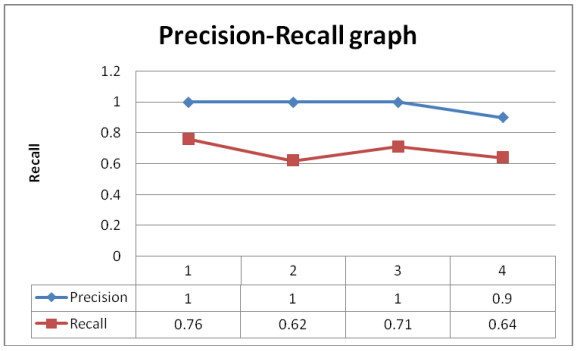

Fig.7 Precision-Recall graph of proposed system

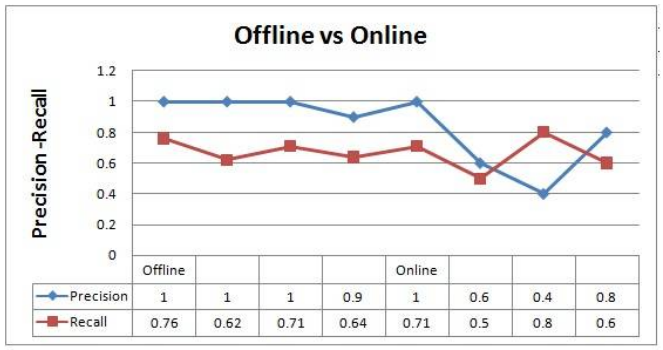

Fig.8 Offline vs. Online approach

Fig.7 shows that, precision-recall graph for offline learning approach. In this novel approach, it seems that, relevance of this system is higher. This is one of the good performance measures of system, because it considers many images while re-ranking. In this experimental result, we have considered 60 images at offline dataset of various categories, but still result produced shows that precision is greater than recall.

Fig.8 illustrates comparison of offline & online approach. In online approach it seems that, precision-recall values may get fluctuated, sometime precision value comes up or sometime recall value or vice-versa. This may happen because, image re-ranking implemented on limited images (as the online approach only takes first 20 images to display and it may be of various categories). But, offline approach overcomes this limitation. In this novel offline image ranking approach, we can add any no. of images to the dataset and from that, we can re-rank the images. But still, result of offline approach seems to be better than online approach. Here, we have considered "Apple" dataset for both approaches with dataset size of 60 images for offline approach (manually maintained dataset, we can increase this number) and online approach takes 20 images (limited images, can't maintain manually). Based on this, results are shown in graph below.

Also, offline approach takes less time to search, retrieve and re-rank the images. Also it is more efficient than online approach. Because, in online approach, user depends on the internet connection, so if, network congestion occur or connection lost, then user unable to retrieve the images. And if, low speed network occur, then it takes too much time to retrieve the images.

So this is good approach for the users who daily searches or retrieves the images for some applications.

IX. Conclusion and Future Scope

Many of the search engines usually suffer from imperfect results caused by the noisy textual description in visual search. The proposed work will overcome these problem using this new image re-ranking model which is based on visual features, click features and semantic signature where both visual and click information are simultaneously utilized in the learning process for re-ranking. Also, as it is offline approach, user has no need to depend on internet connection for every time. This approach improves the search efficiency, accuracy and relevance in image re-ranking. In future, it is also possible to provide more accuracy and relevance using synonym keywords.

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BIOGRAPHY

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